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The perceived effectiveness of mixed reality experiences in a master of arts in teaching (MAT) program for science, technology, engineering, and mathematics degreed individuals

Chana Speir
University of Central Florida

University of Central Florida

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THE PERCEIVED EFFECTIVENESS OF MIXED REALITY EXPERIENCES
IN A MASTER OF ARTS IN TEACHING (MAT) PROGRAM
FOR SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS
DEGREED INDIVIDUALS

by

CHANA MARIE SPEIR
B. S. University of Central Florida, 2006
M. Ed. University of Central Florida, 2010

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ABSTRACT

The purpose of this study was to examine the perceived effectiveness of mixed reality experiences on resident teachers who successfully completed an undergraduate Science, Technology, Engineering, or Mathematics (STEM) degree and were enrolled in a Master of Arts in Teaching (MAT) degree program as part of RTP[3] at a large research university in Orlando, Florida. The population for this study consisted of those selected to be in the RTP[3], which included being in the Masters in the Art of Teaching (MAT) and becoming a middle or high school science, mathematics, or engineering teacher.

The resident teachers experienced mixed reality as a method of practice on two occasions. The first was to introduce a lesson with avatar middle school students and a second time to conduct a parent conference with an avatar parent. This study was focused on the resident teachers' perceptions of (a) the effectiveness of mixed reality in the lesson experience and parent conference, (b) the coach's helpfulness after the lesson introduction experience and the parent conference experience, and (c) the extent to which the resident teachers believe that their confidence was increased and they were prepared for future classroom instruction and parent interactions through the use of mixed reality.

Data were gathered with a feedback form with Likert-type items and open ended items completed immediately upon completion of each experience, as well as an additional open response document completed at a later time after reflection on the entire experience. The researcher analyzed the two qualitative data sources independently to determine trends and themes.

Findings in this study were that the mixed-reality laboratory experience did have a positive effect on the perceptions of the resident teachers regarding their level of preparedness. They were more confident and comfortable teaching a lesson and conducting a parent conference after practicing both experiences with the avatars. Resident teachers overwhelmingly responded that the mixed reality experiences should remain a part of the MAT pedagogy and that they gained insight and confidence through the mixed reality practice.

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CHAPTER 1
THE PROBLEM AND ITS CLARIFYING COMPONENTS

Introduction

"The shortage of certified science, technology, engineering, and mathematics (STEM) teachers is of concern throughout the United States because of significant numbers needed over the next over the next 10 years" (Hutchison, 2012, p. 541). Increased use of end of course exams and an emphasis on STEM in middle and high schools has increased the need for educators who are competent in both the pedagogical aspects of teaching as well and having an increased competence in the subject matter (Hutchison, 2012). Undergraduate teacher preparation programs are recognizing this need as well as increasing their focus on students wanting to teach middle and high school STEM courses (Hutchison, 2012). "A major cause for this concern relates to several factors that include a reduced number of initially certified STEM teachers, the inability to retain certified STEM teachers, and the lack of systematic professional development" (Hutchison, 2012, p. 548). Having teachers who are pedagogically sound is important. However, having teachers who are competent and comfortable teaching their subject matter is also vital to their students' success especially in STEM areas of study.

At a major research university in central Florida, the TeachLivE™ mixed-reality experience was included in teacher preparation for STEM graduates in the Resident Teacher Professional Preparation Program (RTP[3]). Participants in this program were called resident teachers as they had teaching positions and were enrolled in the Master of

Arts in Teaching (MAT) program. At the time of the study, TeachLivE™ was part of RTP[3], complementing the coursework with a hands-on experience with teaching. The resident teachers completed their first summer of coursework learning basic pedagogical skills, including classroom management, and had the TeachLivE™ experience during the summer term (Powell, Andreasen, Haciomeroglu, & Taylor, 2013).

TeachLivE™ is a mixed-reality program that gave resident teachers an opportunity to experience teaching STEM courses at the middle and high school levels while simultaneously practicing pedagogical techniques needed to be successful as teachers (TLE TeachLivE™ Lab, 2014). The resident teachers had the background in STEM fields and had the mixed-reality TeachLivE™ experience to practice learning management and teaching practices necessary for success. Through the TeachLivE™ experience, resident teachers had the opportunity to interact with a classroom of avatar students for a lesson introduction as well as a parent conference with a parent avatar (RTP[3], 2011). Samples of parent conference scenarios used in this experience are in Appendix A. The avatars were controlled by an interactor who was in another location but could hear and see the resident teacher via webcam. In order to hone authentic responses, TeachLivE™ gave resident teachers the chance to practice skills often learned only after having to assume responsibility for student learning outcomes. Appendix B contains a variety of TeachLivE™ mixed-reality images.

The TeachLivE™ environment was established to be similar to a typical classroom, except that the participant was in the front of the room facing a screen rather than a room full of desks (see Appendix B). Digital student avatars or the parent avatar

were on the screen. The STEM graduate and MAT student, hereafter referred to as the resident teacher, was able to move about the virtual room and interact with the digital student avatars in many of the same ways a teacher would interact with students in a classroom. Digital avatars were controlled by a human interactor who was in another location and controlled the speaking and actions of the avatars to make it as realistic as possible. (TLE TeachLivE[TM] Lab, 2014).

In the RTP[3] experience, instructional coaching by a university faculty member or a school district partner was included. In contrast to the RTP[3] mixed reality practice, in a traditional setting there is little or no opportunity for the teacher to stop during a lesson, receive coaching and feedback, and then try again.

The second learning experience the resident teachers had in TeachLivE[TM] was the parent conference. Similar to the student avatars, the parent avatar was controlled by an interactor. Again, the resident teacher interacted with the parent avatar on screen (see Appendix B). The rationale behind this strategy, with both the student and parent interactions, was to give resident teachers the opportunity to practice situations they may encounter prior to interactions with actual students and before their first parent conference. The intention of TeachLivE[TM] was to increase resident teachers' confidence and expertise while positively impacting teacher preparation as a result of the expert feedback (TLE TeachLivE[TM] Lab, 2014).

Problem Statement

The problem addressed in this study was that pre-service teachers need more opportunities to practice the art of teaching with feedback prior to teaching students and conferring with parents. The resident teachers in this study were all STEM degreed individuals. They did not have the benefit of being explicitly taught pedagogical skills like their education-major counterparts. While well versed in the content they plan to teach, they lack the skills necessary to transfer that information to future students. TeachLivE™ is a way for these resident teachers to develop the skills necessary to teach while simultaneously using the content area in which they are already familiar.

Purpose of the Study

The purpose of this study was to determine the effectiveness of the TeachLivE™ mixed-reality as perceived by STEM (science, technology, engineering, and mathematics) degreed individuals (resident teachers) who enter the teaching field without educational preparation as middle and high school teachers of mathematics and science. Resident teachers had the opportunity to virtually experience (a) a lesson introduction in a classroom and (b) communication with a parent during a parent conference.

This analysis, conducted after receiving approval of the Institutional Review Board of the University of Central Florida (Appendix C), was conducted to determine the extent to which the resident teachers perceived they were more effective as teachers as a result of using this technology. The research was also conducted to determine the extent to which the coaching, after the lesson introduction and the parent interaction, was beneficial.

Lastly, the perceptions of resident teachers were analyzed to ascertain their level of confidence in introducing a lesson and conducting a parent conference.

Research Questions

Six research questions were used to guide the study and follow.

1. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivE[TM] in the lesson introduction experience?

2. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivE[TM] in the parent-conference experience?

3. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE[TM] lesson introduction experience?

4. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE[TM] parent teacher conference experience?

5. To what extent did resident teachers in RTP^3 believe that their confidence in classroom instruction was increased through the use of TeachLivE[TM]?

6. To what extent did resident teachers in RTP^3 believe that their confidence in parent interaction was increased through the use of TeachLivE[TM]?

Definition of Terms

Avatar. An on-screen student or parent used to simulate a lesson introduction or parent conference with the resident teacher.

Interactor. A person controlling the on-screen avatar during the TeachLivE™ experience, who, through the use of a specialized suit, can playact certain behaviors, see the reactions of the resident teachers, and respond in real-time. (TLE TeachLivE™ Research Study, 2014).

Coach. A faculty member or school district partner who provides feedback to the resident teachers during and after the TeachLivE™ experience.

Lesson Introduction Experience. The portion of the TeachLivE™ experience that involves the resident teacher introducing a lesson to the on-screen avatar students.

Resident Teacher. The STEM graduate/MAT student who is participating in the TeachLivE™ experience. (RTP[3], 2014)

Resident Teacher Professional Preparation Program (RTP[3]). A program for preparing STEM graduates to be science and mathematics teachers in middle and high schools. (RTP[3], 2014)

STEM (Science, Technology, Engineering, and Mathematics). Term describing participants in this study who completed their undergraduate degrees in one of these fields of study.

TLE TeachLivE™. A mixed-reality laboratory where the resident teachers practice introducing a standards-based lesson with avatar students followed by feedback

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to improve instruction and a simulated parent conference. (TLE TeachLivE[TM] Lab, 2014).

Assumptions

It was assumed that resident teachers participated in the simulations in a professional manner and the Resident teachers responded on the simulation feedback forms in an open and honest manner. It was also assumed the professors of the classes operated under uniform syllabi for corresponding courses and prepared the students in the same manner prior to the TeachLivE[TM] mixed-reality simulation. The professors prepared their students in the same manner prior to participating in the TeachLivE[TM] simulation. It was further assumed that the reflections were completed in a way that reflected the resident teachers' true analysis of their experiences.

Limitations

A potential limitation of this study was that the resident teachers completed the reflections as part of a class assignment. This may have influenced reflections, positively or negatively, in regard to the experience. Another potential limitation of this study was the varying levels of prior knowledge and experience each resident teacher had with the teaching and learning process and parent interactions.

Delimitations

A major delimitation of the study was created in the determination of the population that participated in the research. Because only STEM graduates participated

in the study, the researcher was not able to obtain an indication of the perceived effectiveness of the use of TeachLivE™ from students in other disciplines.

Conceptual Framework

For this study, the conceptual framework came from three areas: critical need for STEM teachers, teacher preparation, and the use of mixed-reality simulations for learning. The history of teacher preparation is also presented to create a context.

Critical Need For STEM Teachers

With a national need to improve STEM education, pre-service teachers must be provided with ample opportunities to increase their own knowledge and confidence in STEM fields in a variety of ways (Ford & Strawhecker, 2011). Many pre-service teachers, upon completion of their teacher education programs, lack pedagogical expertise in scientific inquiry and technological design (Bencze, 2010). Teacher preparation programs have recognized the deficit in numbers of science and mathematics teachers who are adequately prepared to enter the classroom. The challenge lies in finding opportunities for those pre-service teachers to learn both the subject matter of the STEM fields as well as the pedagogical techniques needed to be successful.

Recent attention has been brought to light in the United States regarding low numbers of students pursing STEM disciplines and degree programs (National Science Board, 2010). The vast majority of students who enter the STEM fields as

undergraduates have little or no intention of turning to education following completion of those degrees.

"More than 200,000 students graduate each year from teacher preparation programs" (Greenberg, McKee, & Walsh, 2013, p. 5). That is a tremendous number of first-year teachers entering classrooms at various levels of preparedness to teach with the skills and confidence necessary. According to Greenberg et al. (2013), first-year teachers teach approximately 1.5 million students every year, and they are held to the same expectations as veteran teachers. However, they lack the skills and experience necessary to teach to their highest potential. Teacher preparation programs have begun to recognize the need for more pedagogical instruction along with the subject matter of STEM fields in order to prepare teachers for secondary and high school classrooms. Due to the demand for more teacher preparation in the areas of STEM as well as basic classroom management skills, "education must shift to incorporate computer-based, electronic technologies integrating learning with these technologies within the context of the academic subject areas" (Niess, 2005, p. 509).

<div align="center">Teacher Preparation</div>

The framework for the establishment of teacher preparation programs has undergone significant changes over the last century. As far back as the early 1800s, teacher preparation programs have existed with the intention of preparing new teachers to educate students (Mico University College, 2014). In 1834, the first teacher preparation college was established in Jamaica by Sir Thomas Fowell Buxton. Now called Mico

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University College, it is considered the oldest teacher training institute in the Western Hemisphere and the English-speaking world (Mico University College, 2014). "In 1900, Jacob G. Vanden Bosch and Barend K. Kuiper were added to the Literary Department faculty" (Calvin College, 2014, p. 6) at Calvin College in Grand Rapids, Michigan. Though the main objective of the school was to "train men for gospel ministry" (Calvin College, 2014, p. 5), the yearbook also stated that instruction was offered for "obtaining various teachers' certificates" (Calvin College, 2014, p. 6). Lipsomb University (2014) in Nashville, Tennessee began preparing teachers to enter classrooms in the early 1900s as did many other colleges and universities across the country.

In 1966, the Stiles Report was published and criticized the emphasis placed on professional education coursework and the length of time, often five years, required for most students to complete their education degrees (Hitz & Walton, 2003). The requirements and credit hours were reduced, allowing for shorter preparation periods for pre-service teachers to earn degrees. Only after students completed the obligatory series of courses were they allowed to practice teach with real children in classrooms through the student teaching experience. "Students' experiences in university and school classrooms were poorly integrated and only vaguely connected" (Hitz & Walton, 2003, p. 27).

In 1983, *A Nation at Risk* identified deficiencies in America's public schooling system (National Commission on Excellence in Education, 1983). Traditional teacher preparation programs in colleges of education were seen as part of a larger problem that needed to be solved. Even though many changes have occurred in the ways teacher

preparation programs are conducted, there is still a recognized need for more improvements. According to the United States Secretary of Education, Arne Duncan (2010), "Many, if not most, of the nation's 1,450 schools, colleges, and departments of education are doing a mediocre job of preparing teachers for the realities of the 21st century classroom" (p. 13).

"Currently, many pre-service teachers display anxiety over teaching math and science" (Steele, 2012, p. 113). Thus, an emphasis has been placed on these two subjects in teacher preparation programs. "Pre-service teachers entering the classroom with hesitation in the instruction of science and math presents significant pedagogical complications, as both subjects are considered core components of a balanced education" (Steele et al., 2012).

Mixed-Reality Instruction

"Mixed reality is a term used to refer to environments that combine elements of the real and virtual worlds" (Gregory & Masters, 2012, p.224). Mixed reality includes a variety of gaming and educational programs. The use of mixed reality has gained popularity since the 1990s, "offering a unique environment as it combines real and virtual objects, interactive in real time and registered in three dimensions" (Yusoff, Zaman, & Ahmad, 2011, p. 1370). While mixed-reality has experienced exponential upgrades and changes since its inception, it is still being used for both entertainment and education.

The idea of using mixed-reality as a platform in education appeals to the 21st century learners as this is the environment is which they have grown up and are more

often able to relate. According to TeachThought (2013), only 8% of students in grades 3-5 carry a tablet or smartphone with them to school every day. This number increases to 28% in middle school and 51% in high school. Having access to technology and mixed-reality experiences in classrooms serves as both motivation and incentive for students to want to learn and to stay engaged in classroom assignments both in school and out. Using mixed reality as a tool opens up opportunities for teachers to expose students to different places and ideas that are difficult to contain in a traditional textbook or pre-made video. Applications, or apps, on mobile devices that offer mixed-reality experiences have grown in popularity since the early 2000s (Apple, 2014). One example of such an app is GoogleEarth. GoogleEarth is a virtual map and globe experience that began in 2005 (GoogleEarth, 2014). This experience gave learners the chance to see other places in the world in 3D, via the Internet, without having to actually travel to that location. Mixed-reality experiences, such as this, have increased students' awareness of the world around them without having to leave their school classrooms. Mixed-reality experiences, such as these, have also shown to increase student engagement in classroom activities (TeachLivE^{TM} Conference, 2013).

TeachLivE^{TM} is a mixed reality simulation where resident teachers have the opportunity to experience introducing a lesson as well as conducting a parent conference. For many resident teachers, this was the first time experiencing these situations so having the chance to practice in a virtual environment is an invaluable learning tool. The avatars on screen, the classroom of students as well as the parent, are controlled by an off-site interactor so they react in real time to the resident teacher. The avatars act in much the

same way a traditional middle school classroom or parent could act. Once the resident

teacher has the opportunity to experience the simulation on their own, a coach will sit

with the resident teacher and offers strategies and support for the next time the resident

teacher encounters a similar situation.

<center>Methodology</center>

<center>Population</center>

The population in this study consisted of the resident teachers who successfully

completed an undergraduate Science, Technology, Engineering, or Mathematics (STEM)

degree and were enrolled in a Master of Arts in Teaching (MAT) degree program as part

of RTP[3] at a large research university in Orlando, Florida. The population for this study

consisted of those selected to be in the RTP[3], which included being in the Masters in the

Art of Teaching (MAT) and becoming a middle or high school science, mathematics, or

engineering teacher.   Participants applied to RTP[3] and the MAT, were interviewed and if

accepted in both, became the population for this study. When they accepted the RTP[3]

scholarship, the resident teachers signed an agreement that included required

participation in this research study. The participants all had STEM degrees, not

necessarily from the same research university as the MAT program, and were preparing

to enter the field of education as middle school or high school educators.

The population contained a total of 78 resident teachers. Represented in the

population were the following undergraduate degrees: 53 science-related, 1 technology-

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related, 10 engineering-related, 7 mathematics-related and 7 resident teachers that did not indicate a degree.

<div align="center">Instrumentation and Sources of Data</div>

The sources of data used in this study were student feedback forms and open-response reflections, both completed by participants in the study after completing the TeachLivE[TM] experience during the first summer semester. Table 1 indicates the six research questions in this study as well as the source of data to answer each question. The feedback form and the data therein were pre-existing data that the researcher acquired from the School of Teaching, Learning, and Leadership in the College of Education and Human Performance from the major research university in this study. The feedback form contained a Likert-type scale (Fraenkel et al., 2012) with possible responses being -2 = Strongly Disagree, -1 = Disagree, 0 Neither Agree nor Disagree, +1 = Agree, +2 = Strongly Agree. The original feedback form also contained a rating of N/A at the end of the continuum representing Not Applicable or No Answer. The original scale was modified for the present analysis to use a scale ranging from 1 to 5 where 1=strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree. Samples of the feedback forms are contained in Appendices D and E.

Table 1

Research Questions and Sources of Data

Research Questions	Data Source
1. To what extent do STEM graduates in the MAT perceive the effectiveness of TeachLivE™ in the lesson experience?	TeachLivE™ Lesson Experience Simulation Feedback forms- survey item 1, 2, 3, 4
2. To what extent do STEM graduates in the MAT perceive the effectiveness of TeachLivE™ in the parent conference experience?	TeachLivE™ Parent Conference Simulation Feedback forms- survey item 1, 2, 3, 4, 5
3. To what extent do STEM graduates find the feedback from the coach helpful after the lesson introduction experience?	TeachLivE™ Lesson Introduction Simulation Feedback forms- survey item 5
4. To what extent do STEM graduates find the feedback from the coach helpful after the parent conference experience?	TeachLivE™ Parent Conference Simulation Feedback forms- survey item 6
5. To what extent do STEM students believe that their confidence was increased through the use of TeachLivE™ and prepares them for future classroom instruction?	Reflection document
6. To what extent do STEM students believe their confidence was increased through the use of TeachLivE™ and prepares them for future parent-teacher interaction?	Reflection document

Data Collection

Two types of data were collected: feedback forms and a reflection document. Data were collected during the summer of 2013 individually, immediately after the students completed each TeachLivE™ mixed-reality experience. Students completed a Likert-type scaled feedback form designed to elicit data about their experiences and levels of confidence after (a) the lesson introduction experience and (b) the parent-teacher conference experience. The feedback forms also contained a comments section where the resident teachers could leave any other reflections immediately following the simulation. After having some time to reflect on each TeachLivE™ mixed-reality simulation, the resident teachers also completed a narrative reflection document about their experiences which was submitted to their instructors.

Data Analysis

Quantitative feedback form data were analyzed using SPSS and Excel to investigate participants' responses to questions posed. Overall trends in the data were extracted from an analysis based on undergraduate degrees. The resident teachers' responses were compared using descriptive statistics.

Two qualitative forms of data were analyzed also. The first was gathered after the TeachLivE™ lesson introduction and parent conference experiences. This data was contained on the feedback form. The resident teachers had the opportunity to immediately react to the simulation and leave comments. A second narrative reflection document was completed away from the TeachLivE™ laboratory after the resident

teacher was given time to reflect on the entire experience and receive the coaching after the simulation.

Significance of the Study

This study has increased significance as students, teachers, and institutions of education move into the future with mixed mode and mixed-reality instruction. In terms of present benefits, the TeachLivE™ mixed-reality experience gives resident teachers the benefit of learning to teach students without having accountability for learning outcomes. Teachers who have a deeper understanding of STEM fields are then prepared to enter a classroom with more confidence. Another significant aspect of this study is that the resident teachers are all in STEM related academic areas and have not participated in a traditional teacher preparation program. This research was intended to provide new insight into effective methods of preparing new teachers, especially those with an academic background, who have not completed a traditional teacher preparation program. These results were anticipated to have the potential for practical application by both school district leaders and higher education teacher preparation programs.

Organization of the Study

This study has been explained and documented in five chapters. Chapter 1 has provided an introduction to the components, design, and significance of the study. Chapter 2 contains a review of the literature on the topic of mixed-reality instruction as well as other topics relevant to this study. Chapter 3 provides detailed information about

the methods and procedures used to gather and analyze the data. Chapter 4 presents the

results of the data analysis and any findings regarding students' perceptions. The fifth

and final chapter provides a summary and discussion of the study as a whole. This

chapter includes implications for practice and policy with regard to the TeachLivE™

program and suggestions for future research on this topic.

CHAPTER 2
REVIEW OF LITERATURE

Introduction

This review of literature examines STEM teachers' need for content knowledge and pedagogical knowledge. There have been multiple studies and countless hours of research conducted on the effects of teacher preparation on student achievement. Teachers who are highly effective have a greater impact on their students' academic achievements than teachers who do not have a background in the academic subject area as well as pedagogical skills. Teachers in the 21st century have gained opportunities to achieve a higher level of preparation using various methods than in prior years. With advances in technology, teacher preparation programs can use mixed-reality experiences as a tool to prepare future educators. "Teacher preparation programs have been working to find the right combination of classroom experience and textbook instruction to prepare future teachers" (Greenberg, Putman, & Walsh, 2014, p.15). Through the use of mixed-reality, teachers have the opportunity to see first-hand what it will be like in a classroom of students and be able to practice how to conduct themselves professionally during a parent conference.

A second topic addressed in the review of literature is the critical need for STEM teachers in middle school and high school. Science, technology, engineering, and mathematics (STEM) are academic subjects that have been of high interest and frequently researched in the field of education. These teachers have often received certification in their specific subject areas and have tended to lack formal pedagogical training that their

elementary school counterparts received through college courses. Highly qualified STEM teachers are actively sought by middle and high school administrators. Although they bring to the classroom a wealth of knowledge in content, they may lack the strategies necessary to manage a classroom and to interact with students, parents, and their education colleagues.

The research found in this literature review was gathered from several online research databases. Some of the databases used were EBSCO Host, Wiley Online Library, and Science Direct. These online databases were searched using key terms such as avatars in education, mixed-reality instruction, STEM teacher shortage, teacher preparation programs, and feedback in education. Although several of the preliminary resources found accessed online and practitioner based articles, the majority were articles in peer-reviewed scholarly journals, such as the *American Educational Research Journal, International Journal of Technology & Design*, and the *Peabody Journal of Education*.

This review of literature addresses three major topics: (a) the critical need for STEM teachers, (b) teacher preparation programs, and (c) using mixed-reality instruction for teacher preparation. Explored in this chapter are some of the paths that teacher preparation programs have employed up to the present time, the critical needs for educators who have the content knowledge in the STEM fields to be pedagogically trained, and finally how mixed-reality instruction is an opportunity to be explored by teacher preparation programs.

Critical Need for STEM Teachers

On October 4, 1957, the Soviet Union successfully launched Sputnik. This led directly to President Dwight D. Eisenhower's authorization of the creation of the National Aeronautics and Space Administration (NASA) on July 29, 1958 (History, 2014). This prompted Congress to pass the National Aeronautics and Space Act which sparked interest in STEM subjects across America (National Science Board, 1010; Obama, 2011; Woodruff, 2013). *A Nation at Risk*, published in 1983, brought the topic of STEM education back to the forefront as the United States recognized it was no longer the leader in global technology as was the case in the mid-20th century (National Commission, 1983). "American students lag far behind their international peers in science, technology, engineering and mathematics. Currently, the United States ranks 25th in mathematics and 17th in science among developed nations" (USDOE, 2014, p. 2).

"STEM teaching and learning focuses on authentic content and problems, using hands-on, technological tools, equipment, and procedures in innovative ways to help solve human wants and needs" (Brown, Brown, Reardon, & Merrill, 2011, p. 6). It is difficult to discuss the field of education today without referring to the term, STEM. The STEM fields (science, technology, engineering, and mathematics) are ever-present from the elementary level through college and beyond (Epstein & Miller, 2011). Epstein & Miller wrote, "Few would argue against the need to improve our students' performance in math and science, both to produce citizens who are STEM literate and to grow the STEM workforce that is required for future global competitiveness" (p. 17).

The job market in the 21st century requires graduates to be more STEM savvy with a strong background in these fields to be considered competitive for employment. "STEM jobs--those requiring a mastery of science, technology, engineering, or math skills--are overwhelmingly in high demand and will account for about 38 percent of all high skill jobs created; they are also typically among the highest paid" (Malcolm & Webster, 2014, p. 4B).

The reauthorization in 2001 of the Elementary and Secondary Education Act, also known as No Child Left Behind (NCLB), brought the topic of teacher quality back into focus for the United States (Munoz & Chang, 2007; Stronge, Ward, Tucker, & Hindman, 2007). This shift caused the field of education to re-evaluate the way classrooms were structured, how student academic achievement was monitored, and the ways in which teachers were certified.

Elementary teachers have been certified in a different manner than middle and high school teachers. Elementary teachers earn a certification to teach all academic subjects in grade levels kindergarten through sixth grade, or some combination of grade levels. Middle and high school teachers are certified to teach specific content areas (FDOE, 2014). Teaching certification can be obtained through college course work and earning a degree in the content area or through alternative certification which sometimes only requires a certain score on a state assessment (FLDOE, 2014). Those teachers who have not taken college coursework have not received instruction in subject area content or the pedagogical skills necessary to enter a classroom; and this can create a disconnect for their students. Highly qualified teachers of secondary STEM fields need the content

knowledge as well as the pedagogical skills and strategies to be successful. Also, having teachers who are comfortable integrating technology into their instruction can increase the chances of connecting with 21st century learners (Moeller & Reitzes, 2011).

One way to prepare teachers to use technology in their future classrooms is to use technology in their preparation. Teachers who have prior knowledge and experience using technology will be more confident in their use of it in their classrooms (Houlihan, 2014). "Investing in quality STEM educators to teach and spark interest in science, math, technology and engineering is critical to maintain a steady pipeline of STEM graduates and ensure American competitiveness in the 21st century" (Houlihan, 2014, p. 1).

"According to the U.S. Department of Education, only about 16 percent of high school students are interested in a STEM career and have a proven proficiency in mathematics" (Horn, 2014, p. 5). NEA president, Dennis Van Roekel, noted that "the nation needs to connect students to jobs of the future by reengaging them in these important fields . . . and we must have the teachers to help get them there" (NEA, 2014, p. 2).

Colleges and universities have recognized for some time the need for more science and mathematics courses in their teacher preparation courses. Pre-service teachers with an undergraduate degree in a STEM field require more specialized training in their respective subject areas than teachers in other content areas. "An estimated 10-20% of science and math teachers in U.S. middle schools are not certified in their subjects--nor did they major in a related field in college" (STEM, 2011, p. 1). President Barack Obama (2011) recognized another aspect of the need for teachers when he said,

"Over the next 10 years, with so many baby boomers retiring from our classrooms, we want to prepare 100,000 new teachers in the fields of science and technology and engineering and math" (p. 3).

Taylor (2011) stated, "With the implementation of Senate Bill 4, the stakes for quality mathematics and science instruction are high" (p. 22). She noted that schools were recognizing the need for teachers who are well-versed in mathematics and science content as well as possessing the expertise "at delivering this content to diverse groups of students in innovative ways" (Taylor, 2011, p. 22).

This section of the literature review has been focused on the need for qualified teachers, particularly STEM teachers. Table 2 provides a summary of the authors and researchers in the literature reviewed for the present study, the critical need for science, technology, engineering, and mathematics (STEM) teachers.

Table 2

Summary of Literature Reviewed: Critical Need for Science, Technology, Engineering and Mathematics (STEM)

Area of Interest	Authors
Need for STEM teachers	Brown, Brown, Reardon & Merrill, 2011; Epstein & Miller, 2011; FLDOE, 2014; History, 2014; Horn, 2014; Houlihan, 2014; Malcolm & Webster, 2014; Munoz & Chang, 2007; National Science Board, 2010; National Education Association, 2014;Obama, 2011;Science, Technology, Engineering, Mathematics STEM, 2011; Stronge, J., Ward, T., Tucker, P. & Hindman, J., 2007; Taylor, 2011; USDOE, 2014; Woodruff, 2013.

<u>Teacher Preparation Programs</u>

History

Prior to the 19th century, there were very little formal teacher preparation

programs. Teachers were hired and assigned to teach in a classroom of students.

According to Labaree (2004), "The rule was simply: take the class, teach the class" (p. 3).

Formal teacher education in America began in the first public normal school in

Lexington, Massachusetts in 1839, (Borrowman, 1965; Coble, Edelfelt, & Kettlewell,

2004).

> The concept of a public institution dedicated to the preparation of elementary
>
> school teachers was based upon the European influence of Johann Heinrich
>
> Pestalozzi, who believed that teachers should not impose learning on a child, but
>
> rather employ children's senses to guide their learning. (Helton, 2008, p. 18)

"Teacher education evolved greatly since 1839, and education and training

requirements for teachers increased concurrently with advances in neuroscience and

rising standards for student accountability" (Labaree, 2004, p. 5). Teachers started

receiving instruction based on "the Bible, reading and writing and less arithmetic" (Coble

et al., 2004). This was due in part to a lack of availability of qualified teachers, as well as

time.

Initially, teachers were predominantly male. As the nation expanded to the west

and industries with factories became more prevalent, males began to take advantage of

expanding workforce opportunities, leaving a void in the field of education that women

started to fill (Lucas, 1997). As the nation became more structured, educational leaders including Horace Mann saw the need for formally structured teacher education programs.

<div align="center">Normal Schools</div>

The earliest teacher preparation schools were referred to as normal schools. "The French dubbed it *ecole normale*. E*cole* meaning school, *normale*, coming from the Latin *normal*, figuratively meaning a model or principle. The Americans translated the term to *normal school*," (Coble et al., 2004, p. 5). A typical normal school established graduation requirements for new teachers, i.e., demonstrate subject knowledge, show high morals, and be in good health (Herbst, 1989). Normal schools initially trained elementary school teachers. At their inception, students were admitted directly from elementary school. Eventually, however, schooling beyond the eighth grade became a requirement for normal school admission. Massachusetts was a trailblazer in 1894 when it established the requirement of high school graduation prior to entering a normal school. The majority of teacher preparation was focused on elementary school teaching rather than secondary (Herbst, 1989).

There were some normal schools that worked to provided practical experience for future educators. Many required pre-service teachers to observe master teachers in regular, public schools. Later, the notion of a formal internship experience was included in the curricula. Prior to graduation, pre-service teachers were assigned to a public school, and they would either replace the current teacher or be placed on a rotation to work in several different classroom settings throughout the internship (Fraser, 2006).

Students were provided feedback to address deficits in their teaching abilities and to perfect instruction of academic content. In Pennsylvania in the early 1900s, 18% of the public school teachers had attended a normal school (Urban, 1990). In addition, 10% attended normal school but did not complete the course work, as they were often hired before they were able to finish the courses (Fraser, 2006; Urban, 1990). Many attended high school, but 39% of the 10,000 surveyed had no training beyond elementary level at all (Fraser, 2006).

Twentieth Century

"Post graduate one year Diploma of Education programs for secondary teachers were not established until 1911" (Knipe, 2012, p .4). There was no sense of urgency to create such institutions to train secondary teachers as there was for elementary.

> To echo a sentiment voiced by deans of education schools, almost since colleges of education came into being they have frequently been treated like the Rodney Dangerfield of higher education. Education schools were the institution that got no respect- from the Oval off to the Provost's Office, from university presidents to Secretaries of Education. (Duncan, 2010, p. 16)

By 1920, there were over 320 established normal schools in the United States, each of them in competition for the highest achieving high school graduates, hoping to increase their enrollment. These normal schools began offering college courses for future elementary and high school teachers.

By the beginning the 20th century, society was changing rapidly, and education necessarily followed. In their 1929 article, Robert and Helen Lynd wrote, "For a long time all the boys were trained to be the President. Then we trained them to be

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professionals. Now we are just training those boys to get jobs" (Lazerson, 1987, p. 89).

Normal school reached their peak in the early 20th century, as teacher education shifted

its goal to maintaining an orderly classroom environment and, if possible, to teaching

lessons to the students. In 1918, the Commission of the Reorganization of Secondary

Education, appointed by the National Education Association of the United States,

published its report which included The Cardinal Principles of Secondary Education

(Schugurensky, 2005). The seven principles which applied to all students of

"approximately 12 to 18 years of age" (Schugurensky, 2005, p. 2) defined the ultimate

goals for education at that time. The following dimensions were included:

- Health: the secondary school would provide health instruction, health habits,
  organize a program of physical activities, and generally encourage the practice
  of healthy living.

- Command of fundamental processes: devoting time to teaching reading,
  writing, arithmetical computations and the elements or oral and written
  language.

- Worthy home membership: schools educating both males and females should
  instill wholesome relations between boys and girls and men and women.
  Home membership as an objective should not be thought of solely with
  reference to future duties.

- Vocation: to secure a livelihood for himself and those dependent on him, to
  serve society well through vocation, maintain the right relationships toward
  coworkers and society, and to find in that vocation his own best development.

- Citizenship: A many-sided interest in the welfare of the communities to which one belongs; loyalty to ideals of civic righteousness; practical knowledge of social agencies and institutions; good judgment as to means and methods that will promote one social end without defeating others; and as putting all these into effect, habits of cordial cooperation in social undertakings.

- Worthy use of leisure: recreation of body, mind, and spirit, and the enrichment of his personality; means of enjoyment, such as music, art, literature, drama, and social exchanges, as well as individual interests.

- Ethical character: moral selection of content and teaching methods, ethical relationships among students and other educators, the spirit of service and principles of true democracy, specifically to the moral values of the organization (Schugurensky, 2005, p. 2).

Normal schools, with their focus only on educating elementary school teachers, did not compete well with teacher colleges that expanded beyond those narrow parameters. Coble et al. (2004) described the following glaring differences between normal schools and teachers' colleges.

- Normal schools only required two or three years while teacher colleges required at least a four-year program.

- Students in teacher colleges were educated past the point of instruction on the elementary school level.

- Teacher colleges offered a wider range of educational opportunities, more in the way of a liberal arts college degree at a university.

- Teacher colleges taught more about the professional of teaching, even going as far as teaching the history of education.

- Teacher colleges included outside internships lasting two months or more (pp. 4-5).

Finally colleges and universities began offering teacher preparation courses in addition to their other degree programs. Though this seemed like a positive change for the field of education, females were relegated to elementary classrooms and deterred from middle and high school instruction. Males occupied all the leadership roles in schools as well as most high school classrooms. "As late as 1972, 80 percent of all elementary school principals were male while 84 percent of the classroom teachers were female" (Herbst, 1989, p. 191).

The focus of educational preparation has largely shifted from pedagogical skills to more a subject-matter centered program (Darling-Hammond, 2000a; Darling-Hammond & Youngs, 2002; USDOE, 2002). In 1961, future elementary school teachers spent the majority of their college course on methods classes. Two decades later, only 20% of elementary school teacher preparation focused on pedagogy (National Commission on Excellence in Education, 1985). This lack of knowledge in pedagogical strategies creates a disadvantage for these new teachers. Lee Shulman described effective teachers as having a knowledge base that contained the following elements:

- Knowledge of the academic content;

- Pedagogical knowledge, specifically broad principles and strategies of classroom management and organization that will cross into multiple subject areas;

- Curriculum knowledge;

- Knowledge of learners and their individual characteristics, including learning preferences and styles;

- Knowledge of educational contexts, including workings of the group or classroom and finances of school districts;

- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds (1987, p.8).

Twenty-First Century

Educators, philanthropists, and policymakers have advocated for more efficient and effective teacher education, (Buche, Querrec, De Loor, & Chevaillier, 2004; Foundation, 2010; Hawkins & Heflin, 2011). "The relationship between teacher education and teacher effectiveness has been hotly debated in recent years in both research and policy circles" (Ballou & Podgursky, 2000, p. 22). Over the last decade, school districts have increased the implementation of programs such as Response to Intervention (RtI), or Multi-Tiered Systems of Support (MTSS), proving the need for high quality teaching of all students, from the most struggling to those needing enrichment (Arnberger & Shoop, 2008; Fuchs & Fuchs, 2006). Identifying students who

are in need of specific intervention is not the problem. The difficulty occurs in finding

teachers who possess the content and knowledge as well as the pedagogical skills to

conduct the interventions. The acknowledgement of effective teaching practices has been

the focus of research for decades (Brophy, 1979; Danielson, 2009; Doyle, 1977; Stronge,

2010). Advocates of stronger teacher preparation have argued that teachers need to

understand how children learn and how to make material accessible to a wide range of

students to be successful, (National Commission on Teaching and America's Future,

1996).

In 2005, the American Educational Research Association (AERA) recruited a

panel to address recruitment, preparation, and retention of teachers in education (AERA,

2005). The panel discussed issues ranging from teaching students with disabilities to

teachers with specialized certifications in the STEM fields. The various discussions

included the thought that these topics should be addressed in teacher preparation

programs. The panel observed that though teacher preparation programs were constantly

evolving, the areas with the most critical need were the STEM fields.

Unlike their elementary counterparts, secondary teachers traditional earn degrees

and certifications in a specific subject area. STEM teachers earn degrees in the sciences,

technology, engineering and mathematics fields. Much more of the coursework is

focused on content rather than pedagogical skills. Though elementary teachers take

courses specifically focused on teaching individual subjects such as reading, writing and

social studies, secondary teachers have much more content knowledge embedded in their

preparation (FLDOE, 2014).

"With limited experiential and practical knowledge from which to draw, a great number of beginning teachers feel overwhelmed and uncertain about themselves and their chosen career path" (Feiman-Nemser, Carver, Schwille, & Yusko, 1999, p. 8). Teacher preparation programs have the task of preparing new teachers to handle the demands of a school and classroom. Darling-Hammond and Baratz-Snowden, writing in 2005, noted that approximately two million teachers would be added to the field of education by 2015 who were prepared to teach the content as well as having the pedagogical skills necessary to maintain a highly effective classroom environment of diverse learners. Those pre-service teachers need exposure to the types of challenges they could face once entering the teaching field, including the task of increasing student achievement. "The quality of teacher preparation programs nationally is integral to ensuring that our nation's schools are staffed with skilled professionals capable of raising student achievement" (USDOE, 2006, p. 1).

Outside of the typical school building where one traditionally find teachers and students, there is an entire online community of learners taking advantage of distance learning and virtual schools. With this technology, there is a need for teachers with the content knowledge, pedagogical skills of a traditional teacher, as well as the ability to instruct in an online environment. Florida Statute 1002.321, the Digital Learning Now Act of 2011 (USDOE, 2011), required students entering ninth grade in 2011-2012 or later to complete at least one online course in order to meet the minimum graduation requirements. This statute also provided advance notice that all statewide end-of-course (EOC) examinations would be administered online by 2014-2015. All students must be

prepared to take these assessments, and teachers will need to be confident enough to instruct the students in the use of the technology. According to Taylor (2011), "Currently little training exists to prepare teachers for teaching in online or blended learning environments" (p. 4).

Resident Teacher Professional Preparation Program (RTP[3])

The major research university in central Florida, in conjunction with partnering school districts, offer students a unique opportunity to prepare for the field of teaching. The model for cooperative learning that has yielded the most academic gains is the "traditional triadic model-cooperating teacher, university supervisor, and pre-service teacher" (Giebelhaus, 1995, p. 38). With regard to partnering school districts and universities, "both schools and universities must be open to new ideas regarding their goals and operating structures, and they must be open to the possibility of redefining existing roles" (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006, p. 57).

The Resident Teacher Professional Preparation Program (RTP[3]) gave undergraduate STEM majors an opportunity to transition to teaching mathematics or science in middle and high school (RTP[3], 2014). Through this scholarship program, students earn a Master in the Art of Teaching degree.

A major research university in central Florida, the site of this study, received a Race to the Top grant in partnership with a virtual school and four central Florida school districts that provided this job-embedded residency to students. Teacher candidates with an undergraduate degree in science, mathematics, engineering, or a closely related field

were eligible for admission to the program, although students having earned a bachelor's degree since 2008 were preferred. After acceptance into the university's MAT program, students were able to apply for an RTP[3] residency. Once admitted, the coursework and experiential learning began. As influenced by the NCATE Blue Ribbon Panel (Zimpher & Jones, 2010), the RTP[3] was embedded in clinical practices and reinforced with field experiences which were directly connected to the coursework. Students had opportunities in middle schools and high schools as tutors as well as through the TeachLivE[TM] laboratory on the UCF campus. Thus, students have gained experience through tutoring in middle and high schools, but they have also they have also been able to "acclimate themselves to a classroom environment, culture of schools, and develop relationships" (Taylor, Andreasen, Haciomeroglu, & Powell, 2013, p. 7). Those relationships with mentors and administrators could potentially lead to future employment. Field experiences can increase the students' confidence in the classroom as well as during future job interviews. "Beginning teachers nationwide feel unprepared when they enter their first teaching position" (Taylor et al., p. 3). RTP[3] gave students the skills to feel more prepared.

In 2011, President Barack Obama issued a plan to improve education which included elements of collaboration between school districts and higher education teacher preparation programs. He believed this partnership would help to more effectively measure the success of new teachers in the first two years of teaching as well as the teacher preparation programs, (USDOE, 2011).

Taylor (2011) observed that first-year teachers, nationwide, feel overwhelmed and

unsupported in the first year teaching. This is a fragile time for new teachers as they are

determining if they are in an appropriate career field for them. New teachers require the

support of veteran teachers, or mentors. Through the RTP[3], pre-service and first year

teachers maintained contact with mentors assigned to them. "Resident teachers have

continued support from UCF intern coordinators and school based mentors with job-

embedded learning experiences during their first year of teaching" (Taylor et al., 2013, p.

3).

Meaningful Feedback

"There isn't just one way to give feedback, nor is there just one kind of feedback"

(Elford, Carter, & Aronin, 2013, p. 2).

> Feedback to students assumes many forms and serves many purposes. Public
> praise recognizes student achievements; probing questions can assess student
> understanding; and a simple nod or written comment can encourage continued
> effort. Ultimately, feedback serves as an indispensable step in the learning
> process by extending instruction beyond the initial question or activity. (Latham,
> 1997, p. 86.)

One of the criticisms of many teacher preparation programs is in regard to the

lack of practical application of what is learned in teacher preparation courses to the actual

classroom. One could not conceive of a doctor, engineer, or lawyer not having a period

of training after graduation in which to become familiar with the field under the care of a

master mentor. However, the majority of first year teachers graduate, obtain their first

teaching position, and are handed a key to their first classroom (Levine, 2006).

Through RTP[3], resident teachers were provided the mentor experience during their first one or two years of teaching. The mentors provided meaningful feedback throughout the coursework as well as into the first year the resident teacher is in the field. According to Hattie (2009), feedback has a desired effect size of 0.73 which is very high. This shows that meaningful feedback for pre-service and first-year teachers can greatly impact their experiences and, in turn, can contribute to their retention in the field of teaching. One challenge that teachers face is finding ways to balance encouragement with constructive feedback (Ching, 1991). "When feedback is combined with a correctional review, feedback and instruction become intertwined until the process itself takes on the forms of new instruction, rather than informing the student solely about correctness" (Kulhavy, 1977, p. 212). Berliner (1984) noted that having teachers receive feedback in their preparation courses would equip them with proper ways to give feedback to their future students: "In pre-service programs prospective teachers must learn to provide academic feedback. . . . Research has now shown that each of these activities were teacher behaviors that positively influence academic achievement" (Berliner, 1984, p. 94).

There are several ways in which feedback can be used effectively and efficiently in teacher preparation programs. "In addition to the feedback students receive from course instructors, students in many colleges and universities receive counseling periodically on their progress and future plans" (Chickering & Gamson, 1987, p. 4). One technique, called bug-in-ear, has been used for 35 years to give immediate and meaningful feedback (Rock, Gregg, Gable, & Zigmond, 2009; Scheeler, Bruno, Grubb &

Seavey, 2009). This type of coaching is conducted by a coach in a remote location

(Giebelhaus & Cruz, 1994). The coach observes a lesson while giving feedback that only

the teacher can hear through an earpiece (Scheeler, McAfee, Ruhl, & Lee, 2006). Some

teachers may be concerned that this Big Brother technique may be used in evaluative

systems and is a type of spyware (Rock, Zigmond, Gregg, & Gable, 2011). "Its purpose

is not to accumulate evidence that can be used to terminate a teacher. . . a virtual coach is

a supportive companion who inspires and builds up teachers" (Carson, Tesluk, &

Marrone, 2007, pp. 1225-1226).

There are four types of feedback that are most often used in educational settings

(Rock, 2009) and the TeachLivE^{TM} mixed-reality experience is no exception. The first

type of feedback is encouraging. This use of feedback is employed when the student, or

resident teacher in the case of the TeachLivE^{TM} mixed-reality experience, is performing

well in the experience. The coach will give positive praise and encourage the resident

teacher to continue using the strategies in the future. Even when other forms of feedback

are required, there should always be elements of encouragement demonstrated.

The next type of feedback is questioning. Posing questions provides the greatest

potential for developing autonomy. The intent is for students to answer the feedback

questions with the hopes of constructing questions for themselves in the future with the

ultimate goal of achieving the desired effects (Costa & Garnston, 2013). Examples of

questions asked to provoke this questioning technique include: "How did you know the

class was interested in your topic? What did your classmates say that made you know

they were interested in your topic? What did you learn that you can apply to other projects?" (Costa & Garnston, 2013, p. 2).

A third type of feedback is instructive. "Instructive feedback--which incorporates extra information and instruction in responses to students' work--appears to produce quantifiable strides in learning" (Latham, 1997, p. 86). Under instructive feedback are three types of sub topics: expansion, parallel, and novel. Expansion feedback is when the teacher, or coach, provides feedback on what the student is doing, as well as adds additional information that may be of interest. Parallel feedback is used when the teacher wants the students to provide the same response but in a different manner. "An example is asking students to name a numeral, then showing them the number as a printed word" (Latham, 1997, p.86). The last type of instructive feedback is novel feedback. This strategy is used when "the teacher presents information that is unrelated to the target skill, such as mentioning the color of various shapes after asking students to name the shapes" (Latham, 1997, p. 86). According to Werts, Wolery, Gast, and Holcombe, "instructive feedback consistently helped students acquire knowledge more quickly, without significantly increasing instruction time" (1995, pp. 62-63).

The final type of feedback is corrective. Corrective feedback involves students receiving either formal or informal feedback on their performance of various tasks by a teacher or peers (Heift, 2004). Corrective feedback is the most often used form of feedback. Teachers simply inform the student of the areas in need of improvement.

Although Hattie (2012) indicated that feedback yields one of the highest effect sizes of any strategy teachers can employ, there are multiple ways to use feedback so that

students feel valued and respected. Encouraging, questioning, constructive and corrective are only three forms of feedback that teachers can use to show students that they are using sound strategies as well as identify areas in which they can focus for future improvement.

This section of the review of the literature has been focused on the writings and research of authors who focused on teacher preparation programs. Table 3 contains a listing of authors and agencies whose work was reviewed for this study.

Table 3

Summary of Literature Reviewed: Teacher Preparation Programs

Area of Interest	Authors
Introduction to Teacher Preparation	AERA, 2005; Angus, 2001; Arnberger & Shoop, 2008; Ballou & Podgursky, 2000; Berbst, 1989; Borrowman, 1965; Brophy, 1979; Buche, Querrec, De Loor, & Chevaillier, 2004; Coble, Edelfelt, & Kettlewell, 2004; Danielson, 2009; Darling-Hammond, 2000a; Darling-Hammond, 2000b; Darling-Hammond & Baratz-Snowden, 2005; Darling-Hammond & Youngs, 2002; Doyle, 1977; Duncan, 2010; Feiman-Nemser, Carver, Schwille, & Yusko, 1999; FLDOE, 2014; Fraser, 2006; Foundation, 2010; Fuchs & Fuchs, 2006; Hawkins & Heflin, 2011; Helton, 2008; Herbst, 1989; Knipe, 2012; Labaree, 2004 Lazerson, 1987; Lucas, 1997; National Commission on Excellence in Education, 1985; National Commission on Teaching and America's Future, 1996; Schugurensky, 2005; Shulman, 1987; Stronge, 2010; Taylor, 2011; USDOE, 2002, 2006, 2011; Urban, 1990.
Resident Teacher Professional Preparation Program (RTP[3])	Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006; Giebelhaus, 1995; RTP[3], 2014; Taylor, 2011; Taylor, Andreasen, Haciomeroglu, & Powell, 2013; USDOE, 2011; Zimpher & Jones, 2010
Feedback	Berliner, 1984; Carson, Tesluk, & Marrone, 2007; Chickering & Gamson, 1987; Ching, 1991; Costa & Garnston, 2013; Elford, Carter & Aronin, 2013; Giebelhaus & Cruz, 1994; Hattie, 2009, 2012; Heift, 2004; Kulhavy, 1977; Latham, 1997; Levine, 2006; Rock, Gregg, Gable & Zigmond, 2009; Rock, 2009; Rock, Zigmond, Gregg, & Gable, 2011; Scheeler, Bruno, Grubb & Seavey, 2009; Scheeler, McAfee, Ruhl, & Lee, 2006; Werts, Wolery, Gast, & Holcombe, 1995.

Mixed Reality Instruction

"Mixed-reality presents a viable approach to teaching in mainstream science classrooms that enhances student gains in content knowledge when designed in collaboration with educators" (Tolentino, Birchfield, Megowan-Romanowicz, Johnson-Glenberg, Kelliher, & Martinez, 2009, p. 510). Students in classrooms across the United States have opportunities to use technology, including mixed-reality simulations, to advance their academic accomplishments in a variety of subject areas. Knowing that 21st century learners require much more in the way of engaging instructional practices (Rotherham & Willingham, 2009), teachers are using mixed-reality simulations to instruct and encourage practice of new skills. While students are using this technology to learn and gain knowledge, politicians and university administrators agree that technology should also be used to prepare the teachers of these students.

Mixed-Reality Instruction for Teacher Preparation

Allen (2003) described the lack of consensus regarding the ways in which teachers learn their craft: "While there is a broad consensus that practical experience is important in learning to teach, there's a good deal of disagreement over the best way for prospective teachers to acquire such experience" (p. 5) Dieker, Hynes, Hughes, and Smith (2008) addressed the impact of technology on all of society and specifically in regard to education as follows: "As technology evolves, so does its impact on our daily lives. These changes affect our everyday life as well as education, teacher preparation, and the lives of students and teachers" (p. 9). Belloti, Kapralos, Lee, Moreno-Ger, and

Berta (2013) viewed simulations as "a promising means for safely and cost-effectively acquiring skills and attitudes which are hard to get by rote learning" (p. 1). Mixed reality is no longer the future of education. Post-secondary teacher preparation programs have increasingly begun to use forms of mixed reality or virtual experiences in preparing teachers. Rather than have a pre-service teacher experience the potential anxiety of teaching for the first time in front of a live classroom, they are having the opportunity to interact with virtual students through the use of computers.

Generation Y, also called Millennials, have been documented as spending a record number of hours online and using electronic devices. This age range, those born in the early 1980s to early 2000s were the students enrolled in teacher preparation programs at the time of the present study (Graslie, 2014). Colleges and universities have opportunities to tap into the experiences these students have already had with technology to foster even greater opportunities to learn content and pedagogy (Lei & Zhao, 2005). Lewin (2010) commented, in this regard that, "The average young American now spends practically every waking minute--except for the time in school--using a smart phone, computer, television or other electronic device, according to the Kaiser Family Foundation" (p. 2).

Enicks (2012) discussed the sequence of learning: "Traditionally, pre-service teachers would attend university to learn and then go to schools to practice and apply what was learned in academia" (p. 24). Berlinger, in his 1984 observation, took note of the importance of early practice for pre-service teachers. "Only in pre-service education programs will novice teachers be able to practice [teaching strategies] safely, in an

environment in which they cannot harm children while learning their pedagogical skills" (p. 11).

TeachLivE™

"TeachLivE™ is a 3D mixed-reality classroom with five simulated students, used to facilitate virtual rehearsal of pedagogical skills in pre-service and practicing teachers," (Hayes, Hardin, & Hughes, 2013, p. 1). The students and classroom are seen by the live "teacher" on a large screen. The teacher interacts with the students in much the same way a teacher would interact with a traditional classroom. The teacher can talk to and interact with the students as well as walk around the classroom. "The current interface tracks the user movement allowing the teacher's physical movement to be reflected by changes in the perspective position of the virtual camera" (Hayes et al., 2013, p. 2). A video game system is used to track the teacher's movement and display the visual changes on the screen. This function allows the teacher to practice strategies such as proximity to students that may be more disruptive as well as address individual students without calling to them across the room. The avatars are 3D characters seen as 2D representations on the screen. These are virtual characters that are modeled and rigged by animators to be controllable in real time and are displayed on flat screen surfaces such as TV screens or projected onto viewing surfaces (Nagendran, Pillat, Kavanaugh, Welch, & Hughes, 2014).

"TeachLivE™ is for teachers what a flight simulator is for pilots" (Greenberg, 2013). The five virtual students in the classroom act in a manner corresponding to their

natural personalities as well as the teacher's delivery of the lesson content. "The magic behind the scenes of TeachLivE^TM is a combination of human and computer simulation. A live actor off-site plays the role of the five students, digitally controlling their actions, and when addressed, responding to the teacher in character" (Greenberg, 2013, p. 1). This allows students to answer questions posed by the teacher, interact appropriately to the teacher's actions and lessons as well as react to comments about current issues such as sports or the weather that an otherwise computer-based student may not have the capability of doing (Dieker, Straub, Hughes, Hynes, & Hardin, 2014). Hidden inside avatar personalities can be warning signs of underlying issues such as learning disabilities or abuse at home, giving pre-service teachers the chance to identify these signs in their practice (Abernathy, 2013, p. 1).

As the resident teacher is conducting the lesson simulation, there is a coach present in the room to provided immediate and effective feedback (Hattie, 2012) to the teacher. The resident teacher then resumes the lesson, implementing the feedback suggestions. This is another feature of the TeachLivE^TM mixed-reality experience that could not happen in a traditional classroom setting.

In a traditional classroom, new teachers often have to make mistakes in front of the students in order to learn pedagogical skills. Inside the TeachLivE^TM mixed-reality experience lab, teachers have the opportunity to make those mistakes with the virtual students, reset, and try again. "TeachLivE offers teachers a truly 21st century way to improve their practice" (Dieker et al., 2014). Teacher candidates can practice a skill until it is mastered in the TeachLivE^TM mixed-reality lab. Teacher candidates are not only

given experience with classroom management but also with various pedagogical strategies that could take years to master in a traditional classroom. Such skills include the use of wait time, using higher level questioning, using more cooperative grouping strategies, and overall increasing student engagement (Dieker et al., 2014).

According to Enicks (2012),"At this time ten universities throughout the United States are partnering with the major research university in central Florida to utilize the TeachLivE^{TM} mixed reality experience with pre-service and in-service teachers" (p. xx). Using this technology with pre-service teachers gives them the opportunity to practice pedagogical skills in an environment where it is acceptable to make a mistake and have the opportunity to master the skill with repeated practice. In a traditional classroom, this is not an option. RTP^3 provides students with an opportunity to learn via simulation (Taylor, 2011). This section of the review of literature has been concentrated on the work of authors and researchers who studied mixed-reality and TeachLivE^{TM} initiatives. Table 4 displays the linkage between authors and publications included.

Table 4

Summary of Literature Reviewed: Mixed-reality Instruction for Teacher Preparation

Area of Interest	Authors
Mixed Reality	Allen, 2003; Belloti, Kapralos, Lee, Moreno-Ger, & Berta, 2013; Berlinger, 1984; Dieker, Hynes, Hughes, & Smith, 2008; Enicks, 2012; Graslie, 2014; Lei & Zhao, 2005; Lewin, 2010.
TeachLivE[TM]	Abernathy, 2013; Dieker, Straub, Hughes, Hynes, & Hardin, 2014; Enicks, 2012; Greenberg, 2013; Hattie, 2012; Hayes, Hardin, & Hughes, 2013; Nagendran, Pillat, Kavanaugh, Welch, & Hughes, 2014; Taylor, 2011.

Summary

This review of literature was conducted for three specific areas of interest: (a) the critical need for STEM teachers, (b) teacher preparation programs, and (c) the use of mixed-reality instruction for teacher preparation. Each major topic was further categorized, using subtopics to explore the relevant topics addressed in this study.

At the time of the present study, there was a critical need for qualified STEM teachers. Teachers in the STEM fields must not only have a solid foundation in the content area but also possess pedagogical skills necessary to manage a classroom of students as well as employ a toolbox of teaching resources (Arizona, 2014) to connect with students and make the learning meaningful to them.

Teacher preparation programs have undergone a substantial evolution since their inception in the early 1900s. Pre-service teachers today have tremendous opportunities that were not available even 20 years ago. Using mixed-reality experiences such as

TeachLivE^{TM} to practice teaching content as well as to practice various pedagogical skills

can provide a significant advantage to pre-service teachers.

CHAPTER 3
METHODOLOGY

Introduction

The focus of this research study was to determine the effectiveness of the

TeachLivE™ mixed-reality laboratory experience as perceived by STEM degreed

individuals who enter the teaching field as middle and high school teachers of

mathematics and science without the benefit of having completed a formal teacher

preparation program. This chapter provides a detailed account of the methods and

procedures used to conduct the study. It has been organized into the following sections:

(a) participants, (b) research questions, (c) instrumentation, (d) data collection, and (e)

data analysis.

Selection of Participants

The population for this study consisted of those selected to be in the RTP[3], which

included being in the Masters in the Art of Teaching (MAT) and becoming a middle or

high school science, mathematics, or engineering teacher. Participants applied to RTP[3]

and the MAT, were interviewed and if accepted in both, became the population for this

study. When they accepted the RTP[3] scholarship, the resident teachers signed an

agreement that included required participation in this research study. The participants all

had STEM degrees, not necessarily from the same research university as the MAT

program, and were preparing to enter the field of education as middle school or high

school educators.

A total of 78 students were enrolled and in good standing in the RTP[3] and MAT program during the summer of 2013 when the data were collected. Each of the 78 resident teachers in the RTP[3] participated in the current study. Thus, the intent was to gather data from entire population, however seventy-eight (100%) resident teachers completed lesson introduction feedback forms at the conclusion of the TeachLivE[TM] simulation, seventy-eight (100%) resident teachers completed parent conference feedback forms at the conclusion of the TeachLivE[TM] simulation, 37 (47%) completed reflections on the lesson introduction and 35 (45%) completed reflections on the parent conference.

In order to facilitate analysis, the researcher categorized the self-reported undergraduate degrees into the four STEM areas: science, technology, engineering, and mathematics. A total of 24 types of degrees were reported for the 78 resident teachers. A majority of the resident teachers had completed a baccalaureate degree in the science area, reporting 15 different degrees. Resident teachers also reported having completed degrees in engineering (5 different degrees), mathematics (2 different degrees), and technology (1 degree). Seven of the resident teachers did not indicate a degree field. These data are reported in Table 5.

Table 5

Self-Reported Resident Teacher Degrees (N = 78)

STEM Area	Degree
Science (53)	Astronomy (1)
	AstroPhysics (1)
	Biochemistry (1)
	Biological Sciences (3)
	Biology (21)
	Biomedical Sciences (2)
	Chemistry (4)
	Forensic Science (1)
	Health Science (1)
	Interdisciplinary Computational Science (1)
	Interdisciplinary Environmental Science (1)
	Interdisciplinary Natural Science (1)
	Molecular and Microbiology (9)
	Physics (5)
	Pre-Professional Biology (1)
Technology (1)	Information Technology (1)
Engineering (10)	Civil Engineering (2)
	Electrical Engineering (2)
	Environmental Engineering (1)
	Industrial Engineering (2)
	Mechanical Engineering (3)
Mathematics (7)	Applied Mathematics (4)
	Mathematics (3)
Not Indicated (7)	

Note. STEM = Science, Technology, Engineering, Mathematics.

Instrumentation

Two different instruments were used in the evaluation and analysis of the data
gathered to determine the perceived effectiveness of the TeachLivE™ mixed-reality
experience. First, a feedback form was used to gather quantitative and qualitative data
from the resident teachers. The feedback form was created by the project staff as a tool

to gather the perceptions of the resident teachers with regard to their experience in the TeachLivE[TM] mixed-reality laboratory (TLE TeachLivE[TM] Research Study, 2014). The feedback form was created with three specific objectives: (a) to improve upon teacher preparation, (b) to determine if the TeachLivE[TM] mixed-reality experience should remain a part of the MAT program, and (c) to meet the requirements set forth by the various funding agents through the RTP[3] grant (Taylor et al., 2013).

The feedback form and the data therein were pre-existing data that the researcher acquired from the from the RTP[3] principal investigator. "Selecting an already developed instrument when appropriate is preferred. Such instruments are usually developed by experts who possess the necessary skills" (Fraenkel, Wallen, & Hyun, 2012, p. 113).

The feedback form was separated into two unique sections. The first part of the feedback form was a Likert-type scale (Vagias, 2006), one of the most commonly used scales in educational research. "Subjects circle the word or number that best represents how they feel about the topics included in the questions or statements in the scale," (Fraenkel et al., 2012, p. 126). The original feedback form, which can be found in Appendix D (lesson introduction) and Appendix E (parent conference), contained a Likert-type scale with possible responses ranging from -2 (strongly disagree) to +2 (strongly agree). The original feedback form also contained a rating of N/A at the end of the continuum representing Not Applicable or No Answer. The resident teachers completed the feedback form with the -2 to +2 scale and the researcher modified the scale after the data was collected to support analysis. The modified scale ranged from 1 to 5 where 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5

= strongly agree. (Fraenkel et al., 2012). Table 6 displays the differences in the two rating scales.

Table 6

Comparison of Values: Original and Modified Simulation Feedback Form Scales

Original Feedback Form Scale	Modified Feedback Form Scale
-2 = Strongly disagree	1 = Strongly disagree
-1 = Disagree	2 = Disagree
0 = Neither agree nor disagree	3 = Neither agree nor disagree
1 = Agree	4 = Agree
2 = Strongly Agree	5 = Strongly Agree

The second section of the feedback forms asked the resident teachers to reflect on their TeachLivE[TM] mixed-reality simulation immediately following the lesson introduction and parent conference experiences and leave any additional comments. A full list of comments from the resident teachers for the lesson introduction experience can be found in Appendix F and full comments for the parent conference can be found in Appendix G. It should be noted that there was no attempt on the part of the researcher to show validity in the feedback forms; however, the reliability is based on surveying the entire population rather than a sample (Fraenkel et al., 2012). The population for this study was comprised of the 78 MAT students in Cohort 1 of RTP[3].

The second instrument used in the evaluation and analysis of the data gathered to determine the perceived effectiveness of the TeachLivE[TM] mixed-reality experience was a reflection written away from the TeachLivE[TM] laboratory after the resident teacher had adequate time to reflect upon the entire experience. A table of selected comments for the

lesson introduction can be found in Appendix H and a table of selected comments for the

parent conference can be found in Appendix I. In this source of data, while it was

attempted to gather reflections from all 78 resident teachers, each of them did not return a

reflection. These documents gave insight as to the resident teachers' perceptions about

the overall effectiveness of the TeachLivE^{TM} mixed-reality experience in preparing them

to enter the field of education as middle and high school educators. It should be noted

that the resident teachers are represented in Appendices F, G, H, and I with an alpha-

numeric code. The number coding in one Appendix does not correspond to the coding in

the other Appendices as all data gathered was anonymous except for degree field. Any

data pertaining to the lesson introduction feedback form has an alpha-numeric code

beginning with LI (Appendix F). Any data pertaining to the lesson introduction

reflection has an alpha-numeric code beginning with LIR (Appendix G). Any data

pertaining to the parent conference feedback form has an alpha-numeric code beginning

with PC (Appendix H). Any data pertaining to the parent conference reflection has an

alpha-numeric code beginning with PCR (Appendix I).

<u>Data Collection</u>

The data for this study were collected by the professors in the School of Teaching,

Learning, and Leadership in the College of Education and Human Performance at the

target university. The 78 resident teachers entered the TeachLivE^{TM} mixed-reality

laboratory in pairs and participated in the simulation. Upon completion of the mixed-

reality experience, the resident teachers were asked to complete either the lesson

introduction simulation or the parent conference simulation feedback form individually, depending on which experience they participated in at that time. The resident teachers then returned to complete the other simulation at another time. The feedback forms were collected by the school district partner or faculty member who was present in the TeachLivE^{TM} mixed-reality laboratory at the time of the simulation. Either the school district partner or the faculty member also played the role of the coach in the experience and returned the feedback forms to the principal investigator of the project.

The qualitative open response document data were collected by the project instructors. The resident teachers wrote narrative reports outside of class and away from the TeachLivE^{TM} mixed-reality laboratory, submitting them to their instructors. Reflections were completed based on the resident teachers' agreement to participate in this study, including the required coursework related to the TeachLivE^{TM} mixed-reality experiences.

Data Analysis

Both qualitative and quantitative methods were used in collecting and analyzing data. The methods used in analyzing both types of data are discussed separately in the following two sections.

Analysis of Quantitative Data

The quantitative data in this study were used to respond to Research Questions 1-4 and were gathered using the simulation feedback forms completed as the resident

teachers left the TeachLivE^{TM} mixed-reality laboratory (Fraenkel et al., 2012). The

numerical responses gathered from items 1-5 on the parent conference simulation and

items 1-6 on the lesson introduction simulation were entered into an Excel database and

then transferred to IBM SPSS Statistics 22 for the analysis each of the 78 resident

teachers. Individual degrees were grouped under one of the four STEM degrees (science,

technology, engineering, and mathematics). The percentage and frequency of the

responses were produced using descriptive statistics.

Lesson Introduction Feedback Form

The lesson introduction feedback form, found in Appendix D, contained two

sections. The first section contained the following six questions and were answered using

a Likert-type scale.

1. As a result of this simulation, I feel more comfortable introducing a lesson.

2. After this simulation, I feel more comfortable managing student behavior.

3. This simulation was helpful and should continue to be included in the RTP3 program.

4. This simulation was realistic.

5. This simulation was beneficial

6. The coach's feedback was beneficial.

The answers to these questions were analyzed using descriptive statistics to find

overall trends in the data based on STEM degree. The second section of the lesson

introduction feedback form is explained under Analysis of Qualitative Data.

<u>Parent Conference Feedback Form</u>

The parent conference feedback form, found in Appendix E, contained two

sections. The first section contained the following five questions and were answered

using a Likert-type scale.

1. As a result of this simulation, I feel more comfortable speaking with parents.

2. This simulation was helpful and should continue to be included in the RTP3
   program.

3. This simulation was realistic.

4. This simulation was beneficial.

5. The coach's feedback was helpful.

The answers to these questions were analyzed using descriptive statistics to find

overall trends in the data based on STEM degree. The second section of the parent

conference feedback form is explained under Analysis of Qualitative Data.

Analysis of Qualitative Data

The qualitative data in this study were used to respond to Research Questions 5

and 6 and were gathered from two different sources. The first source was the comment

section of the feedback form completed for the lesson introduction and parent conference

simulations. The feedback forms contained a comment section where the resident teacher

had the option to leave additional information, beyond what was asked through the

Likert-type scale. Not every resident teacher elected to leave comments in this section.

The comments received on the lesson introduction feedback forms are reflected in

Appendix F and the parent conference comments are in Appendix G. The analysis of

those comments included identifying themes that emerged from the residents teachers'

comments. Those themes were identified through the repetition method identified by

Ryan and Bernard (2003). The researcher read each of the lesson introduction feedback

form comments a minimum of three times and then created Appendix F with every

comment provided. Those comments were then grouped by the themes contained in the

comments (Tables 23-27). Those comments were then consolidated into themes based on

the method identified by Opler (1945) who said, "Themes presumably reflect the crucial

points in the value system of the people." Those identified themes became the basis for

analyzing how the resident teachers perceived the effectiveness of the TeachLivE^{TM}

experience with regard to future teaching experiences. Those themes are reflected in

Table 34.

Lesson Introduction Feedback Form

The second section of the lesson introduction feedback form was for additional

comments the resident teacher wanted to include. Not all resident teachers chose to leave

comments. Of the 78 resident teachers, 67 (86%) left additional comments on the lesson

introduction feedback form. A full list of comments from the lesson introduction

feedback form can be found in Appendix F. Each of the 78 resident teachers completed

this feedback form immediately after exiting the TeachLivE^{TM} lesson introduction

simulation.

Parent Conference Feedback Form

The parent conference feedback form, found in Appendix E, contained two

sections. The first section contained the following five questions which were answered

using a Likert-type scale.

6. As a result of this simulation, I feel more comfortable speaking with parents.

7. This simulation was helpful and should continue to be included in the RTP3
    program.

8. This simulation was realistic.

9. This simulation was beneficial.

10. The coach's feedback was helpful.

The second section of the parent conference feedback form was for additional

comments the resident teacher wanted to include. Not all resident teachers chose to leave

comments. Of the 78 resident teachers, 67 (86%) left additional comments on the parent

conference feedback form. A full list of comments from the parent conference feedback

form can be found in Appendix G. Each of the 78 resident teachers completed this

feedback form immediately after exiting the TeachLivE^{TM} parent conference simulation.

Reflection on Lesson Introduction Simulation

The resident teachers were given another opportunity to share comments about

their experience in the lesson introduction simulation through a reflection completed

away from the TeachLivE^{TM} laboratory and after having some time to reflect on the

overall experience. The resident teachers made many similar comments that were

identified after reading each of the reflections a minimum of 3 times each. Ryan and

Bernard (2003) discussed techniques to identify themes, sometimes referred to as codes

(Miles & Huberman, 1994) or concepts (Strauss & Corbin, 1990). Morris E. Opler

(1945), an anthropologist and social psychiatrist, wrote, "Themes presumably reflect the

crucial points in the value system of the people. "Themes are only visible, and thus

discoverable, through the manifestation of expressions in data," (p. 143).

Ryan and Bernard (2003) discussed repetition as a straightforward and relatively

easy method of identifying themes, and the researcher elected to use this strategy in

analyzing the data. The researcher began the process by (a) reading all of the comments

from the lesson introduction feedback form and from the parent conference feedback

form a minimum of three times; (b) reading all of the comments from the lesson

introduction reflections and from the parent conference reflections a minimum of three

times; (c) developing lists of categories that emerged from each of the four sets of data;

(d) grouping and counting like comments; and finally (e) creating themes that

encompassed the comments left by the resident teachers on each of the four data

collection tools.

While reading the reflections those recurring comments developed into themes.

Reflection on Parent Conference Simulation

The resident teachers were given another opportunity to share comments about

their experience in the parent conference simulation through a reflection completed away

from the TeachLivE™ laboratory and after having some time to reflect on the overall

experience. The resident teachers made many similar comments that were identified after

reading each of the reflections a minimum of 3 times each. While reading the reflections those recurring comments developed into themes, in the same manner as explained in the lesson introduction reflections.

The themes are further explained in chapter four. Table 7 outlines each of the six research questions, source of data used to answer each research question, and the method of analysis used to answer each of the six research question.

Table 7

Research Questions, Sources of Data, and Methods of Analysis

	Research Questions	Data Source	Method of Analysis
1	To what extent do STEM graduates in the MAT perceive the effectiveness of TeachLivE™ in the lesson experience?	TeachLivE™ Lesson Introduction Simulation Feedback forms-- survey items 1, 2, 3, 4	Descriptive statistics
2	To what extent do STEM graduates in the MAT perceive the effectiveness of TeachLivE™ in the parent-teacher conference experience?	TeachLivE™ Parent Conference Simulation Feedback forms-- survey items 1, 2, 3, 4, 5	Descriptive statistics
3	To what extent do STEM graduates find the feedback from the coach helpful after the lesson introduction experience?	TeachLivE™ Parent Lesson Introduction Simulation Feedback forms-- survey item 5	Descriptive statistics
4	To what extent do STEM graduates find the feedback from the coach helpful after the parent-teacher conference experience?	TeachLivE™ Parent Conference Simulation Feedback forms-- survey item 6	Descriptive statistics
5	To what extent do STEM graduates believe that their confidence was increased through the use of TeachLivE™ and prepares them for future classroom instruction?	Reflection document	Tabular format (Appendix H); Themes
6	To what extent do STEM graduates believe their confidence was increased through the use of TeachLivE™ and prepares them for future parent-teacher interaction?	Reflection document	Tabular format (Appendix I); Themes

Summary

This chapter restated the purpose of this research and presented the six research questions. The participants were chosen based on their enrollment in the MAT program at a major research university in central Florida. The participants were aware of the commitment to participate in this research as part of their enrollment and scholarship acceptance. The 78 participants all earned degrees in a STEM-related field of study and now aspire to teach middle or high school. A description of the collection tools, the two feedback forms and the two reflection documents, were discussed as well as the reason and need for their modification from their original versions. Data collection procedures as well as the different types of quantitative and qualitative data were also addressed. Quantitative data were collected using a Likert-type scale on the feedback form completed immediately after the TeachLivE^{TM} experience. That same feedback form provided resident teachers with an opportunity for additional comments. A separate reflection document, embedded in the resident teachers' coursework, was collected to gather additional feedback from the experience. The results of the quantitative as well and the two qualitative data collection pieces can be found in Appendices F, G, H, and I. Results of the analysis of quantitative and qualitative data are presented in Chapter 4.

CHAPTER 4
PRESENTATION AND ANALYSIS OF DATA

Introduction

This study was intended to show the perceived effects of the use of TeachLivE[TM] on resident teachers in the RTP[3] at a major research university in central Florida. The participants, referred to as resident teachers, earned STEM (science, technology, engineering, and mathematics) degrees and were preparing to enter the field of education as middle or high school teachers. The overall perceptions of the resident teachers were examined after they experienced the TeachLivE[TM] mixed reality simulation as (a) a teacher introducing a lesson and (b) a teacher conducting a parent conference.

The purpose of this study was to determine if the use of the TeachLivE[TM] mixed reality simulation had an effect on the overall confidence and level of preparedness of the resident teachers prior to teaching actual students in a classroom. The problem in this study was that teachers, not having formal teacher preparation courses, enter the field of education without pedagogical training. Those teacher do not get the experience of learning specific strategies and skills needed to handle classroom management issues such as time, behavior concerns, or communicating with parents. The hope of this study is to give non-education degreed resident teachers the opportunity to learn and practice needed pedagogical training through the TeachLivE[TM] experience.

This chapter presents the results of the data collected as related to the answers to the following six research questions:

1. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivETM in the lesson introduction experience?

2. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivE^{TM} in the parent-conference experience?

3. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE^{TM} lesson introduction experience?

4. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE^{TM} parent teacher conference experience?

5. To what extent did resident teachers in RTP^3 believe that their confidence in classroom instruction was increased through the use of TeachLivE^{TM}?

6. To what extent did resident teachers in RTP^3 believe that their confidence in parent interaction was increased through the use of TeachLivE^{TM}?

Descriptive statistics are presented along with responses to each of the research questions and a concluding summary. Quantitative and qualitative methods were used to collect and analyze the data. The first four research questions were answered using descriptive statistics derived from quantitative data. The last two research questions were answered using qualitative data that were analyzed to identify recurring themes from resident teachers' feedback.

Descriptive Statistics

The lesson introduction simulation and parent conference simulation feedback forms (Appendices D and E) were used to collect information on each of the resident

teacher's STEM degree programs. Descriptive statistics are presented for these

demographic characteristics of resident teachers later in this chapter.

Participant Demographics

The participants for this study consisted of those selected to be in the RTP[3], which

included being in the Masters in the Art of Teaching (MAT) and becoming a middle or

high school science, mathematics, or engineering teacher.   Participants applied to RTP[3]

and the MAT, were interviewed and if accepted in both, became the population for this

study. When they accepted the RTP[3] scholarship, the resident teachers signed an

agreement that included required participation in this research study. The participants all

had STEM degrees, not necessarily from the same research university as the MAT

program, and were preparing to enter the field of education as middle school or high

school educators.

Lesson Introduction Simulation

The lesson introduction simulation data were gathered using a feedback form completed by resident teachers upon exiting the TeachLivE[TM] laboratory. The feedback form utilized a 5-point Likert-type scale (modified from the original scale to support data analysis, as noted in Table 6) ranging from 1 to 5 where 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree. Respondents were asked to indicate their level of agreement in response to the following six items:

1. As a result of this simulation, I feel more comfortable introducing a lesson.

2. After this simulation, I feel more comfortable managing student behavior.

3. This simulation was helpful and should continue to be included in the RTP[3] program.

4. This simulation was realistic.

5. This simulation was beneficial.

6. The coach's feedback was helpful.

Parent Conference Simulation

The parent conference simulation data were gathered using a feedback form completed by resident teachers upon exiting the TeachLivE[TM] laboratory. Utilizing the same 5-point Likert-type scale as was used in the lesson introduction feedback form, which was 1 = strongly disagree; 2 = disagree; 3 = neither agree nor disagree; 4 = agree; and 5 = strongly agree.   respondents' perceptions of the parent conference simulation were assessed using the following five questions:

1. As a result of this simulation, I feel more comfortable speaking with parents.

2. This simulation was helpful and should continue to be included in the RTP[3]

   program.

3. This simulation was realistic.

4. This simulation was beneficial.

5. The coach's feedback was helpful.

<div align="center">Testing the Research Questions</div>

<div align="center">Research Question 1</div>

To what extent do STEM graduates in the MAT perceive the effectiveness of TeachLivE™ in the lesson experience?

Analysis of Research Question 1 was completed by comparing descriptive statistics of the 78 participants' responses on the lesson introduction feedback form. The original feedback forms included a Likert-type response scale of -2 to +2 which was recalibrated to a 1-5 scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The researcher used this scale to illustrate the extent to which resident teachers agreed with statements about the TeachLivE™ experience. Respondents included 53 science degreed individuals, 1 technology degreed individual, 10 engineering degreed individuals, 7 mathematics degreed individuals, and 7 degreed individuals whom did not indicate to which STEM field they were associated.

Table 8 contains an analysis of the resident teachers' level of agreement as to their comfort in introducing a lesson as a result of the TeachLivE™ experience. For item 1 of

the lesson introduction feedback form, a majority of all respondents strongly agreed or agreed that "As a result of this simulation, I feel more comfortable introducing a lesson." Of the respondents, 45 (67.9%) science graduates, 10 (100%) engineering graduates, 6 (85.7%) mathematics graduates, and 7 (100%) of the graduates who did not share their degrees strongly agreed or agreed that their comfort level with introducing a lesson had increased. As seen in Table 8, only four of the 78 respondents, one of which was the lone technology graduate, disagreed or strongly disagreed, indicating that they were not more comfortable in introducing a lesson as a result of the simulation.

Table 8

Resident Teachers' Level of Agreement: As A Result Of The Lesson Introduction Simulation, I Feel More Comfortable Introducing A Lesson (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	1 (1.9)	2 (3.8)	5 (9.4)	21 (39.6)	24 (45.3)	0 (0)
Technology (1)	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	2 (20.0)	8 (80.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	1(14.2)	2 (28.5)	4 (57.2)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	3 (42.8)	4 (57.2)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 9 displays resident teachers' level of agreement as to their comfort in managing student behavior (item 2) during a lesson introduction as a result of the TeachLivE[TM] experience. A majority of all respondents strongly agreed or agreed that "As a result of this simulation, I feel more comfortable managing student behavior during a lesson." Of the respondents, 45 (67.9%) science graduates, 10 (100%) engineering graduates, 6 (85.7%) mathematics graduates, and 7 (100%) graduates who did not share their degrees strongly agreed or agreed that their comfort level in managing student behavior while introducing a lesson had increased. Only three of the 78 respondents, one of which was the lone technology graduate, disagreed or strongly disagreed, indicating that they were not more comfortable managing student behavior while introducing a lesson as a result of the simulation.

Table 9

Resident Teachers' Level of Agreement: As A Result Of The Lesson Introduction Simulation, I Feel More Comfortable Managing Student Behavior During A Lesson (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	1 (1.9)	1 (1.9)	6 (11.3)	21 (37.7)	24 (45.3)	0 (0)
Technology (1)	1 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	4 (40.0)	6 (60.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	1 (14.3)	3 (42.9)	3 (71.4)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	5 (71.4)	2 (28.6)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 10 contains an analysis of resident teachers' level of agreement as to the helpfulness and value of continuing lesson introduction simulation in the RTP[3] (item 3) as a result of the TeachLivE[TM] experience. A majority of all respondents strongly agreed or agreed that "This simulation was helpful and should continue to be included in the RTP[3] program." Of the respondents, 50 (94.3%) science graduates, 10 (100%) engineering graduates, 7 (100%) mathematics graduates, and 6 (85.7%) of the graduates who did not share their degrees strongly agreed or agreed the simulation was helpful and should remain a part of the RTP[3].

Only two of the 78 respondents disagreed or strongly disagreed, indicating that the simulation was not helpful and should not remain a part of the RTP[3]. Two (3.7%) science degreed individuals, the single technology degreed individual, and one

respondent (14.2%) who did not indicate a degree were neutral as to the helpfulness of this item.

Table 10

Resident Teachers' Level of Agreement: The Lesson Introduction Simulation Was Helpful And Should Continue To Be Included In The RTP³ Program. (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	1 (1.9)	0 (0)	2 (3.7)	18 (34)	32 (60.3)	0 (0)
Technology (1)	0 (0)	0 (0)	1 (100.0)	0 (0)	0 (0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	0 (0)	10 (100.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	2 (28.5)	5 (71.5)	0 (0)
Not Indicated (7)	0 (0)	1 (14.3)	0 (0)	2 (28.5)	4 (57.1)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 11 contains an analysis of the resident teachers' level of agreement as to the realism (item 4) of the TeachLivE™ lesson introduction experience. A majority of respondents strongly agreed or agreed that "This simulation was realistic." Of the respondents, 38 (71.7%) science graduates, 9 (90%) engineering graduates, 6 (85.7%) mathematics graduates, and 6 (85.7%) graduates who did not share their degrees strongly agreed or agreed the simulation was realistic.

Only five of the 78 respondents disagreed or strongly disagreed, indicating that the simulation was not realistic. A total of 11 (20.7%) science degreed individuals, the

single technology degreed individual, and one engineering (10%) degreed individual
were neutral as to the realism of the simulation.

Table 11

Resident Teachers' Level of Agreement: The Lesson Introduction Simulation Was Realistic (N = 78)

Degrees (n)	Strongly Disagree $f\,(\%)$	Disagree $f\,(\%)$	Neither Agree/ Disagree $f\,(\%)$	Agree $f\,(\%)$	Strongly Agree $f\,(\%)$	Not Applicable $f\,(\%)$
Science (53)	1 (1.8)	2 (3.7)	11 (20.7)	17 (32.0)	21 (39.6)	1 (1.8)
Technology (1)	0 (0)	0 (0)	1 (100.0)	0 (0)	0 (0)	0 (0)
Engineering (10)	0 (0)	0 (0)	1 (10.0)	2 (20.0)	7 (70.0)	0 (0)
Mathematics (7)	0 (0)	1 (14.2)	0 (0)	4 (57.1)	2 (28.5)	0 (0)
Not Indicated (7)	0 (0)	1 (14.2)	0 (0)	2 (28.5)	4 (57.1)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 12 contains an analysis of the respondents' level of agreement as to the
benefit (item 5) of the TeachLivE™ lesson introduction experience. A majority of all
respondents strongly agreed or agreed that "This simulation was beneficial." Of the
respondents, 47 (91.6%) science graduates, 10 (100%) engineering graduates, 7 (100.0%)
mathematics graduates, and 7 (100.0%) of the graduates who did not share their degrees
strongly agreed or agreed the simulation was beneficial.

Only one of the 78 respondents, disagreed or strongly disagreed, indicating that
the simulation was not beneficial. Four (9.3%) science degreed individuals and the single
technology degreed individual were neutral on this item.

Table 12

Resident Teachers' Level of Agreement: The Lesson Introduction Simulation Was Beneficial (N = 78)

Degrees (78)	Strongly Disagree $f(\%)$	Disagree $f(\%)$	Neither Agree/ Disagree $f(\%)$	Agree $f(\%)$	Strongly Agree $f(\%)$	Not Applicable $f(\%)$
Science (53)	0 (0)	1 (1.8)	4 (7.5)	19 (35.8)	28 (52.8)	1 (1.8)
Technology (1)	0 (0)	0 (0)	1 (100.0)	0 (0)	0 (0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	1 (10.0)	9 (90)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	3 (42.8)	4 (57.2)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	2 (28.5)	5 (71.5)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Research Question 2

To what extent did resident teachers in RTP[3] perceive the effectiveness of TeachLivE[TM] in the parent-conference experience?

Analysis of Research Question 2 was completed by comparing descriptive statistics of the 78 participants' responses on the parent conference feedback form. The original feedback forms included a Likert-type response scale of -2 to +2 which was recalibrated to a 1-5 scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The researcher used this scale to illustrate the extent to which resident teachers agreed with statements about the TeachLivE[TM] experience. Respondents included 53 science degreed individuals, 1 technology degreed individuals, 10 engineering degreed individuals, 7 mathematics degreed individuals, and 7 graduates who did not indicate the STEM field in which they were degreed.

Table 13 contains an analysis of the respondents' level of agreement as to their comfort (item 1) in speaking with parents as a result of the TeachLivE™ parent conference experience. A majority of all respondents strongly agreed or agreed that "As a result of this simulation, I feel more comfortable speaking to parents." Of the respondents, 47 (88.6%) science graduates, 10 (100%) engineering graduates, 7 (100%) mathematics graduates, and 7 (100%) of the graduates who did not share their degrees strongly agreed or agreed that their comfort level in speaking to parents had increased as a result of the parent conference simulation. Only one of the 78 respondents, a science graduate, disagreed or strongly disagreed, indicating that he/she was not more comfortable speaking to parents as a result of the simulation.

Table 13

Resident Teachers' Level of Agreement: As A Result Of The Parent Conference Simulation, I Feel More Comfortable Speaking To Parents (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	0 (0)	1 (1.8)	2 (3.7)	24 (45.2)	23 (43.3)	3 (5.6)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)
Engineering (10)	0 (0)	0 (0)	0 (0)	1 (10)	9 (90)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	7 (100.0)	0 (0)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	6 (85.7)	1 (14.3)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 14 contains an analysis of the resident teachers' level of agreement as to the helpfulness and value of continuing parent conference simulation in the RTP[3] (item 2). A majority of all respondents strongly agreed or agreed that "This simulation was helpful and should continue to be included in the RTP[3] program." Of the respondents, 50 (94.3%) science graduates, the single technology (100%) graduate, 10 (100%) engineering graduates, seven (100%) mathematics graduates, and seven (100%) of the graduates who did not share their degrees strongly agreed or agreed that their comfort level in speaking to parents had increased after the simulation. None of the 78 respondents disagreed or strongly disagreed with the helpfulness and value of continuing to include the parent conference simulation in the RTP[3].

Table 14

Resident Teachers' Level of Agreement: The Parent Conference Simulation Was Helpful
And Should Continue To Be Included In The RTP³ Program. (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	0 (0)	0 (0)	1 (1.8)	6 (11.3)	44 (83)	2 (3.7)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	0 (0)	10 (100.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	1 (14.2)	6 (85.8)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	1 (14.2)	6 (85.8)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 15 contains an analysis of the respondents' level of agreement as to the

realism (item 3) of the parent conference simulation as part of the TeachLivE™

experience. A majority of all respondents strongly agreed or agreed that "This simulation

was realistic." Of the respondents, 46 (86.7%) science graduates, the single technology

(100%) graduate, 10 (100%) engineering graduates, seven (100%) mathematics

graduates, and 7 (100%) of the graduates who did not share their degrees strongly agreed

or agreed that the simulation was realistic. None of the 78 respondents disagreed or

strongly disagreed as to the realism of the parent conference simulation.

Table 15

Resident Teachers' Level of Agreement: The Parent Conference Simulation Was
Realistic (N = 78)

Degrees (78)	Strongly Disagree f (%)	Disagree f (%)	Neither Agree/ Disagree f (%)	Agree f (%)	Strongly Agree f (%)	Not Applicable f (%)
Science (53)	0 (0)	0 (0)	5 (9.4)	26 (49)	20 (37.7)	2 (3.7)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	3 (30.0)	7 (70.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	4 (57.1)	3 (42.2)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	2 (28.5)	5 (71.5)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Table 16 contains an analysis of the respondents' level of agreement as to the

benefit (item 4) of the parent conference as a result of the TeachLivE[TM] experience. A

majority of all respondents strongly agreed or agreed that "This simulation was

beneficial." Of the respondents, 51 (96.2%) science graduates, the single technology

(100%) graduate, 10 (100%) engineering graduates, 7 (100%) mathematics graduates,

and 7 (100%) graduates who did not share their degrees strongly agreed or agreed that the

simulation was realistic. None of the 78 respondents disagreed or strongly disagreed that

the simulation was beneficial.

Table 16

Resident Teachers' Level of Agreement: The Parent Conference Simulation Was Beneficial (N = 78)

Degrees (78)	Strongly Disagree $f(\%)$	Disagree $f(\%)$	Neither Agree/ Disagree $f(\%)$	Agree $f(\%)$	Strongly Agree $f(\%)$	Not Applicable $f(\%)$
Science (53)	0 (0)	0 (0)	0 (0)	17 (32)	34 (64.2)	2 (3.7)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	0 (0)	10 (100.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	2 (28.5)	5 (71.5)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	1 (14.2)	6 (85.7)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Research Question 3

To what extent did resident teachers in RTP[3] find the feedback from the coach helpful after the TeachLivE[TM] lesson introduction experience?

Analysis of Research Question 3 was completed by comparing descriptive

statistics of the 78 participants' responses on the lesson introduction feedback form. The

original feedback forms included a Likert-type response scale of -2 to +2 which was

recalibrated to a 1-5 scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor

disagree, 4 = agree, and 5 = strongly agree. The researcher used this scale to illustrate the

extent to which resident teachers agreed with statements about the TeachLivE[TM]

experience. Respondents included 53 science degreed individuals, 1 technology degreed

individual, 10 engineering degreed individuals, 7 mathematics degreed individuals, and 7

graduates who did not indicate in which STEM field they were degreed.

<u>Analysis of Quantitative Data</u>

Table 17 contains an analysis of the respondents' level agreement in regard to the helpfulness of coach feedback (item 6) in the lesson introduction simulation. A high majority of all respondents strongly agreed that "The coach's feedback was helpful." Strongly agree was the response of 49 (92.4%) science graduates, the only technology (100%) graduate, 9 (90%) engineering graduates, 6 (85.7%) mathematics graduates, and 7 (100%) of the graduates who did not share their degrees. Three (5.6%) science graduates agreed that the coach's feedback was helpful in the lesson introduction simulation. Though several of the resident teachers provided a Not Applicable response, none of the 78 participants indicated disagreement or strong disagreement as to the helpfulness of the coach's feedback.

Table 17

Resident Teachers' Level Of Agreement: The Coach's Feedback During The Lesson Introduction Simulation Was Helpful (N = 78)

Degrees (78)	Strongly Disagree $f(\%)$	Disagree $f(\%)$	Neither Agree/ Disagree $f(\%)$	Agree $f(\%)$	Strongly Agree $f(\%)$	Not Applicable $f(\%)$
Science (53)	0 (0)	0 (0)	0 (0)	3 (5.6)	49 (92.4)	1 (1.8)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	0 (0)	9 (90.0)	1 (10.0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	0 (0)	6 (85.8)	1 (14.2)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	0 (0)	7 (100.0)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Analysis of Qualitative Data

Additionally, through the analysis of qualitative data from the lesson introduction feedback form and lesson introduction reflection, the topic of feedback was an overwhelming theme across the responses from the resident teachers. Seen in Table 18, out of the 78 lesson introduction feedback forms received, 20 (26%) contained comments about the effectiveness of the coaching and feedback provided after the simulation.

Some of the comments provided by the resident teachers on the feedback forms included "The feedback was very beneficial," (LI9), "I really liked the feedback on my teaching style," (LI56), and "Thanks to [coach] for the constructive feedback," (LI72). The resident teachers responded very well to the feedback provided by the coaches. As seen in Table 18, the 20 comments all show that the resident teachers perceived the coaching and feedback to be a major factor in increasing their confidence to introduce a lesson.

Table 18

Lesson Introduction Feedback Forms: Feedback (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Feedback ($f = 20$)	LI3	Civil Engineering	Thank you so much for your specific feedback.
	LI7	Mathematics	The feedback was very helpful.
	LI8	Biology	I really appreciate the feedback that was given.
	LI9	Biological Sciences	The feedback was very beneficial.
	LI10	Biology	I appreciate the feedback.
	LI13	Electrical Engineering	I did get some helpful feedback.
	LI18	Biology	The coach gave me good feedback.
	LI24	Chemistry	The most helpful instructions came from the coach.
	LI33	Biology	Feedback was helpful.
	LI39	Biology	The feedback from the coach was helpful.
	LI42	Molecular and Microbiology	The coach gave me some great feedback.
	LI48	Biology	The coach's feedback was great.
	LI56	Biology	I really liked the feedback on my teaching style.
	LI61	Biology	The best part is the feedback and reflections.
	LI62	Interdisciplinary Natural Sciences	The feedback provided at the end was helpful
	LI68	Molecular and Microbiology	Really appreciated the feedback.
	LI69	Pre-Professional Biology	Feedback was helpful.
	LI70	Biochemistry	My coach's feedback was very helpful.
	LI72	Not Indicated	Thanks to [coach] for the constructive feedback.
	LI74	Not Indicated	I will use the feedback in my classroom.

Research Question 4

To what extent did resident teachers in RTP[3] find the feedback from the coach helpful after the TeachLivE[TM] parent teacher conference experience?

Analysis of Research Question 4 was completed by comparing descriptive statistics of the 78 participants' responses on the parent teacher conference feedback form. The original feedback forms included a Likert-type response scale of -2 to +2 which was recalibrated to a 1-5 scale where 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree. The researcher used this scale to illustrate the extent to which resident teachers agreed with statements about the TeachLivE[TM] experience. Respondents included 53 science degreed individuals, 1 technology degreed individual, 10 engineering degreed individuals, 7 mathematics degreed individuals, and 7 graduates who did not indicate in which STEM field they were degreed.

Analysis of Quantitative Data

Table 19 contains an analysis of the respondents' level of agreement as to the helpfulness of the coach's feedback (item 5) in the parent conference simulation portion of the TeachLivE[TM] experience. With the exception of 5 science graduates who agreed (2, 3.7%) and 3 (5.6%) who responded that the item was not applicable to them, all of the respondents strongly agreed that "The coach's feedback was helpful." The only technology (100%) graduate, 9 (90%) engineering graduates, 6 (85.7%) mathematics graduates, and 7 (100%) of the graduates who did not share their degrees strongly agreed that the coach's feedback was helpful.

Table 19

Resident Teachers' Level Of Agreement: The Coach's Feedback During The Parent Conference Simulation Was Helpful (N = 78)

Degrees (*n*)	Strongly Disagree *f (%)*	Disagree *f (%)*	Neither Agree/ Disagree *f (%)*	Agree *f (%)*	Strongly Agree *f (%)*	Not Applicable *f (%)*
Science (53)	0 (0)	0 (0)	0 (0)	2 (3.7)	48 (90.5)	3 (5.6)
Technology (1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100.0)	0 (0)
Engineering (10)	0 (0)	0 (0)	0 (0)	0 (0)	10 (100.0)	0 (0)
Mathematics (7)	0 (0)	0 (0)	0 (0)	0 (0)	7 (100.0)	0 (0)
Not Indicated (7)	0 (0)	0 (0)	0 (0)	0 (0)	7 (100.0)	0 (0)

Note. STEM = Science, Technology, Engineering, Mathematics.
Level of Agreement: 1 = Strongly Disagree; 2 = Disagree; 3 = Neither Agree nor Disagree; 4 = Agree; and 5 = Strongly Agree. Not all percentages total 100% due to rounding.

Analysis of Qualitative Data

Additionally, through the analysis of qualitative data from the parent conference feedback form and parent conference reflection, the topic of feedback was an overwhelming theme across the responses from the resident teachers. As seen in Table 20, out of the 78 parent conference feedback forms received, 20 (26%) contained comments about the effectiveness of the coaching and feedback provided after the simulation.

Table 20

Parent Conference (PC) Feedback Forms: Feedback (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Feedback (*f* = 20)	PC3	Biochemistry	I received excellent feedback from my coach.
	PC9	Mathematics	The best part of this is definitely the coach feedback.
	PC12	Biology	The coach mentioned positive and negative feedback which is great
	PC14	Molecular and Microbiology	I loved getting feedback on performance.
	PC21	Biology	The coach gave a lot of useful feedback.
	PC23	Biology	The coach has provided very insightful comments before and after the session.
	PC28	Chemistry	The coach provided great feedback.
	PC29	Biology	The coach's feedback was very helpful for future conferences I will have.
	PC32	Molecular, Microbiology	Excellent feedback.
	PC39	Biology	I felt the best part of the whole experience was talking with the coach.
	PC40	Civil Engineering	Great feedback. The feedback allowed me to get a better understanding of what I was doing correctly and what I was struggling on.
	PC46	Molecular and Microbiology	The instructors gave some great constructive feedback.
	PC50		I really liked the feedback.
	PC52	Biology	The coach's feedback was extremely helpful
	PC54	Applied mathematics	The experience provided from the coaches was incredibly insightful.
	PC57	Industrial Engineering	Feedback was great.
	PC59	Not Indicated	The ideas I received from the coach were very good.
	PC62	Biomedical Sciences	I received beneficial feedback.
	PC67	Not Indicated	I found the coach's feedback very helpful.
	PC76	Electrical Engineering	Thank you to the coach as well for the constructive feedback

As seen in Table 21, of the 35 parent conference reflections received, 14 (40%) contained comments about the effectiveness of the coaching and feedback provided after the simulation. Further discussion of these data sources are fully addressed in Research Question 5 and 6.

Table 21

Parent Conference Reflection (PCR) Selected Comments: Feedback (N = 35)

Theme	Resident Teacher	Related Comments
Feedback (f= 14)	PCR2	Good feedback from coach
	PCR3	The strategies suggested by (coach) at the end were very helpful.
	PCR4	Ms. Brown coached me to return to focus on addressing solutions.
	PCR5	The coach told me I could have mentioned how well he works in groups, how polite he is to the teacher, or his interest in extracurricular activities.
	PCR6	The coach told me that was a good strategy.
	PCR7	I got useful feedback on how to improve future conferences.
	PCR12	I thought I did well explaining the situation to the mother
	PCR15	Coach gave good information about ways to improve in the future.
	PCR16	The simulation and especially the feedback from the coach put me more at ease about the idea of real conferences I will have in the upcoming school year.
	PCR20	The coach told me I could always follow up and call the parent even though it was not stated in the conference.
	PCR23	The coach answered a few questions that I had after it was over.
	PCR25	I believe I am more prepared as a result of this simulation and the coach's feedback.
	PCR34	The coach gave me strategies to use if/when this happens in a real conference.
	PCR35	Thanks for the feedback.

Research Question 5

> To what extent do STEM students believe that their confidence was increased
> through the use of TeachLivE™ and prepares them for future classroom
> instruction?

To answer Research Question 5, the researcher used the qualitative analysis

method identified by Ryan and Bernard (2003). Two sources of data were used: (a)

reflections completed by the resident teachers and (b) comments from the TeachLivE™

lesson introduction simulation feedback form.

The second section of the lesson introduction feedback form contained an area for

the resident teachers to leave any comments immediately after experiencing the

TeachLivE™ lesson introduction simulation. Of the 78 resident teachers whom

completed feedback forms after the lesson introduction, 67 (86%) added additional

comments. A full list of those comments can be found in Appendix F. The analysis of

those comments included identifying themes that emerged from the residents teachers'

comments. Those themes were identified through the repetition method identified by

Ryan and Bernard (2003). The researcher read each of the lesson introduction feedback

form comments a minimum of three times and then created Appendix F with every

comment provided. Those comments were then grouped by the themes contained in the

comments (Table 33). Those comments were then consolidated into themes based on the

method identified by Opler (1945) who said, "Themes presumably reflect the crucial

points in the value system of the people." Those identified themes became the basis for

analyzing how the resident teachers perceived the effectiveness of the TeachLivE™

experience with regard to future teaching experiences.

The first theme that emerged from the lesson introduction feedback form comments was that the TeachLivE™ experience was beneficial. Table 22 contains comments from the feedback forms with the resident teachers' degrees. Aside from the two resident teachers who chose not to indicate their STEM degree field, the rest of the comments came from all science-related degreed individuals.

Table 22

Lesson Introduction (LI) Feedback Forms: Beneficial (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Beneficial (*f* = 11)	LI5	Health Sciences	I felt that this was helpful
	LI31	Astrophysics	I feel it would benefit someone greatly who was new to teaching.
	LI39	Biology	Overall this was a helpful simulation.
	LI40	Physics	This was very helpful.
	LI43	Physics	I really think this was very helpful.
	LI47	Biology	Helpful.
	LI57	Biology	This was a great way to practice.
	LI60	Molecular and Microbiology	Allowed me to experience what teaching in a class really is like.
	LI63	Interdisciplinary Computational Sciences	Excellent simulation that puts teachers in a difficult class.
	LI71	Not Indicated	The simulation made me realize I need work on clearly stating the objective and working on constructive comments to address behavior concerns.
	LI74	Not Indicated	I learned a lot from this simulation.

The second theme that emerged from the lesson introduction feedback form comments was related to classroom routines. Of the 78 resident teachers who completed lesson introduction feedback forms, 13 (17%) left comments directly related to learning

more about establishing routines. The resident teachers gained experience and a better understanding of the need for classroom management routines. As seen in Table 23, the theme of routines had comments from nine science degreed individuals, two engineering degreed individual, one mathematics degreed individual, zero technology degreed individuals, and one who did not indicate a degree.

Table 23

Lesson Introduction (LI) Feedback Forms: Routines (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Routines ($f = 13$)	LI4	Applied Mathematics	I can really see the importance of classroom management.
	LI5	Health Sciences	I got a chance to manage a classroom while trying to teach a lesson.
	LI15	Mechanical Engineering	Good variety of classroom management issues. The visual feedback (phone out, disengaged student) were clear.
	LI19	Mechanical Engineering	I feel more comfortable with managing students in the classroom.
	LI22	Physics	It was good practice of how to handle students in a way that is respectful and yet authoritative.
	LI26	Biology	I feel this simulation gave me a little peek into what a real classroom would be like.
	LI28	Molecular and Microbiology	Most beneficial aspect of the simulation is to get experience with time management in a classroom setting.
	LI40	Physics	This was very helpful especially the ability to deal with student who are a little confrontational.
	LI43	Physics	I feel much more comfortable with managing the classroom now.
	LI46	Biological Sciences	It is interesting to balance procedure an instruction.
	LI54	Biomedical Sciences	It helped me with classroom management.
	LI63	Interdisciplinary Computational Sciences	It gives them some experience before being put in a real life hostile situation. The end result is that it gives teachers an opportunity to prepare and acclimate to these difficult situations.
	LI75	Not Indicated	Overall I really appreciated this experience to learn how to manage a classroom.

As seen in Table 24, the next theme that emerged from the lesson introduction feedback forms was on the topic of realism. Of the 78 resident teachers who completed lesson introduction feedback forms, eight of them commented on the realistic nature of the simulation. Of the eight comments, six resident teachers indicated they thought the simulation was realistic while the other two did not believe the simulation was very realistic. The six comments about the simulation being realistic came from four science degreed resident teachers and two engineering degreed resident teachers. The two comments that stated the simulation was not realistic, LI55 and LI76, were from a science degreed resident teachers and one resident teacher who did not indicate a degree field.

Table 24

Lesson Introduction (LI) Feedback Forms: Realistic (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Realistic (*f* = 8)	LI19	Mechanical Engineering	This simulation was realistic and helpful.
	LI23	Molecular and Microbiology	Student behavior and responses were very lifelike and immediate.
	LI26	Biology	I feel this simulation gave me a little peek into what a real classroom would be like. I think that this will help me better prepare for introducing a new lesson.
	LI28	Molecular and Microbiology	Student questioning was realistic and appropriate.
	LI31	Astrophysics	It was realistic, however, as I have had those types of students in my classroom.
	LI51	Industrial Engineering	The simulation was realistic.
	LI55	Molecular and Microbiology	I felt that this was not very realistic because after working in a normal classroom I have realized that not every student is going to be presenting me with behavior issues at the same time.
	LI76	Not Indicated	Of course it is not as realistic because we cannot touch the students but we get close to the students.

The next theme that emerged from the lesson introduction feedback forms was centered upon challenges the resident teachers faced while using TeachLivE[TM]. Of the 78 resident teachers, 15 commented that they encountered unforeseen challenges during the simulation. Some of the challenges they faced were with the technology. Three of the comments specifically mentioned aspects of the technology they would like to see changed or improved upon. Another nine comments were about teaching strategies the resident teachers would like to have used during the simulation but were unable to due to

the limitations of the technology. The 15 comments came from nine science degreed individuals, three mathematics degreed individuals, one engineering degreed individual, zero technology degreed individuals, and two individuals that did not indicate a degree.

Table 25

Lesson Introduction (LI) Feedback Forms: Challenges (N = 78)

Theme	Resident Teacher	Degree	Related Comment
Challenge (*f* = 15)	LI5	Health Sciences	I do however feel that there are certain strategies I couldn't use with the TeachLivE™ simulation.
	LI6	Mathematics	I had some issues with there being no visuals.
	LI14	Molecular, Microbiology	The lesson would be easier if there was a board to write on or could use a PowerPoint.
	LI20	Biology	It would be beneficial to include some kind of visual aid.
	LI25	Chemistry	Without any background knowledge on the students I could not address discipline problems on computer avatars.
	LI31	Astrophysics	The scenario was difficult, I feel, more than an actual classroom. The simulation felt awkward and made me uncomfortable.
	LI33	Biology	I thought the simulation went Okay to well. The simulation was a little weird.
	LI35	Civil Engineering	Need whiteboard to use
	LI38	Mathematics	The lack of a whiteboard for visuals is hard to work around.
	LI41	Chemistry	My students seemed to know NOTHING in relation to chemistry. I still feel nervous about student behavior however.
	LI49	Applied Mathematics	If possible, including the ability to write on an iPad or equivalent tablet device as a functioning whiteboard would be beneficial
	LI64	Physics	The simulation is novel but with a large population of theater students here I feel it would be possible to have real actors to be in a real classroom environment which would be more realistic.
	LI68	Molecular and Microbiology	I felt it was hard to feel real because there was no way to engage with pictures/presentations/clips/etc.
	LI72	Not Indicated	Incorporation of whiteboard and/or podium for teacher notes would be beneficial to make it more realistic. I stood too close and could not see a student. A mark on the floor indicating where to stand would be good.
	LI73	Not Indicated	It was difficult to read the body language of the avatars that weren't activated. I could not tell if they were engaged or not. I wish we could incorporate worksheets/labs/activities.

The final theme that emerged from the feedback forms was the level in which the resident teachers enjoyed participating in the simulation. Five resident teachers left additional comments indicating they enjoyed being able to participate in the simulation. As seen in Table 26, of the five comments, four were from science degreed resident teachers, and one from a mathematics degreed resident teacher.

Table 26

Lesson Introduction (LI) Feedback Forms: Enjoyable (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Enjoyable (*f* = 5)	LI2	Forensic Science,	It was a great experience interacting with the "classroom". I thoroughly enjoyed it.
	LI4	Applied Mathematics	I really enjoyed this simulation.
	LI9	Biological Sciences	I really enjoyed the simulation
	LI42	Molecular, Microbiology	It was a great experience.
	LI54	Biomedical Sciences	I really enjoyed this simulation.

The other data sources were the reflections written after the resident teachers completed the lesson introduction experience and had time to reflect on the overall experience. For this data, it was the intent to gather reflections from the entire population, however this was not successful. Of the 78 resident teachers, 37 (47%) returned a reflection based on the lesson introduction experience. Again, using the Ryan and Bernard method of repetition (2003) the researcher read each document a minimum of three times. As each document was read, the researcher made notes of key ideas and details that were contained in each reflection. Those selected comments are contained in

Appendix H. Again, the researcher took those comments and created themes based on the Opler (1945) method. The themes that emerged from the lesson introduction reflections that represent the perceptions of the resident teachers are represented in the tables below.

The first theme that emerged from the resident teachers' lesson introduction reflections (LIR) was related to increased levels of confidence. The resident teachers perceived that because of their experience with TeachLivE^{TM}, their levels of confidence were increased for future lesson introductions in a classroom. Of the 78 resident teachers, 35 completed reflections on their experience. As seen in Table 27, within those 37 reflections, 10 contained comments specifically addressing an increased level of confidence by the resident teachers.

Table 27

Lesson Introduction Reflection (LIR) Selected Comments: Confidence (N = 37)

Theme	Resident Teacher	Related Comment
Confidence (f = 10)	LIR6	I feel confident that I could already make some major adjustments to improve my teaching methods.
	LIR8	I feel much more confident in my ability to teach a lesson.
	LIR13	My nervousness promoted off task behavior and misconduct because I portrayed a lack of confidence in their eyes but now I feel better.
	LIR16	All in all, the simulation allowed me to gain confidence in my classroom management skills.
	LIR20	I definitely feel more confident to start my new career. The TeachLivE^{TM} simulation gave the opportunity to see first-hand how a class could stray off topic and lead to chaos with normal situations that can occur in the class.
	LIR21	I feel ready to be in front of actual students after this.
	LIR23	This simulation was rather tough, but I certainly feel like I got my first teaching experience out of the way and I will take what I have learned and use it to better myself.
	LIR25	After experiencing TeachLivE^{TM} in a classroom setting, I learned that classroom management is much more difficult than I imagined. I now have some strategies to use next time and feel more confident in my ability to manage behavior.
	LIR28	I got feedback on how to better handle this kind of situation next time and feel more prepared for this kind of disruption.
	LIR35	The TeachLivE™ simulation allowed me to manage a learning environment entirely on my own, and it was eye-opening. Overall, it was a positive learning opportunity that I can certainly use when I have a classroom of my own.

The next theme from the lesson introduction reflections was about time and time management. Several of the reflections, as seen in Table 28, contain comments from resident teachers indicating that time went very fast during the simulation and how it is critical to manage time effectively in a classroom. Of the 37 lesson introduction reflections, 6 contained comments specifically about time and time management.

Table 28

Lesson Introduction Reflection (LIR) Selected Comments: Time (N = 37)

Theme	Resident Teacher	Theme Related Comment
Time (*f* = 6)	LIR4	I will need to practice slowing down in order for each student to have the opportunity to express their thoughts on the material.
	LIR9	I never thought it would take as much time as it did and I had prepared way too much than the time limit allowed.
	LIR17	I felt like I was giving students too much time to think and respond and it took a lot of my time. The coach told me I needed to wait longer between questions. It was good to get practice in knowing what wait time should feel like.
	LIR24	I came out of that session with a much better understanding of what goes on in the classroom and how to manage my time. I believe because of wait time, my students were effectively able to process the material.
	LIR31	When practicing at home, my lesson ran about 8 minutes without questions, so I thought that I would have no trouble filling the ten minutes. I was right! In fact, I was only able to get through my discussion of intersection; I would have needed another five or six minutes to get through everything that I had planned.
	LIR3	I am more confident balancing learning with discipline and creating a positive educational environment is essential

The third theme that emerged from the lesson introduction reflections was recommending others use the TeachLivE™ simulation prior to teaching. The resident teachers perceived this experience to be beneficial and enjoyable, therefore they recommend it to others. After having time to reflect on the experience, they saw the merit in the program and how they benefitted from the experience of practicing introducing a lesson to avatars. As indicated in Table 29, of the 37 resident teachers that completed a lesson introduction reflection, 10 specifically recommended that the MAT program continue using TeachLivE™ and that future resident have the opportunity to experience this simulation.

Table 29

Lesson Introduction Reflection (LIR) Selected Comments: Recommend (N = 37)

Theme	Resident Teacher	Related Comment
Recommend (*f* = 10)	LIR1	This should be part of the MAT in the future.
	LIR6	I heavily recommend this to stay a part of the program.
	LIR8	Everyone should do this prior to teaching.
	LIR11	Great practice for anyone wanting to be a teacher.
	LIR14	All future STEM teachers should do TeachLivE to see how this feels.
	LIR16	Glad I got to do TeachLivE. All teachers should do this simulation to get an idea of what it's like in front of the classroom.
	LIR17	No one should start teaching until they do TeachLivE. It was a great way to see what it is going to be like.
	LIR26	We are lucky to have been able to use TeachLivE to practice. Other MAT students should have to do it too before teaching real students.
	LIR30	I feel that this is an important tool of this course that should be continued.
	LIR37	This simulation shows first year teachers what may work in the classroom and is a good practice. This should definitely continue in the MAT program.

The next theme that was discovered in the lesson introduction reflections was a broader topic of pedagogy. Nine resident teachers made comments specifically about pedagogical issues they encountered during the simulation. The resident teachers realized that there are aspects of pedagogy that they are still lacking and they encountered issues because of these deficits. As seen in Table 30, distractions from students, being aware of student activities, and clearly communicating the learning objective were some of the comments expressed.

Table 30

Lesson Introduction Reflection (LIR) Selected Comments: Pedagogy (N = 37)

Theme	Resident Teacher	Related Comment
Pedagogy (f = 9)	LIR1	I learned that I must become more aware of individual student activity.
	LIR2	I would also move the relevancy portion up earlier in the lesson introduction to give the students a hook for the lesson.
	LIR5	I believe the majority of the avatars would have remained more engaged if I created a better hook at the beginning of class.
	LIR6	Feel confident that I could already make some major adjustments to improve my teaching methods the next time that I present to a class
	LIR9	Teaching this lesson was a lot more difficult than I expected and I learned a lot from this experience.
	LIR10	[Distractions] drew the lesson quite far off of the main objective and took up a significant portion of time.
	LIR12	Clearly communicating the learning objective was beneficial because it addressed the expected outcome of the lesson. When students would stray off task, I would quickly refer back to the learning objective to reinforce the importance of the lesson.
	LIR21	I will ensure that my plans incorporate not just engaging questions, but lower order questions that I can throw at the students that are not engaged in hopes that when they answer correctly they will feel more involved and follow better.
	LIR27	I took my abstract concept in math and created scenarios that relate to the students' actual lives. I felt like this made them more engaged as they could relate to it. One student started the lesson trying to get off task asking me about my last name. I redirected him to the objective and told his we could discuss my last name after class if he would like to, but not during class.
	LIR32	The first thing I learned is that I have to make sure that I get the maximum participation from each student and set this as an expectation that the students are aware of

Another theme identified from the lesson introduction reflections was routines.

The resident teachers recognized the need for established routines in order to conduct a

successful learning environment. As seen in Table 31, of the 37 lesson introduction

reflections completed, 5 specifically commented on classroom routines. Establishing

classroom rules and expectations, circulating the classroom, and having systems in place

for students that do not adhere to the classroom rules were all aspects of routines that

were commented upon by the resident teachers.

Table 31

*Lesson Introduction Reflection (LIR) Selected Comments: Classroom Management
Routines* (N = 37)

Theme	Resident Teacher	Theme Related Comments
Classroom Management Routines (*f* = 5)	LIR3	Use the strengths of the students to overcome their strong personalities and ability to derail the lesson. Balancing learning with discipline and creating a positive educational environment is essential
	LIR7	Some of these [negative] behaviors could have been curtailed with having students familiar with policies and procedures over time.
	LIR15	The avatars in the simulation were rambunctious like human students can be. It is critical that a teacher has a system of routines when dealing with student conduct in the classroom
	LIR17	Students that call out at every chance they get can be difficult to manage while, as the teacher, keeping my cool. I had to remind the same student multiple times to raise his hand and wait to be called upon. Students having side conversations took up teaching time for me to redirect.
	LIR21	Seeing other teachers' handle some classroom management issues was helpful so I knew some tactics to avoid as it would just waste time.

The next theme from the resident teachers' lesson introduction reflections is proximity. The resident teachers recognized the necessity for having appropriate proximity to the students in order to stop or avoid off task behaviors. As seen in Table 32, of the 37 reflections, 4 specifically commented on how proximity would have helped to control the behaviors of the students, specifically when they were off task and not engaged in the classroom activity or discussion.

Table 32

Lesson Introduction Reflection (LIR) Selected Comments: Proximity (N = 37)

Theme	Resident Teacher	Theme Related Comment
Proximity (*f* =4)	LIR4	I will walk around the room a little bit more to make sure all of the students are engaged and connected with me.
	LIR16	She [student] began to fluster me, but through this experience I learned that I should be more assertive. I felt the need to walk around the room and stand in front of certain students in order to gain their attention and keep them engaged and focused on the lesson.
	LIR19	Walking over near students that are off task was a way to get them back on task without interrupting what I was teaching.
	LIR34	My newly acquired classroom management knowledge led to a positive and successful teaching experience. The use of proximity worked successfully and allowed me to ask questions to begin engaging the students.

Having rules and expectations in place was a theme the resident teachers found to be particularly significant to the success of the lesson. While only two resident teacher specifically commented on this topic, it is important to note that it was recognized as vital to the success, or lack of, during the lesson introduction experience. As seen in Table 33, one resident teacher commented, "I spent a lot more time than I thought having to remind

students of the classroom expectations," (LIR18). The resident teachers, coming from

backgrounds outside of education, did not realize prior to the TeachLivE[TM] experience

how students' misbehavior can cause a lesson to last much longer than the teacher plans.

Table 33

Lesson Introduction Reflection (LIR) Selected Comments: Rules and Expectations
(N = 37)

Theme	Resident Teacher	Related Comment
Rules and Expectations ($f = 2$)	LIR18	I spent a lot more time than I thought having to remind students of the classroom expectations for behavior.
	LIR31	Mentioning the rules at the beginning of the lesson was also extremely helpful because it allowed me to reference them any time a student broke a rule or got off topic.

The last theme that emerged from the lesson introduction reflections was students

realizing things about teaching they had not thought about prior to this experience. As

seen in Table 34, having a conversation with a student about why she cannot have a

cellphone out in class (LIR28) and realizing how students can take a lesson "off track"

(LIR37) were two of the reflections experienced by the resident teachers. Not

experiencing any formal pedagogical training, the resident teacher had several reflections

after experiencing teaching a lesson. For some of the resident teachers, this was their

first experience teaching so they had reflections about how to handle situations in the

future.

Table 34

Lesson Introduction Reflection (LIR) Selected Comments: Reflections (N = 37)

Theme	Resident Teacher	Theme Related Comment
Reflections (*f* =3)	LIR28	One student took several of my teaching minutes trying to explain why she needed her cellphone out in class. I realize I spent way too much time talking to her about this rather than teaching. I will have better strategies in place in the future.
	LIR29	Classroom management is much more than being able to keep all of your students in their seat, and getting them to pretend like they are listening and paying attention.
	LIR37	I learned that teaching a lesson is much harder while students are misbehaving and that you can't let yourself get off track. This simulation shows first year teachers what may work in the classroom when considering management.

Research Question 6

To what extent do STEM students believe their confidence was increased through the use of TeachLivE™ and prepares them for future parent-teacher interaction?

The second section of the parent conference feedback form contained an area for the resident teachers to leave any comments immediately after experiencing the TeachLivE™ parent conference simulation. Of the 78 resident teachers who completed feedback forms after the parent conference simulation, 68 (87%) added additional comments. A full list of those comments can be found in Appendix G. The analysis of those comments included identifying themes that emerged from the residents teachers' comments. Those themes were identified through the repetition method identified by Ryan and Bernard (2003). The researcher read each of the parent conference feedback form comments a minimum of three times and then created Appendix G with every

comment provided. Those comments were then grouped by the topics contained in the comments as well as by the resident teachers' STEM field. Those comments were then consolidated into themes based on the method identified by Opler (1945) who said, "Themes presumably reflect the crucial points in the value system of the people." Those identified themes became the basis for analyzing how the resident teachers perceived the effectiveness of the TeachLivE™ experience with regard to their perceived increased in confidence levels for future parent conference experiences. Two dominant themes emerged from the parent conference feedback forms: beneficial and realistic.

The resident teachers leaving additional comments on the feedback form about the parent conference perceived this simulation was beneficial in preparation for future parent conferences. Of the 78 parent conference feedback forms completed, 20 contained comments specifically related to the benefits of participation in the TeachLivE™ experience. As seen in Table 35, the theme of beneficial had comments from 13 science degreed resident teachers, 3 engineering degreed resident teachers, 3 resident teachers not indicating degree field, 1 mathematics degreed resident teacher, and 0 technology degreed resident teachers.

Table 35

Parent Conference (PC) Feedback Forms: Beneficial (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Beneficial (*f* = 20)	PC28	Chemistry	The simulation was helpful.
	PC30	Biology	I liked having the opportunity to do this.
	PC32	Molecular and Microbiology	The program offers a good range of emotion displayed in tone and body language.
	PC35	Astrophysics	I liked how the parent was portrayed, with overconfidence in their child and a seemingly carefree attitude toward the subject.
	PC38	Biology	I'm glad my first encounter with a parent/teacher conference was virtual.
	PC45	Biology	Was helpful to be prepared for expected comments. Good simulations with helpful information and techniques.
	PC50	Not Indicated	It really helped.
	PC52	Biology	It was very beneficial being able to watch my partner and how she dealt with her situation.
	PC54	Applied Mathematics	The experience was incredibly insightful.
	PC55	Biology	I definitely learned from this that I need to go in to these conferences with a plan. This was helpful.
	PC57	Industrial Engineering	I learned a lot on how to handle a conference.
	PC60	Not Indicated	The body gestures were helpful.
	PC61	Molecular and Microbiology	I felt that this simulation really helped. I really am glad we did this.
	PC68	Not Indicated	Having the avatar to practice take the pressure off since there isn't a person staring back at you.
	PC69	Interdisciplinary Natural Sciences	I liked the way the conference flowed where it's an actual conversation.
	PC72	Environmental Engineering	It was great learning experience.
	PC74	Molecular and Microbiology	I was really nervous but this helped.
	PC75	Electrical Engineering	This was a great simulation. Great help!
	PC77	Pre Professional Biology	Simulation was helpful and will make me more comfortable when I have a conference.
	PC78	Interdisciplinary Computational Sciences	I like that the situation was difficult to better prepare me for difficult parents..

The second dominant theme from the parent conference feedback forms was the realism of the simulation. Of the 78 parent conference feedback forms completed by the resident teachers, nineteen contained comments specifically related to the realistic nature of the simulation. As seen in Table 33, the theme of realistic simulation had comments from 12 science degreed resident teachers, 4 engineering degreed resident teachers, 3 resident teachers not indicating a degree, 0 mathematics degreed resident teachers, and 0 technology degreed resident teachers

Table 36

Parent Conference (PC) Feedback Forms: Realistic (N = 78)

Theme	Resident Teacher	Degree	Related Comments
Realistic (*f* =19)	PC1	Biomedical Science	Was realistic and beneficial
	PC11	Biology	Responses were very realistic.
	PC17	Mechanical Engineering	Good verbal realism and quick responses from the avatars.
	PC22	Mechanical Engineering	It was realistic.
	PC26	Molecular and Microbiology	The parent's responses were very realistic.
	PC27	Chemistry	The simulation was very realistic.
	PC28	Chemistry	The mother asked very realistic questions.
	PC35	Astrophysics	I felt that the simulation matched the reality.
	PC43	Chemistry	Realistic scenarios helped greatly..
	PC52	Biology	I do feel like this experience really put it into perspective what a parent/teacher conference could be like.
	PC59	Not Indicated	The avatar was very realistic.
	PC60	Not Indicated	It thought it was pretty realistic.
	PC61	Molecular and Microbiology	I felt that this simulation really helped to understand how parents can act.
	PC65	Molecular and Microbiology	This allowed me to see and experience that parents are going to have their own issues and you have to keep the focus on the student.
	PC68	Not Indicated	Having a live avatar person responding with random questions and responses was a great way to help prepare me for the unpredictability of a real parent/teacher conference.
	PC69	Interdisciplinary Natural Sciences	I liked the way the conference flowed and that it was realistic to the point where it's an actual conversation.
	PC72	Environmental Engineering	It is good that resident teacher candidates get exposed to the type of interaction before being put in a real-life situation.
	PC74	Molecular and Microbiology	I was really nervous but this helped me squash those nerves I like how responsive the parent was and how realistic the simulation was in terms of how easily it could have been a positive or a negative conference.
	PC76	Electrical Engineering	Great simulation. Very realistic. The parent avatar was engaging and interacted appropriately for the situation.

The other data source was the reflections written after the resident teachers completed the parent conference experience and had time to reflect on the overall experience. For this data, it was the intent to gather reflections from the entire population, however this was not successful. Of the 78 resident teachers 35 (45%) returned a reflection based on the parent conference experience. Again, using the Ryan and Bernard method of repetition (2003) the researcher read each document a minimum of three times. As each document was read, the researcher made notes of key ideas and details that were contained in each reflection. Those select comments are contained in Appendix I. The researcher then took those comments and created themes based on the Opler (1945) method. The themes that emerged from the parent conference reflections that represent the perceived increase in confidence level of the resident teachers in future parent conferences were confidence, communication, and focus.

The first theme that emerged from the parent conference reflections was confidence. The resident teachers responded that because of the experience with TeachLivE[TM], they felt more confidence in their abilities to conduct future parent conferences. As seen in Table 34, of the 35 parent conference reflections received, 16 specifically commented on an increased level of confidence in the ability to conduct future parent conferences. The resident teachers felt the simulation gave them the tools necessary to enter future conferences and interact with parents in a professional manner.

Table 37

Parent Conference Reflection (PCR) Selected Comments: Confidence (N = 35)

Theme	Resident Teacher	Theme Related Comments
Confidence (*f* =16)	PCR3	It is a good tool to train teachers. The strategies suggested by (coach) at the end were very helpful
	PCR10	I am glad I was given this scenario because this is something I need to be prepared to deal with.
	PCR12	I feel this is something I can do with good confidence and felt that TeachLivE helped me to understand this.
	PCR15	I am more confident talking to parents and letting them know I am here to work with them for the better of the student.
	PCR16	The simulation and especially the feedback from the coach put me more at ease about the idea of real conferences I will have in the upcoming school year.
	PCR17	I emerged confident in my ability to handle parents' concerns.
	PCR22	Overall, I learned that parent-teacher conferences are nothing to be fearful of, and they can be a great way of getting parents on your side in order to help motivate students at home.
	PCR23	I went in to the simulation nervous, and I emerged confident in my ability to handle parents' concerns.
	PCR24	It gave the opportunity for me as a first year teacher to gain valuable experience and feedback from a simulation where a mistake does not come back to haunt me.
	PCR25	I believe I am more prepared as a result of this simulation and the coach's feedback
	PCR26	I learned that being prepared is going to be key when going into a parent conference.
	PCR29	Fortunately, I am able to use the unsuccessful parts of my conference as powerful learning tools
	PCR30	I feel this simulation was a good starting point into understanding how parent-teacher conferences can go.
	PCR31	It is important that new teachers are able to effectively communicate and partner with parents In my TeachLivE experience, I learned a lot about how I will handle parent-teacher conferences in the future.
	PCR32	This taught me that I need to be ready for all emotions when I go into a conference.
	PCR35	In the end, I learned that I am completely capable of handling these situations. I learned that you need to be confident when talking to parents.

The second theme from the parent conference reflections was related to communication. The resident teachers felt the TeachLivE[TM] simulation gave them the opportunity to practice communicating with a parent during a conference. Several resident teachers commented in the reflections that they had little or no experience with parent conferences and TeachLivE[TM] gave them the chance to experience a conference prior to conducting a real conference with an actual parent. As seen in Table 35, of the 35 parent conference reflections received, 23 resident teachers specifically commented on the topic of improved communication with parents through this experience.

Table 38

Parent Conference Reflection (PCR) Selected Comments: Communication (N = 35)

Theme	Resident Teacher	Related Comments
Communication (*f* =23)	PCR1	I expressed my concern to Mrs. McGowan about Sean's recent disengagement from class and lack of participation.
	PCR2	I also stated I would send her feedback via email.
	PCR5	I would email or call once a week to notify her of Sean's progress.
	PCR6	In the future, I want to have a clear plan to give to the parent to avoid confusion or miscommunication.
	PCR7	It can be a very nerve-racking experience to talk to parents.
	PCR11	Communicating with parents is an essential part of being an effective teacher.
	PCR12	I thought I did well explaining the situation to the mother.
	PCR14	I should have developed a plan to communicate with the parent.
	PCR15	I am more confident talking to parents.
	PCR19	I gave the parent some positive feedback about her son.
	PCR20	This put me more at ease about the idea of real conferences.
	PCR21	It reminded me that I will likely be exposed to students of many different familial and cultural backgrounds.
	PCR22	Getting this information [from the mother] would help me immensely in a real-world situation.
	PCR24	Parents like to see that we know things about their children.
	PCR25	I learned that parent conferences are nothing to be fearful of.
	PCR27	Communicating with parents is crucial.
	PCR28	I found communicating with the parent helped make the conference successful.
	PCR29	I should have told Sean's mother that I would be in contact with her and will follow up to make sure she knows how the situation progresses.
	PCR30	The knowledge and experience I have gained from the TeachLivE^{TM} simulation will allow me to use the powerful tool of parent communication to help my students reach academic success.
	PCR31	In my TeachLivE experience, I learned a lot about how I will handle parent-teacher conferences in the future.
	PCR32	Establishing a plan worked because it directly addressed the problem while also promoting a partnership
	PCR33	I ended by ensuring the parent that I would maintain contact to keep her updated and confirming the contact information that I had on file.
	PCR35	I learned that you need to be confident when talking to parents. I also learned that I should not get intimidated by talking to a parent.

The final theme from the parent conference reflections was focus. The resident teachers found out that keeping parents on topic during the conference can a be difficult yet critical piece of conducting a parent conference. Several resident teachers commented that the parents attempted to take the conversations off course and it was up to the resident teacher to maintain the focus of the conference on the student. As seen in Table 36, of the 35 parent conference reflections received, eight specifically mentioned keeping the conference on topic.

Table 39

Parent Conference Reflection (PCR) Selected Comments: Focus (N = 35)

Theme	Resident Teacher`	Related Comments
Focus (*f* = 8)	PCR4	Ms. Brown coached me to positively deflect the question and return to focus on addressing solutions.
	PCR10	The parent said the reason for the student's tardys and absences was due to a death in the family. The mother then went on to talk about this for a while.
	PCR13	Keeping the student at the forefront of the discussion and having a solution-based attitude was essential in keeping the mother on track
	PCR15	The time went really fast. I need to have a plan of exactly what I want to talk about and stick to it or I'll have conferences that last too long.
	PCR18	I feel like I did fine keeping the meeting about Sean and finding a solution.
	PCR23	I might have been a little abrupt switching topics after she told me her husband was moving out, but I felt there was not anything I could do about that and I did not want her getting completely off topic
	PCR27	One last thing that went well was I was able to keep the conversation on track.
	PCR34	I allowed the parent to make the conversation about me. I should never let the parent critique my teaching style. It must be kept about the student, and what can be done to get the student to improve.

Many themes emerged from the qualitative analysis of the lesson introduction feedback forms, lesson introduction reflections, parent conference feedback forms, and parent conference reflections. As seen in Table 37, the resident teachers overall felt compelled to mention specific topics repeatedly. The themes that emerged from the four data sources were feedback (54), the benefits of the simulation (31), and the critical need for establishing and maintaining classroom routines (28), realism of the simulation (27), increase levels of confidence (25), communication (23), challenges with the use of TeachLivE^{TM} (15), need for pedagogical skills (10), recommending TeachLivE^{TM} to others (10), keeping focus (8), time management (6), enjoyment of the experience (5), proximity (4), reflections (3). and rules and expectations (2). Many other topics were addressed in the comments and reflections of the resident teachers (Appendix F, G, H, and I) however in order to be classified as a theme at least five resident teachers needed to mention the topic.

Table 40

Themes and Frequencies Across Data Sources

Theme	Lesson Introduction Feedback Form (N = 78)	Lesson Introduction Reflection (N = 37)	Parent Conference Feedback Form (N = 78)	Parent Conference Reflection (N = 35)	Total
Feedback	20	0	20	14	54
Benefit	11	0	20	0	31
Routines	13	15	0	0	28
Realistic	8	0	19	0	27
Confidence	0	9	0	16	25
Communication	0	0	0	23	23
Challenge	15	0	0	0	15
Pedagogy	0	10	0	0	10
Recommendation	0	10	0	0	10
Focus	0	0	0	8	8
Time	0	6	0	0	6
Enjoy	5	0	0	0	5
Proximity	0	4	0	0	4
Reflections	0	3	0	0	3
Rules and Expectations	0	2	0	0	2

Summary

The 78 resident teachers participated in both a lesson introduction and a parent conference using the TeachLivE^{TM} mixed reality laboratory experience. After each experience a feedback form was completed with a Likert-type scale as well as a comment section. Both the qualitative and quantitative portions of the feedback forms were analyzed and common themes emerged. One of the most prevalent themes was how the level of confidence and preparedness of the resident teachers increased through both experiences.

A second data source was also analyzed. The resident teachers wrote a reflection after completing the lesson introduction and after completing the parent conference. These open-response documents were examined and several themes also emerged, one being increased confidence.

Overall, the resident teachers believed their levels of confidence increased in both the lesson introduction experience and during the parent conference. The resident teachers believed they had improved their skills and increased their strategies to handle each of these situations in the future as a result of the TeachLivE^{TM} simulated experiences.

CHAPTER 5
SUMMARY, DISCUSSION, AND RECOMMENDATIONS

Introduction

This study was conducted to investigate the use of avatars and mixed-reality instruction to prepare new teachers, specifically STEM (science, technology, engineering and mathematics) graduates enrolled in an MAT program and accepted in the RTP^3. This chapter has been organized to present a summary of the study, discussion of the findings, implications for practice, and recommendations for further research.

Summary of the Study

The purpose of this study was to analyze the perceived effectiveness of the TeachLivE^{TM} mixed reality experience for Master of the Arts in Teaching (MAT) and RTP^3 resident teachers. The 78 resident teachers agreed to participate in this study as part of the acceptance into the RTP^3 and MAT program. The resident teachers participated in two TeachLivE^{TM} experiences, each of which involved a data collection component. With technology such as TeachLivE^{TM}, pre-service teachers are no longer limited to classroom observation hours and an internship experience (NCTQ, 2011). They are able to practice skills and pedagogical strategies with avatar students that can be reset and the same lesson taught over again after receiving feedback and coaching.

The problem this study hoped to examine was teachers entering the classroom without proper pedagogical training. The resident teachers in this study all earned degrees in STEM fields and received no formal training as they would have in a proper

teacher preparation program. These resident teachers then sought teaching jobs based

solely on their background in their respective STEM field.

The first TeachLivE[TM] experience was a lesson introduction. The resident

teachers were given the task of introducing a lesson to a middle school classroom of

avatar students. The students were displayed on a screen in front of the resident teacher.

The resident teacher was faced with a variety of student personalities as the avatars were

controlled by an interactor that was in a different location. The avatar students ranged

from overly eager to completely aloof. One of the students even had a cell phone out

texting in class and the resident teacher had to decide how to effectively handle the

situation. Some of the avatar students were polite while others were more disrespectful

and inattentive.

The second TeachLivE[TM] experience was a parent conference. The resident

teachers were given the task of conducting a conference with a parent addressing a

specific student concern. The avatar parent appeared on screen in front of the resident

teacher. The resident teacher and parent interactions ranged from very cordial to

combative. Some of the parent conferences were calm and went as planned for the

resident teacher. The parent was receptive to the teacher's feedback and

recommendations and the parent agreed to work with the student at home to change the

current behavior. Other conferences were dominated by the parent taking the conference

off topic, going so far as to blame the teacher for the student's behavior.

Two sources of data were used in this study. The first source was a feedback form

completed immediately after resident teachers had completed the simulation experience

and exited the TeachLivE^{TM} laboratory. Data were gathered using (a) a Likert-type scale where the resident teachers rated different components of each experience and (b) an open-response area for comments about the TeachLivE^{TM} experience. The second source of data was an open-response narrative reflection that resident teachers completed as part of a classroom requirement. These were completed away from the TeachLivE^{TM} laboratory so the students were able to process the experience and examine strengths and weaknesses of both themselves and the program. The data collected from these two sources were used to answer the six research questions which guided this study:

1. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivE^{TM} in the lesson introduction experience?

2. To what extent did resident teachers in RTP^3 perceive the effectiveness of TeachLivE^{TM} in the parent-conference experience?

3. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE^{TM} lesson introduction experience?

4. To what extent did resident teachers in RTP^3 find the feedback from the coach helpful after the TeachLivE^{TM} parent teacher conference experience?

5. To what extent did resident teachers in RTP^3 believe that their confidence in classroom instruction was increased through the use of TeachLivE^{TM}?

6. To what extent did resident teachers in RTP^3 believe that their confidence in parent interaction was increased through the use of TeachLivE^{TM}?

Discussion of the Findings

The purpose of this study was to determine the perceived effectiveness of the TeachLivE[TM] experience on MAT and RTP[3] students prior to entering the field of education. Each of the six research questions yielded data which supported TeachLivE[TM] as a perceived effective strategy to prepare future teachers. Overall, the majority of the resident teachers believed that they increased their levels of confidence and preparedness, learned new classroom management strategies, and overall benefitted from the coaching and feedback provided through the TeachLivE[TM] experience. The following discussion presents findings specific to each of the six questions around which the study was organized.

Research Question 1

To what extent did resident teachers in RTP[3] perceive the effectiveness of TeachLivE[TM] in the lesson introduction experience?

"Teacher preparation programs have been working to find the right combination of classroom experience and textbook instruction to prepare future teachers" (Greenberg, Putman, & Walsh, 2014, p.15). Based on the analysis of the feedback forms and the open response narrative reflections, the MAT students in the RTP[3] found TeachLivE[TM] to be very effective during the lesson introduction experience. At varying levels, all 78 resident teachers believed they had more confidence in their abilities to introduce a lesson and were thankful to have had this opportunity. Several even commented they wished they could do more with TeachLivE[TM] to practice different pedagogical skills and teaching strategies. Through the use of TeachLivE[TM], the resident teachers were able to

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experience a classroom experience and introducing a lesson to students in an environment

previously not available in teacher preparation programs.

Research Question 2

To what extent did resident teachers in RTP[3] perceive the effectiveness of TeachLivE^{TM} in the parent-conference experience?

In studying early teacher preparation programs, the researcher found little

mention of teachers having parent conferences in the days of normal schools in the early

1800s. According to Labaree (2004) teachers finished basic education and were given a

class of students. Today's teachers carry many more responsibilities, including

communication with the families of students. This can be a stressful situation especially

for novice teachers (National Commission on Teaching and America's Future, 1996).

Utilizing technology such as TeachLivE^{TM}, new teachers have the opportunity to practice

pedagogical as well as communication skills with an avatar prior to experiencing them

with actual students and parents. Through this study, the TeachLivE^{TM} experience has

proven to be perceptually beneficial for these teachers.

Based on the analysis of the feedback forms and the reflections, the MAT students

in the RTP[3] found TeachLivE^{TM} to be very effective during the parent conference

experience. The resident teachers believed they were more prepared to conduct a real

parent conference in the future after completing the TeachLivE^{TM} simulation. Many

reflected that they appreciated the difficult mother in the scenario as she gave them the

opportunity to experience the reality of a parent conference that did not go as planned.

Once the experience was complete, many of the resident teachers reflected that the

simulation was easier than they had anticipated and were glad they were able to practice

with an aviator instead of a real parent. The resident teachers also reported increased

levels of confidence and feelings of preparation due to the TeachLivE™ parent

conference simulation experience.

Research Question 3

To what extent did resident teachers in RTP[3] find the feedback from the coach helpful
after the TeachLivE™ lesson introduction experience?

According to Latham (1997), there are many forms of effective feedback and

many ways to effectively deliver that feedback in meaningful ways. The coaching aspect

of the TeachLivE™ experience was an overwhelming theme that emerged from the

analysis of the qualitative data in the feedback forms and the reflections. The resident

teachers positively responded to the coaching and feedback they received after each

simulation. Many of the resident teachers commented that they received specific and

meaningful feedback that will be applicable in future classrooms.

Based on the analysis of the feedback forms and reflections, the MAT students in

the RTP[3] found the feedback from the coach during TeachLivE™ to be very effective

during the lesson introduction experience. The feedback received from the coach after

the TeachLivE™ lesson introduction experience was praised by the resident teachers.

The suggestions for improvement as well and the encouragement received made a

tremendous impact on the resident teachers and was noted in the reflections. The resident

teachers appreciated the comments and many reflected on the specific ways they intended

to implement the feedback and coaching they received during the TeachLivE™

experience.

<div align="center">Research Question 4</div>

To what extent did resident teachers in RTP[3] find the feedback from the coach helpful
after the TeachLivE™ parent teacher conference experience?

  Feedback is a critical strategy teachers must be able to use in the classroom with

students. Having effective feedback modeled for them during teacher preparation

programs is a way to both teach the resident teacher how to give and receive feedback but

also to increase their confidence in a positive way. Kulhavy (1977) noted that not only

should students be told when they are doing things correctly, but giving them

constructive feedback will yield even more positive results as they will focus on certain

areas for strategic improvement. This is the purpose of the coaching and feedback

element of the TeachLivE™ experience.

  From the analysis of the feedback forms and the open response narrative

reflections, the MAT students in the RTP[3] found the feedback from the coach during the

TeachLivE™ parent conference experience to be very effective. The resident teachers

appreciated the feedback from the coach following the parent conference. In addition to

being commended for the use of positive strategies, resident teachers were given

suggestions to improve their strategies and preparation for future parent conferences.

Several resident teachers reflected on scenarios in which parents tried to blame the

teacher or attempted to take the conference off topic all together. The coach's suggested

strategies for future implement in the future that could be used to avoid problems in a real

parent conference were appreciated by the resident teachers.

Research Question 5

To what extent did resident teachers in RTP[3] believe that their confidence in classroom instruction was increased through the use of TeachLivE[TM]?

The resident teachers in this study were all STEM degreed individuals, without

preparation in education. They did not have the benefit of any formal instruction in

pedagogical skills and strategies as was received by their education-major counterparts

(FLDOE, 2014). Because of this, the resident teachers, while well-versed in the content

they are teaching, lack the application skills necessary to teach their area of

specialization. Having the ability to use TeachLivE[TM] to practice those needed

pedagogical skills with avatar students, along with their content will prepare them to be

effective when they are faced with a classroom of human students. With this practice, the

resident teachers' confidence increased their ability to manage a classroom while

teaching their specialized content area.

Through the use of TeachLivE[TM], resident teachers believed they had increased

their level of confidence and their ability to introduce a lesson as well as their overall

preparedness to teach. Overall the MAT students believed their confidence in their

ability to introduce a lesson in a classroom increased through the use of TeachLivE[TM].

The following eight themes emerged from the review of the feedback forms and

reflections about the lesson introduction simulation experience. A ninth theme, feedback,

was also determined from the qualitative data but it was discussed in research question 3.

1. The resident teachers believed that due to the TeachLivE^{TM} experience, their confidence in introducing a lesson in the future was increased. Of the 37 lesson introduction reflections received, 10 specifically discussed an increased feeling of confidence after experiencing the TeachLivE^{TM} simulation. A few of the comments included, "I feel much more confident in my ability to teach a lesson," (LIR8), "I feel ready to be in front of actual students after this," (LIR21) and "The simulation allowed me to gain confidence in my classroom management skills," (LIR35).

2. The resident teachers perceived the TeachLivE^{TM} simulation to be beneficial to their future classroom instruction. Of the 78 lesson introduction feedback forms received, 11 specifically contained comments related to the simulation being beneficial. The 11 comments that were received about the benefits of the simulation, nine of the comments were left by science degreed resident teachers and the other two were left by resident teachers that did not indicate a STEM field. The researcher found this interesting that the other STEM fields did not indicate the simulation as beneficial while nine science degreed resident teachers

3. Having established classroom routines and management styles was a theme that emerged for 13 of the resident teachers. Many of them left comments such as "I feel more comfortable with managing students in the classroom," (LI19), "It is interesting to balance procedure an instruction," (LI46), and "I feel much more comfortable with managing the classroom now," (LI43).

4. Eight resident teachers commented that the TeachLivE[TM] simulation was realistic. All eight of the comments were left by science and engineering degreed resident teachers except one comment left by a resident teacher that did not indicate a major.

5. The resident teachers believed this simulation had challenging elements including adjusting to the TeachLivE[TM] platform, interacting with avatars rather than actual students, and not having traditional teaching aides as they would in a regular classroom. Some of the comments left by the resident teachers included "If possible, including the ability to write on an iPad or equivalent tablet device as a functioning whiteboard would be beneficial," (LI49), "I stood too close and could not see a student. A mark on the floor indicating where to stand would be good," (LI72), and "It was difficult to read the body language of the avatars that weren't activated. I could not tell if they were engaged or not," (LI73).

6. Recommending the TeachLivE[TM] simulation to future RTP[3] resident teachers was left as a comment 10 times. The resident teachers thought that this simulation was beneficial enough to continue using with future cohorts. Some of the comments left by the resident teachers included, "All future STEM teachers should do TeachLivE to see how this feels," (LIR14), "No one should start teaching until they do TeachLivE. It was a great way to see what it is going to be like," (LIR17), and "This should definitely continue in the MAT program," (LIR37).

7. Time management was a theme that six resident teachers mentioned in their reflections. They perceived that the simulation gave them some idea of what it is like in a classroom to balance instruction with other tasks that occur during a typical

lesson, including behavior management. Some of the comments left by the resident teachers included "I never thought it would take as much time as it did and I had prepared way too much than the time limit allowed," (LIR9), "I came out of that session with a much better understanding of what goes on in the classroom and how to manage my time," (LIR24), and "I would have needed another five or six minutes to get through everything that I had planned," (LIR31).

8. The last theme that emerged from the lesson introduction comments and reflections was how enjoyable this experience was for the resident teachers. Of the 78 lesson introduction feedback forms, five contained specific comments about the simulation being enjoyable. The five comments that were received, four were from science degreed resident teachers and one from a mathematics resident teacher. The comments received included "It was a great experience interacting with the classroom. I thoroughly enjoyed it," (LI2) and "I really enjoyed this simulation," (LI4, LI9, LI54).

Research Question 6

To what extent did resident teachers in RTP[3] believe that their confidence in parent interaction was increased through the use of TeachLivE[TM]?

The resident teachers in this study were all STEM degreed individuals, without a concentration in education. They did not have the benefit of any formal instruction in pedagogical skills and strategies as was received by their education-major counterparts (FLDOE, 2014). Because of this, the STEM degreed individuals, while well-versed in the content they are teaching, may lack the application skills necessary to communicate with

parents about their students' progress in school. Darling-Hammond (2005) noted that

teacher preparation programs are charged with preparing new teachers to handle the

demands of teaching. This also includes communicating with parents. Parent

conferences, as noted in the resident teachers' reflections can be a source of anxiety.

Having access to a simulation like TeachLivE^{TM} gave these students the chance to

conduct a practice parent conference with an avatar to gain confidence in the experience.

Through the use of TeachLivE^{TM}, resident teachers believed their preparedness

and level of confidence in their ability to interact with a parent during a conference had

increased. Overall the MAT students believed their confidence in parent interaction was

increased through the use of TeachLivE^{TM}. The following five themes emerged from the

review of the feedback forms and reflections about the parent conference simulation

experience. A sixth theme, feedback, emerged from the parent conference feedback forms

and reflections however it was already discussed in research question 4:

1. After the parent conference simulation, the 78 resident teachers completed feedback

   forms. On the 78 feedback forms, twenty resident teachers made specific comments

   about the parent conference simulation being beneficial to their future teaching

   careers. Some of the comments included, "The parent conference experience was

   incredibly insightful," (PC54), "I'm glad my first encounter with a parent/teacher

   conference was virtual," (PC38) and "Simulation was helpful and will make me more

   comfortable when I have a conference," (PC77).

2. The next theme that was almost as popular as the beneficial theme was commenting

   about the realism of the simulation. Nineteen parent conference feedback forms

reflected comments related to the realism of the simulation. The resident teachers seemed to appreciate the realism of the simulation as it gave them a true account of how an actual parent conference could happen. Comments included, "The avatar was very realistic," (PC59), "I do feel like this experience really put it into perspective what a parent/teacher conference could be like," (PC52), and "Great simulation. Very realistic. The parent avatar was engaging and interacted appropriately for the situation," (PC76).

3. The resident teachers commented in their reflections that they feel their confidence has increased due to the TeachLivE™ simulation. They feel more confident interacting with parents and conducting meaningful conferences about students in the future. Of the 35 reflections received, 16 contained comments specifically about increased confidence levels. Some of the comments were, "I feel this is something I can do with good confidence and felt that TeachLivE™ helped me to understand this," (PCR12), "I am more confident talking to parents," (PCR15), and "I believe I am more prepared as a result of this simulation and the coach's feedback," (PCR25).

4. Increased communication skills was another theme that emerged from the parent conference reflections. Many of the resident teachers were not prepared to communicate with a parent about their child prior to this simulation. The practice they got through this experience increased their confidence in the ability to effectively communicate with parents. Twenty three resident teachers commented specifically about an increase in confidence and ability to communicate with parents. Some of the comments included "Communicating with parents is an essential part of being an

effective teacher," (PCR11), "This put me more at ease about the idea of real conferences," (PCR20), and "The knowledge and experience I have gained from the TeachLivE™ simulation will allow me to use the powerful tool of parent communication to help my students reach academic success" (PCR30).

5. The final theme that emerged from the parent conference feedback forms and reflections was an increased ability to maintain focus during a parent conference. The resident teachers commented that the parents often tried to change the topic of the conference away from the student and onto the teacher or even to the parent. The resident teachers had to use a variety of strategies to maintain the parent's focus on the student's academic and behavioral concerns. Some of the comments included "Keeping the student at the forefront of the discussion and having a solution-based attitude was essential in keeping the mother on track," (PCR13), "I might have been a little abrupt switching topics after she told me her husband was moving out, but I felt there was not anything I could do about that and I did not want her getting completely off topic," (PCR23) and "I allowed the parent to make the conversation about me. I should never let the parent critique my teaching style. It must be kept about the student, and what can be done to get the student to improve," (PCR34).

Implications for Practice

"There will always be a need for great teachers. Regardless of temporary economic conditions, hiring practices, budget cuts or any other factors that impact the education system, the need for teachers is timeless and universal" (TEACH, 2014). As

long as teachers are in demand, the need for quality teacher preparation programs will also exist. Teacher preparation programs have come a long way over the last century and with advances in technology, the opportunities available for future educators are endless.

TeachLivE[TM] gives future educators the opportunity to experience teaching in a classroom as well as conducting a parent teacher conference in an environment that is safe to make mistakes and learn from those mistakes without the risk of affecting a student. Based on this study, the researcher believes that TeachLivE[TM] is a powerful tool which provided resident teachers with opportunities to learn and grow their pedagogical skills. In this study, teachers having the opportunity to try strategies and techniques in a virtual classroom prior to executing them in a real classroom was shown to increase the resident teachers' level of confidence.

Highly qualified teachers are always in high demand, but highly qualified STEM teachers are even more sought after by schools. "Science, Technology, Engineering and Math (STEM) education is a great example of an area where there is a high demand for great teachers," (TEACH, 2014). STEM fields are a highly discussed topic in the field of education. Many claim that the STEM fields are the future and teachers have the responsibility to be well versed in the fields and to have the skills necessary to educate students. RTP[3] recognized this and is worked with the TeachLivE[TM] laboratory to increase the number of highly qualified STEM teachers. The resident teachers in the RTP[3] were STEM degreed individuals and are now seeking a Masters in the Art of Teaching. Upon completion of their MAT degree, they will enter middle and high school classrooms to teach various STEM subjects. Through the use of TeachLivE[TM], these

resident teachers had the opportunity to practice pedagogical skills necessary for teaching as well as communication skills used in a parent conference setting. Overall, the resident teachers found this process to be beneficial to future careers in education and, when completing the feedback form upon exiting the TeachLivE[TM] laboratory, responded that this experience was realistic and should continue to be a part of the MAT course requirements.

TeachLivE[TM] also has implications for veteran teachers who could benefit from an experience such as TeachLivE[TM]. Periodically, school districts adopt new curriculum; and teachers, regardless of years of experience, have to adjust to new materials and ways of teaching. Having an opportunity to practice with the technology of TeachLivE[TM] would be advantageous for the teachers as well as the administrators. If teachers had the experience of teaching with the new materials prior to the students arriving in the classroom, the teachers would have increased confidence in their ability to effectively teach the material and the students would benefit.

Recommendations for Further Research

The goal of this study was to research the use of TeachLivE[TM] and its effectiveness as perceived by MAT students in the RTP[3] were previous STEM degreed individuals. Data were collected and used to answer six research questions directly related to the resident teachers who were studied. Following are recommendations for further research which involve the use of TeachLivE[TM] with different populations and settings.

1. Though the MAT resident teachers found TeachLivE™ to be very effective for both the lesson introduction and the parent conference, the data may yield different results in a study conducted to examine the perceptions of a different demographic of students.

2. In this study, data was only gathered on resident teachers. TeachLivE™ could be a powerful teaching tool for veteran teachers as well. A future study of teachers who have been in the field of education for a varying number years and comparing strategies used to handle the same situation coming from different generations of schools of teacher preparation could yield interesting results.

3. If the resident teachers were able to use a recorded TeachLivE™ experience to include in online resumes or teacher portfolios, similar to micro-teach sessions in the past, could show both professors as well as potential employers how the teachers handle certain situations, particularly challenging experiences.

4. Each of the data collection tools, lesson introduction feedback form, parent conference feedback form, lesson introduction reflection, and parent conference reflection were all gathered anonymously. If a future study was able to match the feedback forms to the reflection to see if the resident teachers' perceptions changed at all from immediately following the experience to later after having time to reflect on the entire process that may be interesting to study.

Summary

The purpose of this research study was to analyze the perceived effectiveness of the TeachLivE[TM] laboratory experience on RTP[3] STEM graduates in the MAT program. The population of 78 resident teachers was studied throughout the lesson introduction and the parent experiences in the TeachLivE[TM] laboratory. The resident teachers completed feedback forms upon exiting the laboratory. The feedback form inquired about the resident teachers' perceptions of the effectiveness of the experience. The responses were analyzed and it was determined that the resident teachers perceived the TeachLivE[TM] experience to be effective in increasing their level of confidence and receiving adequate feedback from the coach. The resident teachers responded overall in a positive manner regarding the TeachLivE[TM] experience and believe it should remain a part of the RTP[3] process for future students. The open response reflections were also analyzed and resident teachers were found to be satisfied with TeachLivE[TM] with many requesting more time in the laboratory to try other teaching skills and pedagogical strategies. The need for highly qualified STEM teachers is on the rise. This study has shown using TeachLivE[TM] is an effective way to increase the level of confidence of educators.

APPENDIX A
TeachLivE^{TM} MIXED-REALITY PARENT CONFERENCE SCENARIOS

TeachLivE™ Parent Conference Scenario 1

Sean, one of your middle school students, has recently begun to perform differently in your class. Normally, he may miss one or two homework assignments per month but makes them up promptly. He tends to be pretty attentive in class and is no more distracted than a typical student. Lately, however, Sean has begun to turn in less completed work than usual. He has missed five homework assignments in the past two weeks and has turned in three half-finished in-class assignments. The work that he does turn in is not up to the quality that you have come to expect from him. He seems less attentive than usual and will periodically respond as though he has lost track of what you're doing in class by looking around for clues to what the class is doing and/or looking at other students' work to find his place. You have called home to communicate your concerns with his mother. Sean's mother, Jeanette McGowan, has agreed to come in for a conference with you and another of Sean's teachers.

TeachLivE™ Parent Conference Scenario 2

Sean, one of your middle school students, has recently begun to behave differently in your class. While Sean has always had a great sense of humor and will occasionally come out with a clever pun or a comment that would make the class smile, over the past two weeks his behavior is more like that of a class clown. His humor is more frequent, disruptive, and inappropriately timed. Lately, some of his jokes and comments are at the expense of other students. You are concerned that his comments may get him into trouble in the future if he isn't careful. You have called home to communicate your concerns with his mother. Sean's mother, Jeanette McGowan, has agreed to come in for a conference with you and another of Sean's teachers.

TeachLivE™ Parent Conference Scenario 3

Sean, one of your middle school students, has recently begun to behave differently in your class. He has arrived tardy to your first period class three times, and has been absent four times in the past two weeks. You have called home to communicate your concerns with his mother. Sean's mother, Jeanette McGowan, has agreed to come in for a conference with you and another of Sean's teachers.

TeachLivE™ Parent Conference Scenario 4

Sean, one of your middle school students, has recently begun to perform differently in your class. Normally, he seems to understand the material as well as any other student in his class and will ask questions when he doesn't fully understand a concept. Lately, however, he seems to be struggling with the material and has been unusually silent in class. His test grades are normally As and Bs, but he scored a 37% on his most recent unit test. You have called home to communicate your concerns with his mother. Sean's mother, Jeanette McGowan, has agreed to come in for a conference with you and another of Sean's teachers.

TeachLivE™ Parent Conference Scenario 5

Sean, one of your middle school students, has recently begun to perform differently in your class. He has fallen asleep in class three times in the past two weeks. He does not participate in class as much as he used to and he seems very tired, lethargic, and slow to respond to questions. You have called home to communicate your concerns with his mother. Sean's mother, Jeanette McGowan, has agreed to come in for a conference with you and another of Sean's teachers.

APPENDIX B
TeachLivE^{TM} MIXED-REALITY IMAGES

Image 1.
Teacher conducting a lesson to the TeachLivE[TM] virtual students (Hayes, Hardin, & Hughes, 2013, p. 2).

Image 2.
Virtual students in the TeachLivE[TM] mixed-reality experience (Dieker, et al., 2014, p. 56).

Image 3.
Parent conference with avatar. (TeachLivE.org, 2014).

APPENDIX C
UNIVERSITY OF CENTRAL FLORIDA
INSTITUTIONAL REVIEW BOARD APPROVAL

University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2012 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

From :   **UCF Institutional Review Board #1**
          FWA00000351, IRB00001138

To   :   **Chana M. Speir**

Date :   **July 03, 2014**

Dear Researcher:

On 7/3/2014 the IRB determined that the following proposed activity is not human research as defined by
DHHS regulations at 45 CFR 46 or FDA regulations at 21 CFR 50/56:

Type of Review:	Not Human Research Determination
Project Title:	THE PERCEIVED EFFECTIVENESS OF THE USE OF TeachLivE™ IN A MASTER OF ARTS IN TEACHING (MAT) PROGRAM FOR STEM GRADUATES
Investigator:	Chana M Speir
IRB ID:	SBE-14-10366
Funding Agency:	
Grant Title:	
Research ID:	N/A

University of Central Florida IRB review and approval is not required. This determination applies only to the
activities described in the IRB submission and does not apply should any changes be made. If changes are to be
made and there are questions about whether these activities are research involving human subjects, please
contact the IRB office to discuss the proposed changes.

On behalf of Sophia Dziegielewski, Ph.D., L.C.S.W., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 07/03/2014 03:10:35 PM EDT

IRB Coordinator

APPENDIX D
TeachLivE[TM] MIXED-REALITY LESSON INTRODUCTION
SIMULATION FEEDBACK FORM

Participant Name:

TeachLivE™ Lesson Introduction Simulation Feedback INSTRUCTIONS: Please circle one answer for each item below.	Strongly Disagree SD ↓	Disagree D ↓	Neither Agree nor Disagree NA/D ↓	Agree A ↓	Strongly Agree SA ↓	Not Applicable / No Answer N/A ↓
1. As a result of this simulation, I feel more comfortable introducing a lesson.	-2	-1	0	+1	+2	N/A
2. After this simulation, I feel more comfortable managing student behavior.	-2	-1	0	+1	+2	N/A
3. This simulation was helpful and should continue to be included in the RTP³ program.	-2	-1	0	+1	+2	N/A
4. This simulation was realistic.	-2	-1	0	+1	+2	N/A
5. This simulation was beneficial.	-2	-1	0	+1	+2	N/A
6. The coach's feedback was helpful.	-2	-1	0	+1	+2	N/A

Please share any additional comments that you may have in the box provided below.

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** Thank you for taking the time to complete this questionnaire. **

APPENDIX E
TeachLivE^{TM} MIXED-REALITY PARENT CONFERENCE SIMULATION
FEEDBACK FORM

APPENDIX E
TeachLivE[TM] MIXED-REALITY PARENT CONFERENCE SIMULATION
FEEDBACK FORM

Participant Name:

TeachLivE™ Parent Conference Simulation Feedback INSTRUCTIONS: Please circle one answer for each item below.	Strongly Disagree SD ↓	Disagree D ↓	Neither Agree nor Disagree NA/D ↓	Agree A ↓	Strongly Agree SA ↓	Not Applicable / No Answer N/A ↓
1. As a result of this simulation, I feel more comfortable speaking with parents.	-2	-1	0	+1	+2	N/A
2. This simulation was helpful and should continue to be included in the RTP³ program.	-2	-1	0	+1	+2	N/A
3. This simulation was realistic.	-2	-1	0	+1	+2	N/A
4. This simulation was beneficial.	-2	-1	0	+1	+2	N/A
5. The coach's feedback was helpful.	-2	-1	0	+1	+2	N/A

Please share any additional comments.

** Thank you for taking the time to complete this questionnaire. **

APPENDIX F
QUALITATIVE ANALYSIS OF TeachLivE[TM] MIXED-REALITY
LESSON INTRODUCTION FEEDBACK FORMS

Table 41

Lesson Introduction Feedback Forms Written Responses

Resident Teacher	Degree	Written Responses	Overall theme(s)
1	Biology		
2	Forensic Science and Biomedical Science	It was a great experience interacting with the "classroom". I thoroughly enjoyed it. I think I did a great job keeping my class on track	Enjoyable
3	Civil Engineering	Thank you so much for your specific feedback	Feedback
4	Applied Mathematics	I really enjoyed this simulation. I can really see the importance of classroom management in facilitating learning in the classroom.	Enjoyable Classroom management
5	Health Sciences	I felt that this was helpful because I got a chance to manage a classroom while trying to teach a lesson. I do however feel that there are certain strategies I couldn't use with the TeachLivE simulation that I will put into effect in my real classroom.	Helpful Classroom management Limited strategies available for use
6	Mathematics	I had some issues with there being no visuals.	Limited strategies available for use
7	Mathematics	I could not actually hear the text message beep at all. However, as usual the feedback was very helpful.	Requested changes to technology Feedback
8	Biology	I really appreciate the feedback that was given. It will help me when I write and execute my own lesson plans.	Feedback
9	Biological Sciences	I really enjoyed the simulation. The feedback was very beneficial in telling me how to improve my teaching strategies in the future. I did not realize how many questions I asked the students until (the coach) told me. I was surprised and impressed. Great simulation.	Enjoyable Feedback Great simulation
10	Biology	I appreciate the feedback.	Feedback
11	Biology	Teaching this lesson was very realistic. Throughout the lesson I felt as if I was in a real class.	realistic

Resident Teacher	Degree	Written Responses	Overall theme(s)
12	Molecular and Microbiology		
13	Electrical Engineering	I feel I did fairly well in the sim[ulation]. I did get some helpful feedback concerning relevance and trying to explain the relevance earlier in the lesson.	Feedback
14	Molecular and Microbiology	The lesson would be easier if there was a board to write on or could use a PowerPoint. Lines on the floor to know when you go out of viewing area.	Limited strategies available for use. Need guide to show where to stand
15	Mechanical Engineering	Good variety of classroom management issues. The visual feedback (phone out, disengaged student) were clear.	Good visuals. Classroom management
16	Biology		
17	Industrial Engineering	Students were beneficial because of their various behavior and motivations throughout the class. This demonstration would be useful to do multiple times. Although instructing on TV, I was able to freely move around and interact.	Classroom management. Need more info. Want to do simulation again
18	Biology	After doing the simulation I thought of many more questions I have. One question I had was what to do when students talk out about the topic and (coach) gave me good feedback on that.	feedback
19	Mechanical Engineering	This simulation was realistic and helpful. I feel more comfortable with managing students in the classroom.	Realistic. Helpful. Classroom management
20	Biology	It would be beneficial to include some kind of visual aid (video example) of the simulation in preparing for the session.	Limited strategies available for use
21	Applied Mathematics	The fact that I was able to move freely about the room and interact with the students was very beneficial. Thank you for the opportunity to participate in this simulation.	Could move freely
22	Physics	Refer to learning goal often, procedures and lesson plans, teach them early the layout of the room, it was good practice of how to handle students in a way that	Classroom management

Resident Teacher	Degree	Written Responses	Overall theme(s)
		is respectful and yet authoritative.	
23	Molecular and Microbiology	The software and technology was really cool and fun to use. Student behavior and responses were very lifelike and immediate.	Realistic Good technology
24	Chemistry	The most helpful instructions came from the coach after. She gave me strategies for keeping students engaged.	Feedback
25	Chemistry	This was the single most difficult thing I have done all year. Without any background knowledge on the students I could not address discipline problems on computer avatars.	Difficult activity Need background on students
26	Biology	I feel this simulation gave me a little peek into what a real classroom would be like. I think that this will help me better prepare for introducing a new lesson.	Realistic More prepared
27	Biological Sciences	I think this would be even more beneficial if we had more than one chance to do the same simulation.	Want to do it again
28	Molecular and Microbiology	Visual limitations need to be addressed. Most beneficial aspect of the simulation is to get experience with time management in a classroom setting. Student questioning was realistic and appropriate. The clock in the simulation should change accurately to allow the teacher to monitor timing without looking at a watch.	Time management Realistic Requested changes to tech
29	Interdisciplinary Environmental Science		
30	Physics	It would be nice to know more about the parameters of the simulation beforehand (can you move students?)	Need to know more about what to expect of the program prior to use
31	Astrophysics	The scenario was difficult, I feel, more than an actual classroom. It was realistic, however, as I have had those types of students in my classroom. The reason for my (neutral) rating on questions 1, 2, and 5 is very simply that I have taught a full year so I am already comfortable with 1 & 2 and so I did not	Difficult activity Realistic Helpful for new teachers Simulation

Resident Teacher	Degree	Written Responses	Overall theme(s)
		benefit as much. The simulation felt awkward and made me uncomfortable. That being said, I feel it would benefit someone greatly who was new to teaching.	awkward
32	Biology		
33	Biology	I thought the simulation went Okay to well. The simulation was a little weird. Feedback was helpful.	Simulation was weird Feedback
34	Biology	Helpful. Wish we did more class activities that model the classroom	
35	Civil Engineering	Need whiteboard to use	Limited strategies available for use
36	Electrical Engineering	I need more practice with student behavior, but overall the simulation was great.	Enjoyable
37	Chemistry	Getting used to the perception. I liked seeing the different behaviors. I was fun.	Need to know more about what to expect of the program prior to use
38	Mathematics	The lack of a whiteboard for visuals is hard to work around.	Limited strategies available for use
39	Biology	Overall this was a helpful simulation. The feedback from the coach was helpful and it was helpful to teach in front of other people so they could see your mannerisms and style.	Helpful Feedback
40	Physics	This was very helpful especially the ability to deal with student who are a little confrontational. I think if possible more than one session would be very helpful.	Helpful Classroom management Do it again
41	Chemistry	Was definitely an experience. My students seemed to know NOTHING in relation to chemistry so it was tough to follow my own notes. I still feel nervous about student behavior however.	Still nervous
42	Molecular and Microbiology	It was a great experience to all the different scenarios within the 10 minute period. The coach gave me some great feedback that I will bring into the classroom.	Enjoyable Feedback
43	Physics	I really think this was very helpful. I	Helpful

Resident Teacher	Degree	Written Responses	Overall theme(s)
		feel much more comfortable with managing the classroom now.	More prepared
44	Astronomy	Seeing another go through it doubled the activity's effectiveness. Should be required!	
45	Molecular and Microbiology		
46	Biological Sciences	It is interesting to balance procedure an instruction	Classroom management
47	Biology	The entire experience was interesting. Having a backstory about your students would be helpful. Overall seemed artificial, but helpful.	Helpful Need student background
48	Biology	The coach's feedback was great. There were many realistic aspects to the kids and behavior.	Feedback Realistic
49	Applied Mathematics	If possible, including the ability to write on an iPad or equivalent tablet device as a functioning whiteboard would be beneficial	Limited strategies available for use Requested changes
50	Applied Mathematics		
51	Industrial Engineering	The simulation was realistic. You have the quiet student, the student with a phone, the athlete, the student who likes to talk and the student who is not paying too much attention. The cellphone ringer threw me off.	Realistic
52	Information, Communication, and Technology	We need additional practice on actually teaching the lesson.	
53	Biology		
54	Biomedical Sciences	I really enjoyed this simulation. It helped me with classroom management. I learned a lot about how to handle students falling asleep and cell phone use.	Enjoyable Classroom management
55	Molecular and Microbiology	I felt that this was not very realistic because after working in a normal classroom I have realized that not every student is going to be presenting me with behavior issues at the same time. It was helpful to know how to handle 5 students with behavior issues.	Not realistic
56	Biology	I think that tutoring is much more helpful. I really liked the feedback on my teaching style and techniques.	Feedback

Resident Teacher	Degree	Written Responses	Overall theme(s)
57	Biology	This was a great way to practice without feeling embarrassed by mistakes.	Helpful
58	Biology		
59	Biology	I found that the students had physical limitations. I feel they should be more capable with physical participation (i.e. both hands up)	Requested tech changes
60	Molecular and Microbiology	Allowed me to experience what teaching in a class really is like.	Enjoyable Helpful
61	Biology	This simulation was a great exercise to practice theories and have (coach) feedback. The best or most productive part is the feedback and reflections.	Enjoyable Feedback
62	Interdisciplinary Natural Sciences	The feedback provided at the end was helpful	Feedback
63	Interdisciplinary Computational Sciences	Excellent simulation that puts teachers in a difficult class. It gives them some experience before being put in a real life hostile situation. The end result is that it gives teachers an opportunity to prepare and acclimate to these difficult situations.	Helpful Classroom management
64	Physics	The simulation is novel but with a large population of theater students here I feel it would be possible to have real actors to be in a real classroom environment which would be more realistic. You are paying for expensive tech equipment but going for the real deal maybe more beneficial to us as student teachers.	Weird/awkward
65	Mechanical Engineering	Class background should be given- middle school or high school? Otherwise the simulation was very beneficial.	Need background info
66	Environmental Engineering	It is a really good experience for someone who has never taught before. It is great opportunity to use technology such as this.	
67	Biology		
68	Molecular and Microbiology	Really appreciated the feedback. It was hard to determine engagement because of movement within the room. I felt it was hard to feel real because there was no way to engage with	Feedback More info prior to use

Resident Teacher	Degree	Written Responses	Overall theme(s)
		pictures/presentations/clips/etc.	Limited strategies available for use
69	Pre-Professional Biology	I really enjoyed this exercise. I definitely feel more comfortable about teaching how. Feedback was helpful.	Enjoyable Feedback
70	Biochemistry	I was a little nervous to start the lesson. The students were fun and engaged. I tried to relate to what they might know about how we organize things. I tried to bridge their knowledge to the organization of elements in the periodic table. I tried to ask everyone, however, I missed that CJ was texting on the phone. My coach's feedback was very helpful. She pointed out what I did well and what I have to work on. This experience gave me some insight on what types of behavior I can expect in class.	Feedback
71		The simulation made me realize I need work on clearly stating the objective and working on constructive comments to address behavior concerns.	Helpful
72		Incorporation of whiteboard and/or podium for teacher notes would be beneficial to make it more realistic. I stood too close and could not see a student. A mark on the floor indicating where to stand would be good. Thanks to (coach) for the constructive feedback.	Limited strategies available for use More info prior to use Feedback
73		It was difficult to read the body language of the avatars that weren't activated. I Could not tell if they were engaged or not. I wish we could incorporate worksheets/labs/activities.	Unrealistic Limited strategies available for use
74		I learned a lot from this simulation and definitely will use feedback in my classroom.	Helpful Feedback
75		Overall I really appreciated this experience to learn how to manage a classroom.	Classroom management Enjoyable
76		I wish we could record this to see ourselves, show someone, or even show on an interview. Of course it is not as realistic because we cannot touch the	Requested changes Unrealistic

Resident Teacher	Degree	Written Responses	Overall theme(s)
		students but we get close to the students. Also I think the students were meaner than real students. I would recommend this to others because I think it prepares you. It also helps with the "cold feet" feeling.	Helpful
77	Biomedical Sciences		
78			

APPENDIX G
QUALITATIVE ANALYSIS OF TeachLivE^{TM} MIXED-REALITY
PARENT CONFERENCE FEEDBACK FORMS

Table 42

Parent Conference Feedback Form Written Responses

Resident Teacher	Degree	Written Responses	Overall theme(s)
1	Biomedical Science	Was realistic and beneficial but very nerve-racking	Realistic Beneficial
2	Biology		
3	Biochemistry	I was a little nervous and did not know what to expect. It was mostly improvisation about his student's performance. This was beneficial and helpful simulation to get some insight on a parent teacher conference. It was a very good learning experience and I received excellent feedback from my coach.	Feedback Beneficial
4	Forensic Science & Biomedical Science	It was a lot easier than I anticipated. I don't think the other RTP[3] students should be in the room because they get all the feedback from the first student and so they do better by using the feedback.	Feedback Other students in the room
5	Health Sciences	I thought the TeachLivE[TM] experience was very helpful. The avatar responded in a way that I wasn't expecting which gave me something additional to think about before going into real conferences.	Beneficial
6	Mathematics	I didn't know where to look at first.	Need more info
7	Civil Engineering	It was really helpful to practice this type of scenario and to get such constructive feedback to help me improve. The feedback was so specific I know what specific areas I need to target and work on.	Beneficial
8	Applied Mathematics	I really liked the experience although I was really nervous. I feel that it was a realistic interaction that gave me practice thinking on my toes. Also gave me situation I wasn't expecting.	Enjoyable Unexpected situations
9	Mathematics	The best part of this is definitely the coach feedback. I feel that it would be helpful to receive the scenarios more in advance to mimic a real conference more closely.	Feedback Want scenarios in advance
10	Biological Sciences	Great simulation	Enjoyable
11	Biology	Overall great simulation. Responses were very realistic	Enjoyable Realistic

Resident Teacher	Degree	Written Responses	Overall theme(s)
12	Biology	The simulation was very helpful and felt realistic. The coach mentioned positive and negative feedback which is great	Beneficial Feedback
13	Biology	The TeachLivE experience was very helpful and helped me realize that parents can easily distract you from the intended point of the conference. This experience will help me get a better understanding of how to deal with them next time.	Beneficial Time management
14	Molecular and Microbiology	I loved getting feedback on performance. I learned a lot about how to go into teacher parent conferences.	Feedback Beneficial
15		This was a great simulation. The reflection on the simulation was the most helpful. It reinforced my strengths and gave me direction to address my weaknesses.	Enjoyable Beneficial
16	Molecular and Microbiology	It would have been helpful to have more information about the students past or to have known to create the student in your head. It is a little hard to talk to a character instead of a person. I feel that is would have been more beneficial to have more information about TeachLivE before entering.	Want info on students in advance
17	Mechanical Engineering	Good verbal realism and quick responses from the avatars. A little more introduction to the simulator would be nice as it takes a little while to orient to the interface. Coaching feedback was very helpful.	Realistic Need more info about technology prior to use
18	Biology		
19	Biomedical Sciences	It was difficult to read body language on a 2D screen when it is a 3D innate observation. It provided realistic, plausible explanations/questions parents would ask.	Difficult to read body language of avatars
20	Industrial Engineering	Given the face to screen simulation I believe this type of simulation was done as effectively as possible. Clearly being able to run through various types of situation would be appropriate if time (and money) permits.	Good technology Want to use more than once
21	Biology	The coach gave a lot of useful feedback. I feel much better about how to organize a parent conference.	Feedback Feel more prepared
22	Mechanical Engineering	It was realistic and I know it will be helpful when I have real parent teacher conferences in	Realistic

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Resident Teacher	Degree	Written Responses	Overall theme(s)
		the future. It definitely gave me a better idea and it was good practice, especially for when the parent starts to get negative.	
23	Biology	The coach has provided very insightful comments before and after the session. It would have been more beneficial if the session was in a private room with no other participant of TeachLivE present to minimize distraction. Their presence made me more self-conscious and pressured.	Feedback Other MAT students in the room
24	Applied Mathematics	No additional comments. Thanks for the opportunity to participate in this simulation program.	Enjoyable
25	Physics	The over active and dictator mom was not what I was expecting and so I think it was good because it caught me off guard which is a good thing for a simulation.	Unexpected situations
26	Molecular and Microbiology	The parent's responses were very realistic and responded in real time.	Realistic
27	Chemistry	The simulation was very realistic. The use of an actor behind the avatar is a very effective strategy. I felt that the parent acted exactly how I expect a parent to act.	Realistic
28	Chemistry	The coach provided great feedback. The simulation was so nerve-racking, but the mother asked very realistic questions. The simulation was helpful for thrusting in the realism of parent behaviors on the Resident Teachers.	Feedback Realistic Beneficial
29	Biology	The simulation was realistic and the interactive actor was very good at holding the conversation. She challenged me and made me think fast. The coach's feedback was very helpful for future conferences I will have.	Realistic Unexpected situation Feedback Beneficial
30	Biology	I thought it was very easy and relaxed conversations. I liked having the opportunity to do this because it eases the expectations. I was prepared to sit next to the mother but I was not able to move my chair.	Beneficial Requested technology change
31	Biological Sciences	If there is a way to multiple scenarios so we get experience with easy parents and difficult parents that would be beneficial.	Want to use simulation more than once
32	Molecular and Microbiology	Excellent feedback. The program offers a good range of emotion displayed in tone and body language. Good variety of scenarios.	Feedback Beneficial
33	Interdisciplinary	I liked seeing both mine and my partner's	Seeing

Resident Teacher	Degree	Written Responses	Overall theme(s)
	Environmental Science	TeachLivE. It was beneficial to see two different scenarios.	another MAT student was good
34	Physics	This really helped me a lot but I really have trouble understanding why the university is spending money developing fancy software like this when a live actor could have done 100% the same job, without software or simulations.	Not sure why using this instead of a human parent
35	Astrophysics	I was very nervous before the simulation, but it was very helpful. Coming from my first year teaching, I have had a few parent conferences and I felt that the simulation matched the reality. I liked how the parent was portrayed, with overconfidence in their child and a seemingly carefree attitude toward the subject.	Beneficial Realistic
36	Biology	Since it's in the beta form, I'm sure the kinks will be sorted out. Eventually it will be like being in a video game or alternate universe. Gotta start somewhere and this is a great beginning.	Requested tech changes
37	Biology		
38	Biology	For me, it was hard performing in front of an authoritative crowd. I get this is mandatory but it doesn't make it any easier. I could have done better but I'm just glad my first encounter with a parent/teacher conference was virtual.	Others in the room Beneficial
39	Biology	I've never had to do a parent conference and I found it difficult to relate to. The simulation is very intimidating. I felt the best part of the whole experience was talking with the coach.	Difficult situation Feedback
40	Civil Engineering	Great feedback, during simulation, time seemed to go very fast and I was unable to register everything that was going on. The feedback allowed me to get a better understanding of what I was doing correctly and what I was struggling on.	Feedback Time management
41	Chemistry	Much better than expected but still kind of creepy.	Awkward experience
42	Mathematics		
43	Chemistry	Realistic scenarios helped greatly. Nowhere near as scary as I imagined.	Realistic
44	Physics	Seemed to be a delay in the audio and sometimes I wasn't sure when to stop talking. Perhaps some indicator when the simulator is about to speak	Requested technology changes

Resident Teacher	Degree	Written Responses	Overall theme(s)
45	Biology	The parent was more intense than I expected. It was a real world scenario and she surprised me with some of her comments. Was helpful to be prepared for expected comments. Good simulations with helpful information and techniques.	Difficult Beneficial
46	Molecular and Microbiology	This was a great way to train 1st year teachers. The instructors gave some great constructive feedback. I will use what I learned today and apply it to my classroom.	Beneficial Feedback
47	Physics		
48	Astronomy	I was pleasantly shocked by this activity. The questioning of the parent helped me to understand how to cope with real-life situations. Watching another student perform helped immensely.	Seeing another MAT student Enjoyable
49	Molecular and Microbiology	Nice curveball	Enjoyable
50		Having additional people in the room makes it a bit more unrealistic. I really liked the feedback. It really helped.	Others in the room Feedback Beneficial
51	Biology	The simulation was great, however I would think doing them more than once would be more helpful.	Want to do more than once
52	Biology	The coach's feedback was extremely helpful and it was very beneficial being able to watch my partner and how she dealt with her situation. I do feel like this experience really put it into perspective what a parent/teacher conference could be like.	Feedback Beneficial Saw other MAT Realistic
53	Biology		
54	Applied mathematics	The experience provided from the coaches was incredibly insightful. I will certainly try to employ strategies given here to communicate more effectively with parents entering my first year as a teacher.	Feedback Beneficial
55	Biology	I definitely learned from this that I need to go in to these conferences with a plan. This was helpful, and I will have a lot to say in my reflection.	Beneficial
56	Applied Mathematics		
57	Industrial Engineering	Feedback was great. I learned a lot on how to handle a parent/teacher conference.	Feedback Beneficial

Resident Teacher	Degree	Written Responses	Overall theme(s)
58	Information, Communications, and Technology	We need to have access to multiple opportunities to practice parent conferences besides just one time.	Want to do simulation again
59		The ideas I received from the coach were very good and I will use them when I teach. The avatar was very realistic. Keep doing these simulations.	Feedback Beneficial Realistic
60		It thought it was pretty realistic and I enjoyed the simulations. The body gestures were helpful.	Realistic Beneficial
61	Molecular and Microbiology	I felt that this simulation really helped to understand how parents can act and how to help them and their student in the best way. I really am glad we did this.	Beneficial Realistic Enjoyable
62	Biomedical Sciences	I really liked this once I started. I received beneficial feedback.	Enjoyable Feedback
63	Biology		
64	Biology		
65	Molecular and Microbiology	The simulation was helpful. I have never experienced a conference before to discuss a problem. Throughout school, I have always had positive conferences. This allowed me to see and experience that parents are going to have their own issues and you have to keep the focus on the student.	Beneficial Realistic
66	Biology		
67		I really liked this simulation and I found the coach's feedback very helpful.	Enjoyable Feedback
68		Having a live avatar person responding with random questions and responses was a great way to help prepare me for the unpredictability of a real parent/teacher conference. Having the avatar to practice take the pressure off since there isn't a person staring back at you. That would make me nervous.	Realistic Unexpected situations Beneficial More prepared
69	Interdisciplinary Natural Sciences	I liked the way the conference flowed and that it was realistic to the point where it's an actual conversation.	Realistic beneficial
70	Mechanical Engineering	A little more guidance/background on what to say and how to conclude the session	Need more info on how to talk to

Resident Teacher	Degree	Written Responses	Overall theme(s)
			parents
71	Physics		
72	Environmental Engineering	It is good that resident teacher candidates get exposed to the type of interaction before being put in a real-life situation. It was great learning experience.	Beneficial Realistic
73		Any extra info about the student? Is there a way to program the simulation to make it more realistic?	Need info about students in advance Unrealistic
74	Molecular and Microbiology	I was really nervous but this helped me squash those nerves I like how responsive the parent was and how realistic the simulation was in terms of how easily it could have been a positive or a negative conference.	Feel more prepared Realistic Beneficial
75	Electrical Engineering	This was a great simulation. Great help!	Enjoyable Beneficial
76	Electrical Engineering	Great simulation. Very realistic. The parent avatar was engaging and interacted appropriately for the situation. Thank you to the coach as well for the constructive feedback	Realistic Enjoyable Feedback
77	Pre Professional Biology	Simulation was helpful and will make me more comfortable when I have a parent teacher conference. Feedback after was very constructive and helpful.	Beneficial More prepared Feedback
78	Interdisciplinary Computational Sciences	I like that the situation was difficult to better prepare me for difficult parents. It is better to make mistakes in a safe environment that to make them in person.	More prepared Beneficial

APPENDIX H
REFLECTIONS: OVERALL EFFECTIVENESS OF TeachLivE™
LESSON INTRODUCTION EXPERIENCE

Table 43

Lesson Introduction Reflection Selected Responses

Resident Teacher	Selected Comment(s)	Overall theme(s)
1	I learned that I must become more aware of individual student activity and not become so focused on individual students. I believe that they would become more engaged in the classroom when a better teacher-student relationship becomes established. This should be part of the MAT in the future.	Classroom management Definitely recommend TeachLivE™ to others
2	I would also move the relevancy portion up earlier in the lesson introduction to give the students a hook for the lesson.	Classroom management
3	Use the strengths of the students to overcome their strong personalities and ability to derail the lesson. I am more confident balancing learning with discipline and creating a positive educational environment is essential	Increased confidence Classroom management
4	I will walk around the room a little bit more to make sure all of the students are engaged and connected with me I would also try to ease off on complicated analogies I will need to practice slowing down in order for each student to have the opportunity to express their thoughts on the material.	Classroom management Student engagement Time management
5	I believe the majority of the avatars would have remained more engaged if I created a better hook at the beginning of class.	Classroom management
6	Feel confident that I could already make some major adjustments to improve my teaching methods the next time that I present to a class. I heavily recommend this to stay a part of the program.	Heavily recommend this for all potential future teacher
7	We could practice without having to worry about what would happen to real students. Some of these [negative] behaviors could have been curtailed with having students familiar with policies and procedures over time.	Great practice Classroom management
8	That teacher-student relationship is very important and can lend you a little bit of wiggle room in terms of student attitudes. Next time I will try to include all of the students, including the back row, which I missed a lot, according to the coach. Everyone should do this prior to teaching. I feel much more confident in my ability to teach a lesson.	Student engagement Great benefit for me Feedback was helpful

Resident Teacher	Selected Comment(s)	Overall theme(s)
9	Teaching this lesson was a lot more difficult than I expected and I learned a lot from this experience. The clock displayed in the Teach Live environment was not a working clock and therefore was not able to be used to monitor my time. I never thought it would take as much time as it did and I had prepared way too much than the 10 minute time limit allowed.	Classroom Management Student engagement Requested change- need a working clock to monitor time management better
10	When I would pose questions to the students, I would leave little to no wait time in order for them to answer [Distractions] drew the lesson quite far off of the main objective and took up a significant portion of time.	Time management Classroom Management
11	I have learned that mathematics teachers are very dependent on visuals and high effect tactile simulations to present their lessons, and the lack of such devices was crippling, Effective lesson planning is a crucial part of teaching. Great practice for anyone wanting to be a teacher.	Requested change- use of visual aides Great practice
12	Clearly communicating the learning objective was beneficial because it addressed the expected outcome of the lesson. When students would stray off task, I would quickly refer back to the learning objective to reinforce the importance of the lesson.	Classroom management
13	Students quickly became disengaged with the lesson because I did not emphasize the relevance of the objective. My nervousness promoted off task behavior and misconduct because I portrayed a lack of confidence in their eyes but now I feel better.	Student engagement Increased confidence
14	This experience helped me learn the importance of understanding and using various teaching strategies to ensure success for all students. I have learned that the behavior and learning styles of all students greatly differ The lesson plan introduction in TeachLivE^{TM} was an interesting experience that teachers should have the opportunity to perform before entering a classroom. It gives the chance to practice before being in front of real students. All future STEM teachers should do TeachLive to see how this feels.	Student engagement Increased preparedness
15	The avatars in the simulation were rambunctious like human students can be It is also critical that a teacher has a system of routines when dealing with student conduct in the classroom	Realistic situations Classroom management
16	She [student] began to fluster me, but through this	

Resident Teacher	Selected Comment(s)	Overall theme(s)
	experience I learned that I should be more assertive. I felt the need to walk around the room and stand in front of certain students in order to gain their attention and keep them engaged and focused on the lesson. All in all, the simulation allowed me to gain confidence in my classroom management skills. Keeping students engaged in the lesson was challenging. They had other things distracting them while I was teaching. Glad I got to do TeachLivE. All teachers should do this simulation to get an idea of what it's like in front of the classroom.	Student engagement Increased confidence Classroom management
17	I felt like I was giving students too much time to think and respond and it took a lot of my time. The coach told me I needed to wait longer between questions. It was good to get practice in knowing what wait time should feel like. Students that call out at every chance they get can be difficult to manage while, as the teacher, keeping my cool. I had to remind the same student multiple times to raise his hand and wait to be called upon. This was great practice. Students having side conversations took up teaching time for me to redirect. No one should start teaching until they do TeachLivE. It was a great way to see what it is going to be like.	Time management Classroom management
18	I spent a lot more time than I thought having to remind students of the classroom expectations for behavior. I only got through about half of what I had planned to teach.	Classroom management Time management
19	Walking over near students that are off task was a way to get them back on task without interrupting what I was teaching.	Classroom management
20	I definitely feel more confident to start my new career. The TeachLivE™ simulation gave the opportunity to see first-hand how a class could stray off topic and lead to chaos with normal situations that can occur in the class.	Increased confidence Classroom management
21	Seeing other teachers' handle some classroom management issues was helpful so I knew some tactics to avoid as it would just waste time. I will ensure that my plans incorporate not just engaging questions, but lower order questions that I can throw at the students that are not engaged in hopes that when they answer correctly they will feel more involved and follow better. I feel ready to be in front of actual students after this.	Classroom management Increased confidence
22	From this experience I learned that I am going to need to	Increased preparedness

Resident Teacher	Selected Comment(s)	Overall theme(s)
	be extremely prepared for my classes. I understand further how valuable reflection will be and I plan on utilizing it after each class in order to set apart what works and what does not for each of them	
23	This simulation was rather tough, but I certainly feel like I got my first teaching experience out of the way and I will take what I have learned and use it to better myself.	Increased confidence
24	I came out of that session with a much better understanding of what goes on in the classroom and how to manage my time. I believe because of this wait time, my students were effectively able to process the material.	Increased preparedness Time management
25	If I were to teach this lesson again, I would be much more observant with what my students are doing. What I could have done, was praise a student after correctly answering a question, but then remind him that he needs to raise his hand next time. After experiencing TeachLivE in a classroom setting, I learned that classroom management is much more difficult than I imagined. I now have some strategies to use next time and feel more confident in my ability to manage behavior.	Classroom management Increased preparedness
26	In addition, I learned that I need to be flexible. Due to classroom engagement and other unforeseen situations, I may not cover exactly the amount of material that I had planned. Having a lesson plan helps you maintain focus. Implementing a preplanned lesson is the best way to steer the lesson back on course. We are lucky to have been able to use TeachLivE to practice. Other MAT students should have to do it too before teaching real students.	Student engagement Being flexible Increased awareness
27	I took my abstract concept in math and created scenarios that relate to the students' actual lives. I felt like this made them more engaged as they could relate to it. One student started the lesson trying to get off task asking me about my last name. I redirected him to the objective and told his we could discuss my last name after class if he would like to, but not during class.	Student engagement Classroom management

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Resident Teacher	Selected Comment(s)	Overall theme(s)
28	One student took several of my teaching minutes trying to explain why she needed her cellphone out in class (sick brother). I realize I spent way too much time talking to her about this rather than teaching. I will have better strategies in place in the future.	Classroom management Increased confidence Classroom management
	I need to have more awareness of all students in the room as one had a cellphone out and on it the majority of the time. I didn't notice that seven text messages were sent and received during my lesson. I got feedback on how to better handle this kind of situation next time and feel more prepared for this kind of disruption.	Student engagement Increased preparedness
29	I would arrange my desks so the students are seated and prepared to work in cooperative groups.	Classroom arrangement Classroom management
	Classroom management is much more than being able to keep all of your students in their sit, and getting them to pretend like they are listening and paying attention.	
30	Overall, I feel it was a helpful simulation	Helpful simulation
	It [simulation] gave the experience of lecturing in front of a group of students, and taught us how necessary it is to think on our toes. I feel that this is an important tool of this course that should be continued.	Good experience Should be continued
31	When practicing at home, my lesson ran about 8 minutes without questions, so I thought that I would have no trouble filling the ten minutes. I was right! In fact, I was only able to get through my discussion of intersection; I would have needed another five or six minutes to get through everything that I had planned.	Time management Classroom management
	Mentioning the rules and the CBC [common board configuration] at the beginning of the lesson was also extremely helpful because it allowed me to reference them any time a student broke a rule or got off topic.	
32	The first thing I learned is that I have to make sure that I get the maximum participation from each student and set this as an expectation that the students are aware of	Classroom management
33	I will take away from the experience is that I need to develop my ability to see what each individual student is doing at any given time	Classroom management Student engagement
34	My newly acquired classroom management knowledge led to a positive and successful teaching experience	Classroom management Positive experience
	The use of proximity worked successfully and allowed me to ask questions to begin engaging the students. I will continue using this strategy in the future.	Increased preparedness Increased preparedness; will increase planning in the future
	The confusion could have been easily rectified had I adequately planned.	

Resident Teacher	Selected Comment(s)	Overall theme(s)
35	The TeachLivE™ lesson provided valuable experience in a live classroom The TeachLivE™ simulation allowed me to manage a learning environment entirely on my own, and it was eye-opening. This gave me a better understanding of how to handle disrupting situations. Overall, it was a positive learning opportunity that I can certainly use when I have a classroom of my own.	Good experience Increased confidence Positive experience
36	When CJ told me my question was stupid, I told her that no questions or answers are stupid in this classroom. I was shocked for a student to say this to a teacher so I guess it was good practice for me if it happens in a real classroom. After reflecting on my lesson with my coach, I realized that I should have introduced relevance into the lesson before anything else so all of the students were engaged from the beginning.	Increased preparedness Coaching Student engagement
37	I learned that teaching a lesson is much harder while students are misbehaving and that you can't let yourself get off track. This simulation shows first year teachers what may work in the classroom when considering management. Next time, the teacher will engage in all the students equally to keep them all awake and engaged. This should definitely continue in the MAT program.	Classroom management Increased preparedness Student engagement

APPENDIX I
REFLECTIONS: OVERALL EFFECTIVENESS OF TeachLivE^{TM}
PARENT CONFERENCE EXPERIENCE

Table 44

Parent Conference Reflections Selected Responses

Resident Teacher	Selected Comments	Overall theme(s)
1	I expressed my concern to Mrs. McGowan about Sean's recent disengagement from class and lack of participation. I recommend possible solutions such as moving Sean to the front of the classroom to allow me to have more interaction with him.	Communication Recommended possible solutions
2	She stated that Sean was intimidated by Kevin and that it would be a good idea to move Kevin to the front of the class. I replied that Kevin was in the class and that I was unaware of any issues between Kevin and Sean. Good feedback from coach. I suggested that I contact Mrs. McGowan in about a week to let her know how Sean was doing and she recommended the telephone. I also stated I would send her feedback via email on a continuing basis about Sean.	Student relationships Feedback Communication Feedback
3	Prior to this TeachLivE™ session, I did not expect to learn much, but I was greatly mistaken. It is a good tool to train teachers. The strategies suggested by (coach) at the end were very helpful. The biggest failure on my behalf was inadequately reading her body language.	More prepared Feedback Communication
4	Ms. Brown coached me to positively deflect the question and return to focus on addressing solutions. I asked the parent reasons for Sean's absences. I was trying to get a better understanding of Sean's home life, but this later proved unimportant and focused the conversation on the problems, not the solutions.	Staying on topic
5	The coach told me I could have mentioned how well he works in groups, how polite he is to the teacher, or his interest in extracurricular activities. I should have concluded the meeting by notifying the parent that I would email or call once a week to notify her of Sean's progress	Include positive information Feedback Communication
6	I gave the parent options for the student to catch up on the missed work in my class. The student was given the opportunity to receive tutoring before or after school or during lunch with me. The coach told me that was a good strategy. In the future, I want to have a clear plan to give to the parent to avoid confusion or miscommunication.	Recommend possible solutions Recommend possible solutions Feedback Communication

Resident Teacher	Selected Comments	Overall theme(s)
7	This [communicating with parents] is an important skill for future educators because it can be a very nerve-racking experience to talk to parents about problems their children may be having in the classroom. Overall, the TeachLivE™ activity was extremely helpful because it replicated what it would be like to interact with parents in this type of scenario. I got useful feedback on how to improve future conferences.	Communication Good experience Feedback
8	Complementing the student before and after offering any criticism on the student. I think I would be better served to make suggestions and then ask the parent what they think about the plan than to ask them to come up with specific action steps to take.	Communication Recommend possible solutions
9	This practice session demonstrated how critical it was to frame the problem in the classroom in the context of positive feedback. Without appropriately framing the problem at hand the teacher can appear to be attacking or singling out the student. I offered to tutor after school and during lunch. Offering choices made it easier for the parent to feel involved because she had a hand in the decision-making of her son's education. The solution I came up with before I met with the parent was to have the student make up any missed assignments either before or after school, or during my lunch period.	Communication Communication Recommend possible solution
10	I am glad I was given this scenario because this is something I need to be prepared to deal with. The parent said the reason for the student's tardies and absences was due to a death in the family. The mother then went on to talk about this for a while.	Overall positive Staying on topic
11	At the conclusion of our meeting, I said that I would contact her via email to let her know how Sean's behavior was progressing and that I appreciated her coming in to see me. Communicating with parents is an essential part of being an effective teacher.	Communication Communication
12	I offered a solution of extra instructional time in the form of my workshops. After, (the coach) told me I used good strategies and suggested others as well. I feel this is something I can do with good confidence and felt that TeachLivE helped me to understand this. I thought I did well explaining the situation to the mother	Recommend possible solutions Feedback Increased confidence Communication

Resident Teacher	Selected Comments	Overall theme(s)
13	Keeping the student at the forefront of the discussion and having a solution-based attitude was essential in keeping the mother on track and feeling like she could also contribute to her son's success.	Staying on topic Concern for student success
	I explained that it was my responsibility to create a safe and positive climate for my students to learn.	Concern for student success
14	Next time I will make it known to the parent that we both care about Sean and that I want him to learn and succeed.	Communication Concern for student success
	I should have developed a follow up plan to communicate with the parent.	Communication
15	This simulation was great. I am more confident talking to parents and letting them know I am here to work with them for the better of the student. The time went really fast. I need to have a plan of exactly what I want to talk about and stick to it or I'll have conferences that last too long. Coach gave good information about ways to improve in the future.	Communication More prepared More prepared
16	The simulation and especially the feedback from the coach put me more at ease about the idea of real conferences I will have in the upcoming school year.	More prepared Feedback
17	I emerged confident in my ability to handle parents' concerns.	More prepared Recommend possible solutions
	I suggested he meet with me during lunch so I wouldn't have to add to her trouble by having to pick him up if I kept him after school.	
18	I feel like I did fine keeping the meeting about Sean and finding a solution.	Staying on topic Realistic
	I believe that my conference was very realistic.	
19	I gave the parent some positive feedback about her son's historical performance and behavior in my class. I felt this set a nice tone for the rest of the conference. When I mentioned his recent failing test grade, I immediately also explained my personal classroom policy, which allows for students who do poorly on a single assignment to be able to recover, and I explained that no one grade can be detrimental to a student's course grade	Realistic More prepared Communication

Resident Teacher	Selected Comments	Overall theme(s)
20	The one big thing I forgot to do was to set up a second meeting or phone call, something to check back with her on Sean's progress. The coach told me I could always follow up and call the parent even though it was not stated in the conference. The goal of this experience was to test out some of the techniques I have learned over the course of this semester with regard to parent-teacher communication and also to put me more at ease about the idea of real conferences I will have in the upcoming school year.	Communication Feedback Communication More prepared
21	It reminded me that I will likely be exposed to students of many different familial and cultural backgrounds, and I need to be sensitive to that fact. Overall I feel I did well and am more confident about this in the future.	Communication Overall positive
22	Getting this information [from the mother] would help me immensely in a real-world situation because I could rearrange my classroom seating in order to minimize such a distraction. Overall, I learned that parent-teacher conferences are nothing to be fearful of, and they can be a great way of getting parents on your side in order to help motivate students at home.	Communication More prepared
23	I might have been a little abrupt switching topics after she told me her husband was moving out, but I felt there was not anything I could do about that and I did not want her getting completely off topic I went in to the simulation nervous, and I emerged confident in my ability to handle parents' concerns. The coach answered a few questions that I had after it was over. I concluded my conference by getting the parent's direct contact information and letting her know that I would be following up with her about the status of her son's progress in one week.	Staying on topic More prepared Feedback Communication
24	It gave the opportunity for me as a first year teacher to gain valuable experience and feedback from a simulation where a mistake does not come back to haunt me. I learned that I will be forced to take a more personal interest in my students' lives. Parents like to see that we know things about their children.	More prepared Communication

Resident Teacher	Selected Comments	Overall theme(s)
25	I offered to speak to Sean myself to see if he would open up to me about the issue since his mother was being shut out. I believe I am more prepared as a result of this simulation and the coach's feedback. I learned that parent-teacher conferences are nothing to be fearful of, and they can be a great way of getting parents on your side in order to help motivate students at home.	Recommend possible solutions More prepared Feedback Communication More prepared
26	I had never been in a parent-teacher conference scenario before, so this experience was new to me and very useful as practice. From this simulation, I learned that being prepared is going to be key when going into a parent conference.	More prepared Realistic More prepared
27	Communicating with parents is crucial for enhancing the academic development and success of students. One last thing that went well was I was able to keep the conversation on track.	Communication Staying on topic
28	I offered tutoring and the parent agreed that the extra help would be beneficial. Overall, I found that establishing a partnership, organizing a plan, and openly communicating with the parent helped make the conference successful.	Recommend possible solutions Overall positive More prepared
29	I should have told Sean's mother that I would be in contact with her and will follow up to make sure she knows how the situation progresses. Fortunately, I am able to use the unsuccessful parts of my conference as powerful learning tools	Communication More prepared
30	I feel this simulation was a good starting point into understanding how parent-teacher conferences can go. The knowledge and experience I have gained from the TeachLivE^{TM} simulation will allow me to use the powerful tool of parent communication to help my students reach academic success. I suggested that Sean could come in either before school, during lunch, or after school in order to do some extra work to show his understanding of the content in order to bring his grade up	More prepared Communication More prepared Recommend possible solutions
31	It is important that new teachers are able to effectively communicate and partner with parents In my TeachLivE experience, I learned a lot about how I will handle parent-teacher conferences in the future. There is no telling how a parent might react to anything that is said, so professional courtesy and demeanor is a must.	Communication More prepared Communication

Resident Teacher	Selected Comments	Overall theme(s)
32	This seemed to make her feel better and understand that I see a solution to the problem This taught me that I need to be ready for all emotions when I go into a conference. Establishing a plan worked because it directly addressed the problem while also promoting a partnership	Recommend possible solutions Communication Communication
33	I ended by ensuring the parent that I would maintain contact to keep her updated and confirming the contact information that I had on file. I told her that I will allow Sean to make up the assignments. I will then schedule a follow-up meeting with her since she's on a time limit.	Communication Recommend possible solutions Communication
34	I allowed the parent to make the conversation about me. I should never let the parent critique my teaching style. It must be kept about the student, and what can be done to get the student to improve. This led the parent to get off track and start discussing a group project that I had assigned in my class. The coach gave me strategies to use if/when this happens in a real conference.	Staying on topic Feedback
35	The simulation does force us to think about what we would say. Considering that I have now done the parent meeting and the lesson plan simulation, I know exactly what made me the most uncomfortable in the parent meeting. In the end, I learned that I am completely capable of handling these situations. Thanks for the feedback. I learned that you need to be confident when talking to parents. I also learned that I should not get intimidated by talking to a parent.	More prepared More prepared Feedback More prepared

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