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Los Angeles

Mixed Reality Simulation in Teacher Preparation Programs in the United States

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Education

by

Ashley Lauren Ireland

2021

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ABSTRACT OF THE DISSERTATION

Mixed Reality Simulation in Teacher Preparation Programs in the United States

by

Ashley Lauren Ireland

Doctor of Education

University of California, Los Angeles, 2021

Professor Mark Hansen, Co-Chair

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Practice is a vital component of teacher preparation. Mixed Reality Simulation (MRS) is a technology that provides teacher candidates opportunities for practice and rehearsal. As of 2021, MRS can be found in just 52 of the estimated 1,200 teacher preparation programs nationwide. Within the Diffusion of Innovation theory, these programs are considered innovators and early adopters. Applying the theory, learning and sharing how these programs are using MRS may help to diffuse and ultimately grow the use of this innovation in teacher preparation programs.

This explanatory sequential mixed methods study included a survey and interviews of leaders of simulation to discover (1) how simulation is being used in teacher preparation in the United States and (2) how the leaders of the technology perceive MRS for teacher preparation.

During phase one of the study, data were collected from 41 of 52 teacher preparation programs in the U.S. known to use MRS. In regard to extent of use and structure, the survey found that: Most programs have low integration; most respondents reported integrating simulation into 20% or less of their courses and exposing an average of 43% of their teacher preparation students to MRS each year. Though annual hourly use ranged, respondents reported using an average of 88 hours a year, with a mode of 30 hours. Most respondents reported delivering MRS in a lab model—where individual students rehearse in front of their peers. All respondents reported using classroom management scenarios and reported the use of these scenarios as frequent more than any other scenario. Respondents also most frequently reported management scenarios as most beneficial to students. The survey found that COVID-19 caused changes in simulation frequency, content, and integration, with most programs reporting an increase in MRS use as a result of school shutdowns and limits to opportunities for clinical practice.

In regard to how MRS is perceived by leaders, respondents overwhelmingly described their experience with MRS as positive. Respondents frequently referenced opportunities for practice and the ability to facilitate and rehearse in otherwise impossible scenarios as the most positive aspect. They referenced the time commitment, technology issues, and building faculty buy-in as the most challenging issues.

Phase two of the study included interviews with a purposeful sample from the survey respondents. One leader of simulation from an institution exemplifying typical MRS use was interviewed, and three leaders from institutions found to have atypical or “special” MRS use were interviewed. The institutions with special use included: one institution using less than average hours, yet exposing 100% of their student population to the technology, one

institution vending the technology to other programs, and the institution that reported using the most MRS hours annually. Qualitative data from the interviews further described how MRS was being used at the institution as well as detailed how the leaders perceive the technology for teacher preparation. The qualitative data also elaborated on typical and atypical MRS use such as vending practices, course integration, and student assessment. This data elaborated on divergent beliefs about MRS in teacher preparation.

The dissertation of Ashley Ireland is approved.

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2021

DEDICATION

First, beyond anything, this dissertation is dedicated to my boys Ethan James Dann and Owen Gregory Dann. I know the last few years have not been easy on you; often work on this took me away from you when I would have much rather been by your side. Please know that I did this for you, for us, for our future. “Work hard, get smart!”

This dissertation is also dedicated:

- To my mom, Kerry Ireland. A woman I watched work hard to achieve her dreams and who always believed in mine. Thank you for showing up when it got hardest. Thank you for caring for the boys, cooking, cleaning, folding, and supporting me. You did all the things so that I could do this. I could not have done it without you.
- To my sister Seychelle who passed away during my first year in the program. Your checkered Vans were on my feet or beneath my desk for much of the writing and thinking of this work. Your joy and laughter continue to inspire me every day. I hope this made you proud... right before you rolled your eyes at me and called me a nerd. Hey Sey, I love you, I miss you so much.
- To my dad, Greg Grouwinkel for always believing in me. The pride you have in me causes me to think bigger and reach higher.
- To my first class of 4th graders at Creekside Elementary in Salinas, California. I wish I had been the practiced, prepared teacher you deserved. I will spend my life striving to make great teachers for great students like you.

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- Education Policy
- Social Foundations of Education
- Blended Learning
- Education Leadership

CHAPTER ONE: INTRODUCTION TO THE STUDY

The Problem

I started my teaching career in Salinas, California in 2006. On an emergency permit, I stood in front of 33 fourth graders, completely unprepared to teach. I loved my students and tried my hardest every day, but the reality is I never should have been allowed to be their teacher. I was underprepared, underqualified, and lacked the necessary practice I needed to be effective. My story is not unique.

According to Darling-Hammond, Furger, Shields, and Sutcher (2016), half of all teachers entering the field in California do so inadequately prepared. Lack of teacher preparation has been linked to higher levels of teacher attrition (Betts, Rueben, & Dannenberg, 2000; Carver-Thomas & Darling-Hammond, 2017b; Zhang & Zeller, 2016), and lower student achievement scores (Carver-Thomas & Darling-Hammond, 2017a; Fetler, 1999; Goe, 2002). With teacher quality being the most critical in-school factor influencing student achievement (Rivkin, Hanushek, & Kain, 2001; Sanders & Rivers, 1996), it is vital for students to be taught by well-prepared, high-quality teachers.

A major contributor to teacher quality is the strength of their preparation (Carver-Thomas & Darling-Hammond, 2017a; Lewis, Parsad, Carey, Bartdai, & Westat, 1999). However, teacher preparation strength and quality are not yet sufficiently defined, with no single pedagogical approach or set of experiences empirically supported (Cohen, Wong, Krishnamachari, & Berlin, 2020). What is known is that high-quality practice is vital to new teacher development (Goldhaber et al., 2016; Papay et al., 2012; Ronfeldt, Reininger, & Kwok, 2013). However, the amount and quality of practice provided to candidates during

preparation varies greatly, with most occurring during what is known as clinical practice (Hoppey & Yendol-Hoppey, 2018).

Although practice is abundantly important to teacher preparation, the substantiality of clinical practice provided varies greatly across programs. Facilitating quality observation, student teaching, and mentoring for teacher candidates is often a highly complicated affair requiring the collaboration and coordination of multiple schools, master teachers, faculty, teacher candidates, and unpredictable students (Decker, Roth, & Cooner 2019). Subsequently, teacher preparation candidates often miss out on practice with vital pedagogical techniques.

A variety of policies, interventions, and alternative models have been introduced into the field of teacher education to improve, enhance, or supplement clinical practice. Programs such as Beginning Teacher Support and Assessment (BTSA) and Teacher Induction in California and Professional Development Schools nationwide have been implemented to provide further training to teachers in clinical settings. Although these programs support many teachers in their development, many leave the profession before they have the chance to improve. Alternatively, some education programs have implemented innovative clinical models to increase student teaching, observation, and other rehearsal experiences during teacher preparation. However, the interventions are neither widely applied across programs nor providing ample high-quality practice to all preservice candidates.

Facilitating quality clinical practice for pre-service teachers became even more difficult in the spring of 2020 as a highly contagious and deadly virus causing Coronavirus 2019 (COVID-19) swept across the globe. In an effort to slow the virus, countries around the world began a practice known as social distancing—limiting person-to-person contact

outside of tasks deemed essential. As a result, public and private districts closed schools. By April 3, 2020, over 124,000 public and private schools were closed in the United States, with an estimated 55.1 million students out of school—a truly unprecedented occurrence (EdWeek, 2020). As a result of the school shutdowns, pre-service teachers including student-teachers were no longer able to complete their required clinical practice hours as they had previously. Education policies in the 2020-2021 school year further limited clinical practice opportunities to teacher preparation students across the country.

As clinical practice is both a state-mandated requirement and a vital teaching tool for developing teachers, teacher preparation programs and state-level education policymakers were forced to become more creative and flexible with their models and alternatives for clinical practice. In California for example, the California Commission on Teaching Credentialing (CTC) allowed Mixed Reality Simulated teaching experiences to count toward clinical practice required hours for the first time (California Commission on Teacher Credentialing, 2020). Similar policies passed across the nation.

Mixed Reality Simulation (MRS) is an emerging technology that can provide teacher candidates with additional opportunities for clinical practice and rehearsal. The technology has been shown to improve pedagogical proficiencies through structured simulated practice (Dawson & Lignugaris/Kraft, 2016; Dieker, Hughes, Hynes, & Straub, 2017; Kaufman & Ireland 2016; Straub, Dieker, Hynes, & Hughes, 2014). It was also found to significantly increase teacher self-efficacy during the preparation of pre-service teachers of science (Gundal, Piro, Straub & Smith, 2019; Gundal & Piro, 2021) and improve early-education majors' self-efficacy beliefs for teaching science (Bautista & Boone, 2015).

The technology began in 2008 at the University of Central Florida, then was adopted by a handful of programs across the U.S. Despite its promise, adoption to date has been limited in teacher preparation programs. A decade after it was first used to train teachers, MRS can be found in less than 4% of teacher preparation programs in the United States—just 52 of an estimated 1,200 teacher preparation programs (Mursion®, 2020). Those institutions that have integrated the technology vary in size, Carnegie classification, and geographic location.

Many working with MRS have found the technology promising as a tool for providing meaningful opportunities for practice and rehearsal during teacher preparation. However, little is known about how the technology is being used at the institutions to train teachers. Within the Diffusion of Innovation theory (Rogers, 2003), the 52 MRS using institutions are considered innovators and early adopters. Applying the theory, discovering and sharing how MRS is used by the institutions may help to further diffuse the technology to others.

Statement of the Project

The purpose of this study was to investigate how teacher preparation programs in the United States are utilizing Mixed Reality Simulation (MRS) and discover how the leaders of MRS perceive the technology for teacher preparation. The study utilized an explanatory sequential mixed methods research design—with a survey of simulation leaders at 41 institutions of higher education utilizing simulation and follow-up interviews of a purposeful sample. The survey and interviews garnered quantitative and qualitative data on simulation utilization, goals, and perceptions.

The study focused on the following research questions:

Research Questions

RQ1: How is Mixed Reality Simulation being used in teacher preparation programs?

RQ2: How do the leaders of simulation at MRS-using institutions perceive the technology for teacher preparation?

Research Design

Mixed methods research involves the collection of both quantitative and qualitative data (Cresswell & Cresswell, 2018). While a quantitative design could have been used to answer the research questions in a broad sense (Creswell & Creswell, 2018), the collection of qualitative data allowed for a deeper investigation of simulation leaders' experiences, perceptions, and perspectives. An explanatory sequential mixed methods study was an appropriate method to examine the current use of simulation in the field as well as gain a deeper understanding of how and why the technology is being used at institutions with typical and atypical MRS use. As this study aimed to incorporate leaders from all the institutions of higher education in the United States currently using simulation in teacher preparation (n=52), a purely qualitative study would not have been able to adequately capture its breadth. Similarly, a solely quantitative design would not have been able to thoroughly describe the perceptions of simulation leaders related to the research questions.

Population

The study's population consisted of the leaders of U. S. institutions of higher education that have integrated Mixed Reality Simulation into their teacher preparation program. The definition of leader of simulation in this context refers to the individual staff or faculty member at an institution responsible for the implementation of simulation at the

site or someone immersed enough in the use of the technology, they could thoroughly answer questions about MRS use at their institution. The definition of integrated in this context refers to teacher education programs that have written simulation scenarios into their curriculum scope and sequence—enabling candidates to take part in simulation during their tenure in the program. As of October 2020, there were 52 known teacher preparations programs with integrated simulation. For the qualitative phase of the study, a purposeful sample was drawn from the survey respondents.

Methods

Survey. For this explanatory sequential study, first, a survey was created following the principles of survey design provided by Fowler (2014) and distributed via Qualtrics, an online platform. The survey questions focused on how the simulation is being used in regard to simulation content, modality, student population, and amount of use, as well as perceptions of benefit, positives and negatives of the technology, and changes caused by COVID-19. Following the collection of the survey data, the mostly nominal data was coded and analyzed reporting on frequency, count, and trends. The quantitative data was analyzed with descriptive statistics by use level, with institutions being divided into low, medium, and high MRS use through a variety of “extent of use” variables. The survey’s qualitative data was also analyzed and coded. A purposeful sample of survey respondents from teacher preparation programs with typical and atypical use were selected for phase two of the study, the qualitative data collection—one-on-one interviews.

Interviews. The interviewees were selected from four different institutions represented in the survey sample. The selection of the institutions included one leader of MRS at an institution with typical MRS use based on their quantitative and qualitative

answers on the survey. This institution's MRS use was representative of the norm in the survey sample. The others were selected because of their atypical or "special" use of the technology. Of the atypical cases, one maximum case was selected; an outlier in regards to hours used annually. Another atypical institution was selected because of their relatively low use of hours, but a high percentage of student exposure to the technology. The last atypical case selected was an MRS institution that vends the technology to other universities and businesses, in a revenue-generating scheme. In order to garner a more holistic and thorough view of simulation at the institution as well as triangulate findings, additional information including documents, syllabi, and schedules were collected and analyzed from the intuitions. All the selected interviewees took part in a neo-positivist, semi-structured interview. This type of interview was an appropriate choice as it allowed me to gather the information desired and respond to the emerging information from the respondents while also maintaining a neutral stance in order to minimize bias (Merriam & Tisdell, 2016). The structured interview questions gathered more detail in regard to the research questions as well as delved more deeply into specific and unique uses and structures found at the particular institutions.

Project Significance

This project is most significant to two specific and varied groups. First, to the current leaders and users of simulation in teacher preparation programs, this accumulation of information will act to educate, define, inspire, and elaborate on the current state of the field as well as inform about atypical use. Second, applying the Diffusion of Innovation theory, this study may act as an invaluable implementation guide for teacher preparation programs looking to integrate the technology to enhance candidates' clinical experience, provide

additional opportunities for practice, and/or innovate their teacher preparation curriculum. In addition, the data garnered around simulation's use during the COVID-19 pandemic may serve to inform future policy and practice around simulation in teacher preparation outside of the pandemic.

As I attempted to conduct surveys of simulation leaders in all teacher preparation programs utilizing the technology, but did not procure a complete census, and garnered information from just one leader at each site, there are some limitations to the generalizability of this study. However, insight into the practical application of this powerful innovation in teacher preparation is meaningful. I plan to share my research with my home institution, a university looking to integrate simulation into their school of education, then publish to share my findings more broadly.

In chapter two, the literature review, I establish a need to study this innovation, concentrating on the importance of practice in teacher preparation. In chapter three, I detail the explanatory sequential mixed method design. In chapter four, I report on the data from phase one of the study—describing the state of the field. In chapter five, I delve more deeply into the uses of the technology at four distinct institutions. Finally, in chapter six, I summarize and discuss the findings and provide my suggestions for practice.

CHAPTER TWO: A REVIEW OF THE LITERATURE

This study examined the current state of Mixed Reality Simulation (MRS) in teacher preparation programs in the United States. It sought to understand the present utilization of MRS and synthesize the practices and perceptions of those in this field. Chapter Two, a review of the literature, provides context for the study, ultimately demonstrating the necessity of researching the use of this powerful innovation.

First, this review explains the importance of teacher preparation. It then describes why rehearsal and clinical practice are necessary components for preparing high-quality teachers. I then provide a definition for high-quality clinical practice, as well as detail the range of clinical practice found in teacher preparation programs. I then discuss interventions designed to improve, enhance or supplement clinical practice. Given technology's

potential, the chapter next reviews common

technologies currently being used in teacher preparation to enhance or facilitate clinical practice, the most promising being Mixed Reality Simulation. The review then identifies

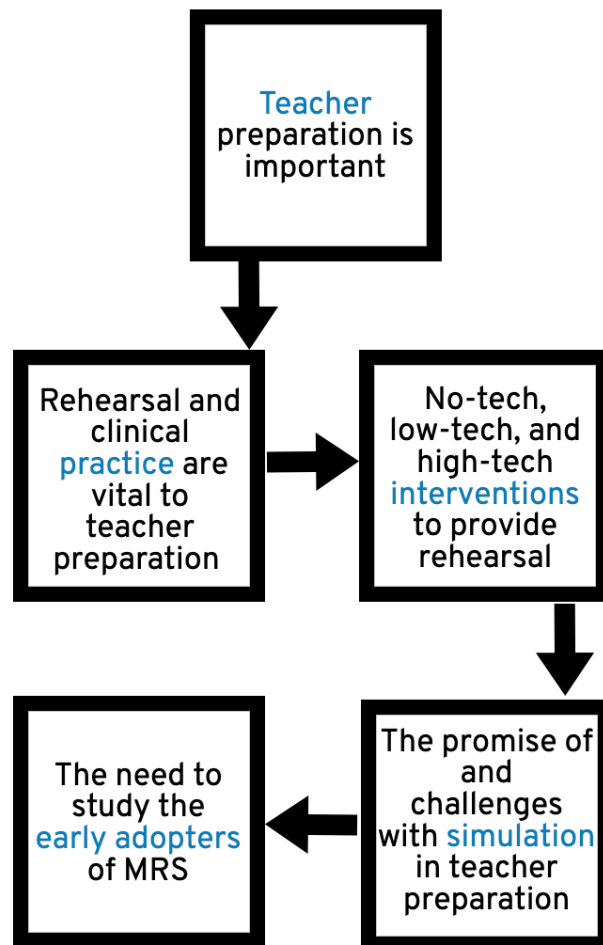


Figure 1: Literature Review

research on MRS for teacher training and details what little is known about the field of application. See [Figure 1: Literature Review](#) for an overview of the chapter.

This literature review ultimately argues for the need to study early adopters of Mixed Reality Simulation in teacher preparation in order to further diffuse the technology within the teacher education field. The greater diffusion of this powerful technology will ultimately result in more teachers entering the field better prepared to teach.

Teacher Preparation

Teacher quality is the most critical in-school factor influencing student achievement (Darling-Hammond, 2003; Rice, 2003; Sanders & Rivers, 1996). A key contributor to teacher quality is the strength of their preparation (Carver-Thomas & Darling-Hammond, 2017a; Lewis, et al., 1999). Yet, the quality of teacher preparation programs in the United States varies greatly (Zeichner, 2016). As a result, teachers enter the profession with differing skills and levels of knowledge. In California for example, half of all teachers entering the field do so inadequately prepared (Darling-Hammond et al., 2016). Lack of teacher preparation has been linked to lower student achievement scores (Rockoff, 2004). It is also linked to higher rates of teacher attrition—an occurrence that disrupts school stability, prevents the accumulation of institutional knowledge, and costs districts thousands of dollars each year (Carver-Thomas & Darling Hammond, 2017b). Lack of teacher quality and subsequent retention undermines learning environments and student achievement (DeBiase, Butler, Khan, Dyer, 2018).

However, with the practice provided to them in their classrooms, most new teachers improve within the first few years (Atteberry, Loeb & Wyckoff, 2015; Harris & Sass, 2011; Kraft & Papay, 2014; Papay & Laski, 2018). This practice-based improvement leads many

involved in teacher preparation to believe that some of this development could occur earlier (Cohen, et al., 2020). Although practice is fundamental to new teacher development, (Goldhaber, Krieg & Theobald, 2016; Papay, et al., 2012; Ronfeldt, Reininger, & Kwok, 2013), a specific amount of practice or set of experiences necessary to prepare teachers has not yet been established.

Clinical Practice in Teacher Preparation

Opportunities for teaching practice provided to candidates during preparation varies across programs. What is provided to candidates occurs most often during clinical practice (Hoppey & Yendol-Hoppey, 2018). Clinical practice includes student teaching, master teacher observation, and other practical work completed on-site in schools. Although abundantly important, the amount, substantiality, and quality of clinical practice required to adequately train teachers has yet to be defined. Students' experiences in clinical practice varies greatly across and even within programs.

Clinical practice is the component of teacher preparation in which pre-service teachers learn on-site at school districts, usually in classrooms. Clinical practice can include observation, student teaching, and co-teaching, as well as mentoring and feedback, and other authentic learning experiences. Academically, clinical practice is defined as “a preparation pathway that requires teacher candidates to work for an extended period in authentic educational settings to engage in the pedagogical work of the profession of teaching” (Hoppey & Yendol-Hoppey, 2018 p. 4).

The purpose of clinical practice is twofold. First, it bridges the academic and practical—enabling teaching candidates to connect the research they learn in the higher education classroom with the routines and practices of real classrooms. Second, it enables

teacher candidates to observe, rehearse, and receive guidance on teaching moves, routines, and decisions in order to increase their skills and subsequent teacher self-efficacy.

Clinical practice has long been established as a vital component of teacher preparation (Dewey, 1964; Ross, Hughes & Hill, 1981; Sunal, 1980; Zeichner, 2016).

Clinical practice within teacher education is as old as teacher education itself. In fact, it can be traced back to *Normal Schools*, the earliest iterations of teachers' colleges. Originally founded in the late 1600s in France and popularized in the United States in the 1800s after the Common School boom, *Normal Schools* were coupled with traditional primary and secondary schools in order to authentically teach teachers pedagogy and curriculum in the classroom context. Within the *Normal School* model, teachers learned from professors and master teachers while watching them interact and teach to primary and secondary students in a clinical setting.

Clinical practice has evolved since the early iterations in the *Normal Schools*, but the practice continues to be fundamental to teacher training. Extensive research documents that teacher candidates are better prepared from well-designed and monitored clinical practice (Darling-Hammond, 2005; Darling-Hammond & Bransford, 2005; Grisham, Laguardia & Brink, 2000). Teacher education programs with quality clinical practice develop teachers' implementation of High Leverage Practices (HLPs) that impact student learning (Darling-Hammond & Bransford, 2005). Quality clinical programs also bridge teaching theory with practice, enabling pre-service teachers to practice the pedagogies they learn about in class (Grossman, 2011; Zeichner, 2010, 2012).

A substantial body of research confirms that quality clinical practice prepares teachers to apply academic concepts and support students' learning (Baumgartner, Koerner,

& Rust, 2002; Darling-Hammond, 2005; Denton, 1982). More recently, the National Council for Accreditation of Teacher Education (NCATE), published *Transforming Teacher Education through Clinical Practice: A National Strategy to Prepare Effective Teachers* (2010). The report found that teacher preparation programs grounded in clinical practice were stronger and better able to adequately prepare effective teachers. Aligned with that finding, Feiman-Nemser (2001), found that new teachers identify practice and fieldwork as the most impactful portion of teacher preparation. Clinical practice is clearly an essential component of teacher preparation. In fact, clinical practice is so important that “preparation programs that are focused more on the work of the classroom and that allow teachers to engage in actual practices involved in teaching tend to produce first-year teachers who are more likely to remain in the profession” (American Association of Colleges for Teacher Education, 2013, p. 9). Ingersoll, Merrill, and May (2014) confirmed this, also finding that new teachers who experienced high-quality clinical preparation were significantly more likely to stay in the profession.

Deficits in Clinical Practice

The reasons for deficits in teacher preparation programs’ clinical practice vary, with many authors detailing various barriers (Bain & Moje, 2012; Decker, Roth, & Cooner, 2019). Often cited barriers include collaboration difficulties between P-12 school systems and higher education programs. These entities often have competing expertise, practices, and policies—which may create conflict and a lack of coherence (Decker et al., 2019; Weston, 2019). In addition, substantial barriers emerge from P-12 and higher education differences in policy and program design, as well as financial barriers for teacher candidates and compensation barriers for master teachers and other school-based personnel (Decker et

al., 2019). Further barriers surface in logistics, placement, communication, curricular alignment, coherence, and even values (Decker et al., 2019; Weston, 2019). These complexities undermine clinical practice in teacher preparation. An innovative way to provide more opportunities for practice and rehearsal in teacher preparation is needed.

Interventions to Provide Clinical Practice and Rehearsal

A variety of supports have been introduced into the teacher education field to provide more practice to new teachers and improve teachers' skills following their formal teacher preparation. These include programs like California's Beginning Teacher Support and Assessment (BTSA) and Teacher Induction programs, the use of Professional Development Schools, and a variety of innovative clinically-intensive programs.

Beginning Teacher Support and Assessment (BTSA). California's Beginning Teacher Support and Assessment (BTSA) program was initially formed to bridge the gap between teacher preparation and classroom practice. The program was created in 1988 due to low rates of teacher retention in urban and rural environments (Olebe, 2001). In a rare combination of education research, state education policy, and teacher education, the program was co-developed and co-administered by California Commission on Teacher Credentialing (CCTC) and the California Department of Education to provide effective supports after teacher preparation for first- and second-year teachers (California Commission on Teacher Credentialing & California Department of Education, 1992; Olebe, 2001). The multimillion-dollar program included mentoring, peer assistance, and review. During its 28-year run, the BTSA program supported tens of thousands of teachers through their first years of teaching—including the writer of this research. But the program was quite flawed—often referred to as burdensome and unrealistic. It was criticized for not being able

to meet teachers' individual needs, nor addressing the diverse context of the California teaching landscape.

Teacher Induction. In 2016 BTSA was replaced by Teacher Induction. Like BTSA, Teacher Induction works within California's two-tiered credentialing system. While the teacher preparation program prepares candidates in California for an initial teaching credential (the Level I or preliminary credential), the two-tiered system acknowledges that teachers learn on the job and become better with more practice and support. Before earning the second-tier credential (the Level II or Clear credential), the teacher must complete a variety of tasks including inquiry cycles and work with mentors (California Commission on Teacher Credentialing, 2019). As the new Teacher Induction program was piloted in the 2016-2017 school year, it is still too soon to know how much long-term impact the program will have on the profession. Regardless of what is later discovered, however, programs like these are designed to improve teachers' skills by providing additional support and practice in clinical settings. It seems possible that some of this improvement could occur earlier—within teacher preparation.

Professional Development Schools (PDS). Akin to BTSA and Teacher Induction, Professional Development Schools (PDS) were also designed to help further develop teachers for the classroom after completing a formal preparation program. The schools, an innovative trend beginning in the late 1980s and early 1990s, were started by the Holmes Group, an organization of the deans of schools of education in research universities (Levine, 2020). PDS consisted of a partnership between university preparation programs and school districts. They aimed to reform teacher preparation in higher education and to restructure P-12 schools: in sum, to distribute professional learning to all school stakeholders. Similar to a

teaching hospital in the medical field, Professional Development Schools were designed for intensive clinical practice and continued professional growth for experienced teachers (Darling-Hammond, 1995; Levine, 2020). PDS differed from the norm because they partook in research-practitioner collaboration (Byrd, McIntyre, & John, 1999; Fishchetti, Hovda, Kyle, & Stroble, 1999). By the mid-1990s, research began to indicate that students in PDS achieved at higher rates than those in non-Professional Development Schools. In 2001, thirty-one states had PDS with several hundred appearing across the nation (Levine, 2020).

Despite the promising student data, PDS were not without controversies. Most notably, PDS often struggled to gain institutional support and coherence between the university and the P-12 school. Differences in policies around promotion and tenure requirements, leadership, and teachers' unions often led to contentious environments (Fishchetti et al., 1999; Levine, 2020). In addition, many PDS included a requirement of a full-year unpaid internship as a part of the professional preparation. This added cost, in an already low-paying career, acted as a discouragement for many looking to enter the field, limiting the role of PDS in the development of new teachers to the field (Levine, 2020). Although a sound concept, like BTSA and Teacher Induction, the purpose of PDS were to further develop teachers after their teacher preparation programs through structured support and practice. Since this development comes with more practice and support, more opportunities for practice and support belong within teacher preparation itself.

Independent teacher education and innovative clinical practice models. A few innovative interventions to improve clinical practice have been attempted directly within teacher preparation programs (Polly, Putman, Petty & Good, 2018). These interventions aim to improve clinical practice leading to more coherence between teacher preparation

coursework and what is experienced in the field (Swartz, Lynch, & Lynch 2018). For example, Swartz and colleagues (2018) describe an integrated approach where topics are taught in a traditional higher education setting, rehearsed in safe structured higher education environments, and then directly enacted in classrooms with small groups of students. Schroth and Helfer (2018) also describe an innovative model designed to improve clinical practice. This model differentiates clinical practice for pre-service teachers according to their needs and varying readiness levels. Both models signaled a need for wider adoption in the teacher education field (Swartz et al., 2018; Schroth & Helfer, 2018). However, the many complexities of enacting clinical practice such as lack of mentor teachers, difficulty with appropriate student-teacher placement, and differences in the P-12 and higher education goals make large scale adoption unlikely.

In addition to the innovative clinical models, many independent teacher education programs have risen in popularity as alternate routes to traditional university-based teacher preparation. These programs claim to provide a more effective route to preparation through more clinical practice. Currently, there are five prominent programs that function outside of traditional university settings: The Relay Graduate School of Education (Relay), Match Teacher Residency (MTR), High Tech High's Internship (HTH), iTeach, and TEACH-NOW. These independent teacher education programs often combine clinical practice with online learning. While advocates of these alternative programs claim they are a bold and innovative approach creating high quality teachers, Zeichner (2016) reported the claims to be unsubstantiated. In fact, Zeichner found the programs to, at best, contribute to the inequitable distribution of prepared teachers, and at worst, further stratify schools by social class and race due to their over-reliance on highly controlling management techniques.

Furthermore, all of the independent programs showed minimal or no evidence of producing high-quality teachers (Zeichner, 2016).

All of these post-preparation interventions, innovative clinical models, and independent teacher education programs acknowledge that teachers improve when provided additional opportunities for practice. While BTSA, Teacher Induction, and PDS aimed to enact meaningful change in teacher quality by providing more practice and support for already in-service teachers, the innovative clinical models aimed to enhanced preparation for pre-service teachers through more clinical practice. The existence of these programs demonstrates that more opportunities for practice, support, and rehearsal are needed directly within teacher preparation.

The Importance of Rehearsal

Rehearsal in teacher education is similar to clinical practice, but provided in a more controlled environment. Rehearsal involves teacher candidates publicly practicing instructional moves and interactions with students for the purposes of skill development. Rehearsals have been found to be robust learning experiences for teacher candidates (Davis, Kloser, Wells, Winschitl, Carlson, & Marino, 2017). Within rehearsals, students often act as- or perform as- the teacher, while others act as students in a mock lesson (Grossman, Compton, Ronfeldt, Shahan, Williamson, 2009). According to McDonald, Kazemi and Kavanagh (2013) like clinical practice, these rehearsals provide rich opportunities for novice teachers to develop their skills with students.

Unlike typical clinical practice, rehearsals usually involve observation by the teacher educator. The educator often facilitates and provides real-time and after-action feedback to the novice teacher. In addition, rehearsals usually are completed in front of

peers. This social learning setting enables teacher candidates to discuss and problem-solve with their peers and/or the instructor. Rehearsals can provide the novice teacher with opportunities for deliberate practice with specific teaching skills. It can also be used as a mechanism to provide specific instructional coaching and other forms of targeted support.

In addition to circumventing many of the challenges of typical clinical practice, rehearsals also have unique capabilities. Unlike in student teaching, during rehearsal, it is possible to pause the interaction (Grossman et al. 2009). Pausing rehearsals can enable teacher educators to highlight an action occurring in the rehearsal, provide feedback, help problem-solve, or facilitate a discussion (Davis et al. 2017). Like clinical practice, rehearsals provide practice-based development to teachers but their unique characteristics afforded by the format add to their value in teacher education.

Technology for Clinical Practice and Rehearsal

As with many professional fields, technology offers promise to disrupt and enhance teacher preparation. Technology in teacher preparation is used to streamline communication, provide additional routes for assessment and data analysis, disseminate information, and improve practice and facilitate rehearsal (Hixon & So, 2009). In recent years, various technologies have been used to facilitate or enhance practice for the purpose of teacher preparation. In a report prepared for the U.S. Department of Education, Dieker, Kennedy, and colleagues (2014) present an overview of the most common technologies in teacher preparation. The report guides those in teacher preparation in their use of technology. The researchers identified podcasts, video case studies, online delivery of content, technology-enhanced supervision and feedback, and teaching simulations as innovative tools in teacher preparation. Described below are the teacher preparation technologies specifically

associated with or supporting clinical practice. While these technologies demonstrate some effectiveness in preparation, simulation may offer the most robust opportunities for practice and rehearsal.

Podcasts

A podcast is an internet disseminated audio recording focused on a specific topic. The podcasts used in teacher education are often coupled with visuals--these are referred to as Content Acquisition Podcasts (CAPS). The use of podcasts and CAPS enables professors to spend less class time lecturing and more time addressing real-life clinical scenarios, facilitating student learning, and discussing practical application and implications of academic content. Research on the use of podcasts and CAPS, in particular, has shown promise as a practical teaching tool used during typical classroom instruction (Kennedy & Thomas, 2012; Kennedy, Thomas, Aronin, Newton, & Lloyd, 2014).

Video Case Studies

Like podcasts, video case studies are often used by professors to provide real-life clinical examples of the academic topics being taught. These case studies usually consist of video footage of real classrooms, teachers, students and/or other education stakeholders or school environments. Video case studies allow professors to speak directly to clinical scenarios that pre-service teachers may encounter in the classroom. Video case studies aid clinical practice by providing additional exposure to real-life situations in a controlled environment. In one study on the effectiveness of the tool a teacher reported “from watching the video, they learned about nuances of the strategy that were not clear from either reading the book or participating in the training” (Dieker, Lane, Allsopp, O'Brien, Butler, Kyger, Lovin, & Fenty, 2009, p188). Video case studies are promising resources that teacher

educators may use to expose pre-service teachers to clinical scenarios. However, exposure to clinical videos alone cannot adequately prepare teachers. Video case studies lack the necessary rehearsal and feedback needed to provide teachers' quality clinical practice.

Technology for Supervision and Feedback

A variety of technologies have been adopted in teacher preparation for supervision and feedback during clinical practice. As discussed earlier, supervision and feedback are vital components of clinical practice in teacher preparation (Buck et al., 1992). The type of technology used is referred to as eCoaching (Dieker, Kennedy, et al., 2014). eCoaching has shown to be an effective tool for improving pre-service teachers' practice through multiple quantitative and qualitative means (Rock, Schumacker, Gregg, Gable, Zigmond, & Howard, 2014) and is expected to become the norm in teacher education (Dieker, Kennedy et al., 2014). Although the authors reported eCoaching as promising, they concluded it must be integrated into theory and practice (Dieker, Kennedy et al., 2014).

Technology Enhanced Teaching Simulations

The most complete technology used to provide rehearsal and support clinical practice in teacher preparation are those technologies used to simulate teaching experiences and provide opportunities for practice. Teaching simulations can span lower- and higher-tech platforms and include mixed reality immersive simulations as well as a variety of role-playing online games designed to simulate clinical experiences. The technologies are used to practice pedagogical skills in a way that does not put real people (e.g., students, parents, or other education stakeholders) at risk. Typically, teaching simulations enable the pre-service teacher to act-as or game-as the classroom teacher while responding to representative classroom scenarios encompassing various pedagogical practices. Simulations can take

many forms, but the technology is often used to create and facilitate learning during a conflict scenario, emergency situation, or clinical setting (Dieker, Kennedy et al., 2014; Kaufman & Ireland, 2016). During simulations, the pre-service teachers must make decisions, utilize effective communication, and apply pedagogical skills to respond as they would in real-life to rectify the situation. Currently research into game-based simulation for teacher preparation is limited. Research into immersive simulations such as Mixed Reality Simulation in teacher preparation is a fertile ground with much left to discover.

Mixed Reality Simulation

Mixed Reality (MR) refers to a continuum that encompasses both Virtual Reality (VR) and Augmented Reality (AR). While VR immerses users in a completely artificial environment, AR overlays virtual objects in the real world. Mixed Reality Simulations (MRS) are technology-enhanced scenarios that merge real and virtual worlds (Milgram & Kishino, 1994). Within MRS, physical and digital objects co-exist and interact in real-time. MRS is often referred to as an immersive technology as it creates the feeling of immersion in a life-like environment. The technology currently used for MR teacher simulations utilizes a combination of immersive virtual environments and human directed in-the-moment puppetry, a model known as human-in-the-loop (HITL). These scenarios simulate environments in which the individual experiencing the MRS must act (Milgram & Kishino, 1994; Ohta & Tamura, 2014).

MRS have a long history of successful use in the military, aviation, and medical fields as they provide ample opportunities for practice. Participants taking part in MR technology-enhanced simulations look-like, act-like, and feel like they would in a real-life environment (Dieker, Kennedy et al. 2014). The immersive quality of these environments

leads to a suspension of disbelief—leaving participants feeling not as if they are pretending or gaming, but that they are actually interacting in a real-life scenario (Dede, 2009; Dieker, Kennedy et al., 2014; Dieker, Straub et al., 2014).

TeachLivE™ and Mursion®

The Mixed Reality Simulation most widely used in teacher preparation across the nation and specifically involved in this study is the technology originally designed as TeachLivE™. TeachLivE™ was created in 2008 through a cooperative effort by a University of Central Florida (UCF) team of education and computer science faculty (Dieker, Straub et al., 2014; TLE TeachLivE™, 2016). The technology utilizes HITL avatar-based simulated environments—meaning those participating in the MRS interact with computer-based, human-controlled avatars acting as students or other education stakeholders. With TeachLivE™, pre-service teachers at UCF delivered mock lessons, honed their content-specific teaching practices, developed their classroom management skills, and practiced new pedagogical skills in a safe and controlled environment. The technology-enabled novice teachers to develop their teaching practice before working with real students.

In 2015, Mursion®, a California-based company, acquired the rights to TeachLivE™ and expanded its use. According to their website, the technology can now be found in over 65 universities globally and is used by 150 organizations operating in 50 countries around the world; the company delivers over 10,000 simulations per week and has been used by over 100,000 learners (Mursion®, 2021, Mursion®, 2020). TeachLivE™ continues to use the technology for research out of the University of Central Florida. Along with expanding access to the technology, Mursion® and its various vendors have developed dozens of new

simulation scenarios for pre-service and in-service teachers. Popular simulations include those used to practice how to teach new content with students, those created to practice specific teaching moves, as well as scenarios of high stakes educational meetings such as IEPs, parent-teacher conferences, principal interviews, and peer feedback routines.

Mursion® has also expanded into other areas in schools of education, including psychological counseling and school-based leadership training.

Relevant Research on Simulation for Teacher Preparation

Although the full impact of this new and promising innovation is yet to be established, MRS's ability to enhance teacher education is clear. Numerous published studies and research have been completed.

The most notable study on Mixed Reality Simulation for teacher training was a national research study completed by Lisa Dieker, Charles Hughes, Michael Hynes and Carrie Straub in 2017. The study looked at the impact of MRS on High Leverage Practices (HLPs). The large-scale pre- post- quasi-experimental research study included the observation of more than 135 teachers assigned to either an experimental or control group. The study found that participants, after spending four 10-min sessions in the simulator, increased their use of HLPs and the skills gained in the simulator transferred into the teachers' classrooms. The researchers also found that the students in the (simulator trained) teachers' classrooms also made academic gains as measured by a pre-post assessment from the National Assessment of Educational Progress (NAEP). In addition, teachers who were assigned to the simulator were found to ask a larger percentage of higher-order thinking questions in their real classrooms than those who were not assigned the treatment in the simulator. Similar findings were discovered when specifically looking at teachers of math

(Straub, Dieker, Hynes & Hughes, 2014) and science (Dieker, Straub, Hynes, Hughes, Bukaty, Bousfield & Mrstik, 2019).

Along with the large-scale quasi-experimental study, other promising findings on Mixed Reality Simulation for teacher training have emerged. A time-series design study completed in 2016 by Dawson and Lignugaris/Kraft found the use of mixed reality and simulated environments effective at teaching classroom management practices to new teachers—a vital component of teacher education earlier identified as a deficit. The researchers found mixed reality successful at training teachers in “delivery of specific praise, praise around, and error correction” (p. 26), practices identified as key for a positive classroom climate. Mixed reality technology has also been used to instruct preservice teachers in evidence-based reading practice.

In addition, Chini, Straub, and Thomas (2016) found mixed reality technology to be a successful tool to teach physics pedagogy to undergraduate learning assistants. The researchers reported that the mixed reality technology provided an effective and safe environment for the learning assistants to practice a variety of content-related pedagogical skills.

An experimental study by Ely, Alves, Dolenc, Sebolt, and Walton (2018) found classroom simulation improved pre-service teacher knowledge of evidence-based reading practices. In addition, Mixed Reality Simulation was found to be an effective tool to increase teacher self-efficacy in pre-service teachers of science (Gundal & Piro, 2021; Gundel, Piro, Straub & Smith, 2019). Similarly, Bautista and Boone (2015), found Mixed Reality Simulations to improve early-education majors’ self-efficacy beliefs for teaching science.

Beyond published studies, conference proceedings, dissertations, and current research expose a growing field studying the potential of MRS in teacher education. Research by many of the technology's early adopters includes simulation as an effective tool for training teachers in math and science discussions (Mikeska, Kruse, & Prawat, 2020), as well as developing literacy instruction for pre-service educators via the simulator (Elford, James, & Haynes-Smith, 2014) and as a component of a multi-tiered approach to preservice teacher preparation (Wallace & Whitten, 2015). MRS were also found to lower anxiety levels of teachers teaching math (Eisenreich & Harshman, 2014). In addition, a pre-test, post-test control group design found simulation to be a significantly better tool than roleplay for training special education teachers (Spencer, Drescher, Holbrook, Schreffler, & Fulchini, 2018).

Furthermore, Reinking and Martin (2018) found MRS to be a successful tool for teacher candidates to receive real-time feedback on their teaching as well as mentoring. Similarly, in 2020, Cohen and colleagues found that coaching after simulated teaching practice significantly improves teaching skills and significantly impacts teacher candidates' perceptions about student behavior as well as their ideas to address it. These findings are particularly interesting as they focus on supportive elements identified earlier as often missing from or difficult to facilitate in traditional clinical practice.

Simulated Practice in Other Fields

MRS has been used successfully in other clinically focused fields. Most notably, it is used as an educational tool in the aviation, military, and medical fields—with the most prolific integration within the field of nursing. Within these clinically focused fields, the technology is quite diffused.

Military

The military has a long history of using simulation for training (Smith, 2010). Most often used to simulate combat, MRS enables soldiers to practice high-stakes combat moves and procedures in safe and controlled environments. It also allows researchers to study military scenarios in which personnel would likely not survive. Within the military, MRS has been credited with reducing training costs and better preparing military personnel for real-life scenarios (Bukhari, Andreatta, Goldiez, Rabelo, 2017; Smith, 2010).

Aviation

Similar to its use in the military, MRS has a long history in aviation. Although flight simulators have been used to train and practice with pilots since the mid-1920s, more modern uses of MRS continue to be employed. Currently, the field is flooded with competitors, each with its own MRS training tool for operational training and rehearsal (Attariwala, 2019). The technology has been credited with cutting down training costs and enabling pilots to practice scenarios that would be otherwise impossible (Attariwala, 2019).

Medical

Akin to the military and aviation fields, MRS has been found to be a powerful training tool for the medical field. The tool has been used to teach and practice high stakes surgical techniques such as those in neurosurgery (Bova, Rajon, Friedman, Muran, Hoh, Jacon, Lampotang, Lizdas, Lombard, & Lister, 2013) as well as teaching and practicing minimally invasive surgeries (Lacey, Ryan, Cassidy, & Young, 2007). In fact, Mursion® has developed many scenarios for use in the medical field. Their scenarios include those to teach doctors and nurses to effectively deliver bad news to their patients, scenarios to increase the effectiveness of therapy skills of psychologists, scenarios for taking patient

histories, and scenarios that practice debriefing skills for a surgical team. MRS is thought to be a cost-effective alternative to standardized patients, a highly common practice in the medical field (Lavoie & Clarke, 2017; Mursion®, 2020).

Nursing Education. Of all the fields currently utilizing MRS, no field has integrated the technology more than nursing. In fact, nursing education programs that use simulation as a teaching tool grew from just 66 institutions in 2002 to 917 by 2010 (Jason & Hunt, 2015). The use of this technology grew because of the clinical hour requirements placed on nurses. Similar to the clinical requirements for teachers, nurses must complete a specific number of clinical hours along with their academic program for their certifications. In California, for example, nurses must complete 560-clinical hours; for comparison, pre-service teachers in California must complete 600-clinical practice hours. In order to combat the difficulties and barriers in clinical practice found in nursing school programs, the National Council of State Boards of Nurses (NCSBN) recommends that up to 50% of clinical hours be replaced with simulation (Bradley et. al., 2019).

Unlike the thorough integration of simulation into nursing education and the technology's diffusion in other clinically-based professions, teacher preparation has not yet fully integrated simulation.

A Lack of Diffusion of MRS in Teacher Preparation

Despite the promise of the technology, as of October 2020, MRS is only available in 4% of teacher preparation programs nationwide, or 52 of the estimated 1,200 programs. It has not yet become integrated nationwide and is currently being used by its original innovators and some early adopters. Within the early adopter programs, the technology is being used in different ways with differing methodologies, contents, rates, and with different

student populations. Anecdotally, much effort is being doubled and tripled because there is no communication or sharing across programs nor routes for collaboration. Although MRS researchers share study findings through formal routes such as publications and conferences, few or no communication networks exist to describe how the technology is used clinically to train and prepare teachers for the field. Applying the Diffusion of Innovation theory, without a thorough understanding and communication of the behaviors of the innovators and early adopters of MRS in teacher preparation, the technology is not likely to further diffuse or may diffuse more slowly than it might otherwise.

Preliminary Fact Findings

During preliminary fact-finding research for this study, I interviewed seven leaders of simulation at various institutions of higher education across the United States—innovator, early adopters of MRS for teacher preparation. I also met with three key informants.

Through those informal interviews and meetings, I discovered immense variabilities across programs:

- One university uses MRS in their undergraduate teacher preparation program, with one or two simulations per semester delivered in a fishbowl modality—where one student teaches within the simulator while other students watch and provide feedback.
- Another university utilizes the technology in most of their teacher education courses, but the technology is delivered solely online where students log in to the virtual platform alone from their personal computer to practice teaching.
- Yet another university, utilizes MRS to bridge theory and practice across multiple teacher preparation courses. Here, the technology serves as a

mechanism to monitor and assess teacher candidates' growth as a teacher over their time in the program, as well as an effective feedback tool for mentors.

- At yet another university, all simulation scenarios are video recorded and then studied by the teaching candidates themselves as well as the teacher educators in order to provide mentoring and feedback.

Each of the teacher education programs utilized MRS according to their specific needs and/or situations. And although some of the early adopters were aware of their colleagues' use of the technology or their research, none had a thorough understanding of what was happening within other MRS-using teacher preparation programs. As a result, many had spent time and effort developing scenarios, modalities, and resources that had already been developed at other universities.

Researching and ultimately communicating the ways in which MRS is being used by teacher preparation programs would streamline efforts among early adopters. In addition, it would work to inform the broader teacher education field. My own university has been looking to integrate MRS for several years but has not been able to do so in any substantial way.

MRS is a tool that improves teacher education, specifically by providing more opportunities for clinical practice. It would be beneficial for my home institution and the other 96% of teacher preparation programs that have not integrated MRS to learn from those that have. In order to further diffuse the innovation into the broader teacher education landscape, the behaviors of the early adopters of the technology need to be studied.

Diffusion of Innovation Theory

According to the Diffusion of Innovation (DoI) theory, the 4% of schools that have integrated Mixed Reality Simulation are considered innovators and early adopters.

According to Rogers (2003), the first 2.5% of consumers of an innovation are innovators, and the first 13.5% are early adopters. Thus, all 52 institutions that have adopted MRS would fall into one of those two categories depending on when they first adopted the technology. The DoI theory seeks to explain why, how, and at what rates technology and new ideas spread (Rogers, 2003). The theory posits that studying and communicating the behavior of innovators and early adopters can act to inform and persuade others (considered the early majority, late majority, and laggards) to take on the innovation. In order to report on the behavior of early adopters, this study will rely on data obtained from the leaders of MRS from early adopter teacher preparation programs. The data garnered in this study will be used to communicate and ultimately guide the further diffusion of MRS to others in the teacher education field.

Summary of the Chapter

Chapter two, a review of the literature, revealed the need to study the early adopters of MRS within teacher preparation programs. By first demonstrating the necessity of clinically well-prepared teachers, then describing teacher preparation's current challenges in clinically preparing teachers, I established the need for more practice, rehearsal, and support. I then detailed current and historic interventions that have attempted to address the challenges in teacher preparation's clinical practice. I then described promising technologies used in teacher preparation to facilitate practice for teachers—the most promising of which is Mixed Reality Simulation. The chapter then explained MRS, providing definitions and

examples within teacher education as well as providing an overview of research in the field of teacher education and other clinically focused professional fields. I then described the current state of MRS in teacher preparation, exposing a small yet diverse field. The chapter concluded with an overview of the Diffusion of Innovation theory. The theory contends that communication channels stemming from early adopters, such as the early adopters of MRS in teacher preparation, will help to spread the innovation to others. The DoI theory gives clear instruction to garner information from the early adopters as a means to ultimately diffuse simulation to other teacher preparation programs. Such diffusion will provide more opportunities for practice and rehearsal in teacher education and ultimately help to make more prepared teachers who will stay in the profession and have greater positive impacts on student achievement.

CHAPTER THREE: METHODS

Introduction

Mixed Reality Simulation (MRS) is an emerging technology that may improve teacher preparation by providing additional opportunities for candidate practice and rehearsal. While the technology is well-diffused in a variety of clinically-based fields it is only available in 4% of teacher preparation programs nationwide. Within those early adopter and innovator programs, the MRS is being used in different ways with differing methodologies, contents, and student populations.

This mixed methods study sought to learn how Mixed Reality Simulation is being used in teacher preparation programs as well as discover how leaders of simulation at the MRS-using institutions perceive the technology for teacher preparation. As simulation has proven to be a powerful resource to provide clinical practice, this study will inform the teacher preparation field and ultimately seeks to advance the training of teachers in the United States. The study sought to answer the following research questions, sub-questions, and foci:

Research Questions and Sub-questions

RQ1: How is Mixed Reality Simulation being used in teacher preparation programs?

1. To what extent is simulation being used in teacher preparation programs?
 - a. Number of hours, number of students exposed, percent of course integration
2. In what ways is simulation used in teacher preparation?
 - a. Types of scenarios, modalities/delivery methods, focus skills, types of applications, goals, assessment of goals, vending

3. How is MRS funded at the institution?
4. How has MRS use changed over time?
 - a. How did MRS start at the institution? How was the use of MRS spread or grown? In what ways has simulation usage changed, if at all, in relation to school shutdowns during the COVID-19 pandemic?

RQ2: How do the leaders of simulation at MRS using institutions perceive the technology for teacher preparation?

1. How do leaders of simulation perceive the benefits of specific scenarios?
2. How do leaders of simulation perceive the benefits of specific modalities?
3. What do leaders of simulation perceive as challenges to using the technology?
4. What do leaders of simulation perceive as positives of using the technology?

Research Design

I implemented an explanatory sequential mixed methods research design. This design involved collecting survey data in the first phase of the study and then built on those results in the second phase, the one-on-one interviews. The quantitative phase “informed the types of participants to be purposefully selected for the qualitative phase” (Creswell & Creswell, 2018, p. 222). As such, the survey data—specific information on simulation usage—served to inform which programs were chosen for the purposeful sample interviewed in phase 2. Following the analysis of the survey data, I identified and interviewed four leaders of simulation from four MRS using institutions. One interviewee led an MRS program that exemplified typical simulation use and three interviewees led simulation programs that exemplified atypical use.

A survey design in phase one of the study was appropriate and useful to answer the research questions and sub-question involving simulation use including scale, percentages, frequencies, degrees of use, and perceptions across many sites currently using MRS in teacher preparation. This data collected in this phase speaks broadly to the state of the field. The one-on-one interviews in phase two more deeply investigated the perceptions and opinions of leaders of simulation and described variances in use across programs. Thus, an explanatory sequential

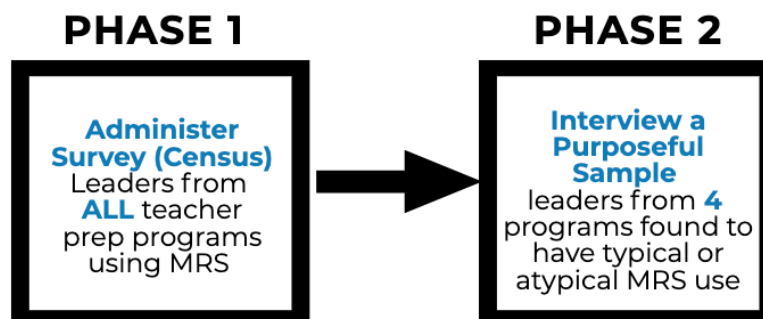


Figure 2: Research Design

Figure 2: Research Design, was an appropriate method to examine the current use of simulation nationally as well as gain a deeper understanding of how the technology is being utilized. As this study aimed to incorporate users from all U.S. institutions of higher education currently using simulation, a purely qualitative study could not adequately capture its breadth. Similarly, a solely quantitative design could not thoroughly describe the perceptions of simulation leaders related to the research questions.

Data Collection Methods

Survey

For this explanatory sequential study, first, a survey was created following the principles of survey design provided by Fowler (2014). See: Appendix A: Survey Instrument. The survey was created and distributed via Qualtrics, an online platform, and distributed to all leaders of simulation in teacher preparation programs in the United States (i.e., the individual staff or faculty member at an institution responsible for the

implementation of simulation at the site). The population consisted of 52 individuals at the 52 programs that have integrated simulation in teacher preparation (i.e., programs that have written simulation scenarios into their curriculum scope and sequence—enabling teacher candidates to take part in simulation during their tenure in the program).

Most of the individuals who completed the survey did so in under 30 minutes. The survey's questions primarily focused on simulation usage within the teacher preparation program, including questions on frequency, modality, student population, scenario content, changes in simulation use related to COVID-19 school shutdowns, as well as questions about the leader's perceptions of the usefulness of simulation scenarios and modalities. The survey also included open-ended questions regarding when and how the simulation began in the program, how it was diffused, and how it is being led in order to inform the interview questions and further inform the selection of interviewees for the second phase.

The survey instrument was divided into eight sections or “blocks.” The eight sections included:

1. Informed Consent
2. Screener
3. Demographics
4. Level of Adoption / License
5. Simulation Use-Content
6. Simulation Use-Modalities
7. Simulation Use-COVID-19
8. Open-Ended

Open-ended questions were also included throughout sections four, five, and six of the

survey. These questions asked respondents to elaborate on their reporting in each section.

Appendix A: Survey Instrument

Section one, Informed Consent, informed the respondent of the survey's purpose, disclosed the identity of the primary investigator, and determined consent. If consent was not affirmed, the survey ended. The next section, the Screener, determined if the person taking the survey was qualified to do so based on simulation usage within their teacher preparation program, the respondent's role, and their level of knowledge of simulation usage. If the respondent did not identify as qualified to take the survey based on their perception of their ability to answer questions about simulation use in their program, the survey ended.

The next section of the survey solicited information about the respondent's institution. This section included questions about the institution's location (by U.S region), Carnegie classification, size of the education program at the institution, and questions about the students that experience simulation at the institution. The next section—Level of Adoption / License—asked questions about the institution's level of adoption, funding sources, and perceptions of simulation experience overall.

The Simulation Use- Content section included multiple-selection questions about frequency and perception of simulation scenarios. Thirteen of the 16-items in these questions represented the most often referenced scenarios brought up by simulation leaders during the preliminary, fact-finding interviews I conducted before this study, lists found in Mursion® documents, and scenarios found on Mursion® vending institutions' documents. The remaining items offered "other," with a corresponding fill-in-the-blank section to capture any scenario(s) not included in the original list. The first two questions in this

section included matrix-type tables with Likert-type scales yielding ordinal data on scenario frequency. The Likert-scale included four categorical scale points written as “Frequently used,” “Somewhat used,” “Minimally used,” and “Not used.” Participants were asked to report the frequency of each of the original 16 items on the scale across two separate questions. The section then inquired about the leaders’ perceptions of benefit to teacher preparation students for each scenario—grouping the 16 items into one of five groups. The five groups labeled with “Most beneficial,” “Somewhat beneficial,” “Least Beneficial,” “No Experience,” and “Harmful.” Following this question, there was an open-ended question asking why certain scenarios were more beneficial than others. Section six also contained open-ended questions asking respondents to elaborate on their answers.

The next section, Simulation Use-Modalities, sought to discover how students experienced simulation. It investigated the ways that MRS is delivered to students, the population of students that experience simulation, and the amount of simulation used in the teacher preparation program. This section asked multiple-choice, multiple-selection questions as well as questions yielding percentage, and open-ended questions on simulation scale yielding numeric, continuous data. This section also contained open-ended questions asking respondents to elaborate on their answers.

Section seven of the survey instrument sought to answer the research sub-question dealing with the extent of changes in simulation usage, if any, associated with school shutdowns during the COVID-19 pandemic. This section included multiple-choice questions, multiple selection questions with Likert scales, and open-ended questions.

Section eight of the survey instrument contained open-ended questions about simulation usage, implementation, and leadership. This section was designed to inform the

interview questions involved in the second phase of the research.

Interviews

Following the survey, I conducted interviews with a purposeful sample of the leaders of simulation from four simulation-using teacher preparation programs representing a range of use cases. The criteria for phase 2 selection emerged from the survey data. Analysis of the survey data identified one institution with typical simulation use and three institutions with atypical or “special” use (See: [Site Selection Criteria and Rationale](#)). Four interviews were completed; one from each of the three institutions with atypical use, and one from the institution shown to have typical use. In order to triangulate the data collected in the interviews, documents were collected and analyzed from each of the interviewees. The documents collected included simulation schedules, syllabi, simulation rubrics, and other documents pertaining to MRS use at the institution.

The selected interviewees took part in a neo-positivist, semi-structured interview. This type of interview was an appropriate choice as it allowed me to both gather the information desired and respond to the emerging information from the respondent while also maintaining a neutral stance in order to minimize bias (Merriam & Tisdell, 2016). Each interview lasted just over one hour.

The structured interview questions were aimed both at confirming the survey findings and diving more deeply into them. As the interview was semi-structured, the protocol included a variety of scripted open-ended questions (See: [Appendix B: Interview Protocols](#)). The questions asked about how simulation began in the teacher preparation program, the intent, goals, and assessment of the integration, changes made during its tenure, and challenges that have surfaced. Questions about leading simulation were also

included and focused on techniques used to diffuse the technology, such as demonstrations, studies, and partnerships. I also asked about the interviewee's perceptions of the simulation and its capabilities to train new teachers. I asked questions about changes in use during school shutdowns related to COVID-19 and the leader's perceptions about the future of simulation in teacher preparation. In addition, I included questions dependent upon the individual's answers to the survey. These questions sought to elaborate on the survey findings—describing and/or confirming common uses and/or explaining deviations from the norm. These additional questions were especially prevalent during the interviews with the leaders found to have atypical, “special” or aspirational use of the technology.

The interviews occurred and were recorded synchronously over Zoom, an online video platform.

Data Analysis

Survey

The analyses of survey data focused on obtaining basic descriptive statistics such as frequency distributions, means, and standard deviations (Creswell & Creswell, 2018). In addition to the basic descriptive statistics of the overall data sets, I completed analyses based on the level of use (e.g., low, medium, and high users of MRS across the other variables). Use levels were determined using a combination of three “extent of use” variables: number of hours used annually, percent of students exposed to the technology, and percent of course integration. See: Table D: 1 Categories to Influence Use

In addition to the statistical analysis of the survey data garnered in sections three through five, I analyzed and coded the answers to open-ended qualitative questions. I made notes on themes and trends, categorizing and coding each open-ended answer in an Excel

spreadsheet. The themes and trends I found in this data are elaborated on in chapter four and I used this data to further inform my subsequent interviews as well as help create categories for the analysis of the interview data.

Interviews

I listened to the audio-recorded interviews prior to transcription to provide initial opportunity for analysis. While I listened to the interviews, I recorded notes on emerging themes or trends I noticed. The interviews were transcribed through Rev.com, a high-quality transcription service. Following the transcription, I reviewed the transcripts for accuracy. All interviewees were sent the transcripts for member checks. I read the transcripts and listened to the interviews multiple times, wrote notes on what I saw, and developed tentative ideas about categories and relationships. Although I was open to unanticipated trends emerging from the qualitative data, I primarily used the information previously established from the survey data to create the categories for which to code the data. After all of the categories were finalized, the transcripts were reviewed again and coded according to the established categories.

Site Selection Criteria and Rationale

For the first phase of this study, I took a census approach, inviting all known members of the population—all known leaders of simulation at all U. S. institutions of higher education which have integrated Mixed Reality Simulation into their teacher preparation program. In order to be eligible for the study the leader must come from an institution that is:

- in the United States
- actively engaged in teacher preparation or teacher education

- using MRS with teacher candidates/novices as a part of their education program.

Access

In order to avoid conflict of interest and credibility and validity issues, I originally worked outside of my professional connections within Mursion® (the for-profit company behind MRS in teacher preparation) in order to gain access to the majority of my study's population. Instead, I utilized public documents located on the Mursion® website to create a master list of possible survey participants.

I then added to the master list the programs working with TeachLivE™ —the non-profit, university-based original creator of the technology now owned and primarily operated by Mursion®. As this group continues to do research and development with the technology, I wanted to explore their partners' eligibility for the survey. This list was public on the TeachLivE™ website. Simultaneous with this process, I began emailing the points-of-contact in each of the programs on the master list to learn if simulation was being utilized for teacher education. At this stage, a few of my points-of-contact referred me to other individuals who had taken over the work. In addition, some contacts informed me they were vending the technology to other universities and subsequently referred me to contacts at other universities who were also using the technology.

These steps yielded a list of 110 entities using MRS. Of these, 52 were judged to be in the population of interest: institutions of higher education in the United States that are involved in teacher preparation and currently using MRS. The remaining 58 entities were excluded (13 using MRS solely for research, one state department of education, five public school districts, four for-profit companies, five institutions that had previously used MRS

but had stopped, six institutions outside the United States, and 23 institutions using MRS outside of teacher preparation, and one was my home institution).

In the end, I identified 52 leaders of simulation by name and email from the 52 institutions in the United States known to be using MRS in teacher preparation. Their status as leader of simulation was confirmed from the public facing website of their institution, vetted by a professional contact at Mursion® as a primary point of contact for MRS at their institution, and then confirmed by self-identification.

Recruitment

The 52 leaders received a personal link to the Qualtrics survey (See [Appendix C: Recruitment, Reminder, and Thank You Emails](#)). The purpose of the personal link was to ensure alignment between the demographic information of the teacher preparation program and the data collected, as well as cut down on the time it would take the participant to enter that information themselves. Those recipients who did not respond to the email received a reminder email (See: [Appendix C: Recruitment, Reminder, and Thank You Emails](#)). Those individuals who completed the survey were sent a “Thank You” email with a \$5.00 gift card code to Amazon.com (See: [Appendix C: Recruitment, Reminder, and Thank You Emails](#)).

The study’s interviewees were a purposeful sample selected from the survey respondents, See [Figure 2: Research Design](#). The sample consisted of one individual leading simulation in teacher preparation programs identified as having typical use and three individuals from programs with atypical use. The typical use institution was identified through a combination of variables. (1) percentage of courses with integrated simulation (Q 3.5_1), (2) percentage of students who experience simulation (Q 3.5_2), and (3) the number of simulation hours used annually (Q3.6). Consideration of the schools’ teacher preparation

program size (Q3.3) and Carnegie class (Q3.2) was also taken. I chose the one school whose program was the closest to the average, or most close to typical in those categories.

Following the identification of a typical use case, I chose three atypical use cases to interview. These atypical use cases represented cases identified to be interesting or aspirational of the entire sample. Atypical cases were discovered after analysis of the quantitative and qualitative survey data. (See: Chapter 5 Purposeful Sample).

Interviewees were recruited through the survey, with a specific question (See Appendix A: Survey Instrument), asking participants if they are willing to be interviewed. Those individuals who had self-identified as willing to be interviewed, and were identified by the data collected in Phase 1 as a purposeful sample were sent an Interview Recruitment Email (Appendix C: Recruitment, Reminder, and Thank You Emails). The four interviewees were sent \$10.00 Amazon gift cards as a thank you after completing the interview.

Validity & Credibility

For the quantitative research design portion of this mixed methods study, issues of internal validity and reliability lied with the survey instrument. As an original questionnaire without previously-established information on its validity, I was responsible for affirming its suitability and the reliability of the data it captures. A significant step taken toward this end was the ten informal interviews and meetings I conducted during fact-finding exercises early in this research process.

The initial fact-finding interviewees included seven leaders of simulation at universities across the country and three key informants including a researcher at Mursion®, one of the original founders of the TeachLivE™ technology, and a member of Mursion®'s board. During the interviews, I took notes on what I was hearing about the history, usage,

diffusion, and future of MRS at the individuals' institution as well as their perceptions of the technology. I used those notes, along with my own knowledge of the technology gained from my experience using MRS over the past eight years to formulate the survey questions.

With specific regard to the validity of constructs measured in the study (e.g., modalities, simulation scenario content, student population), the design of the questionnaire will be an influential factor. Once the survey was created in Qualtrics, it was cognitively tested by one survey expert, a UCLA faculty member, and one leader of simulation. The survey was reviewed together synchronously over Zoom. The feedback from these reviews informed various edits of the instrument wording, question order, and question type. In addition to reviewing the instrument with survey and content experts, I field-tested my survey at my own university, a university I have excluded from this research because of my affiliation.

Along with issues with the validity of the survey instrument, I also took proactive measures to address the study's credibility. My study is subject to the threat of reactivity. It is possible that simulation leaders—participants in both the survey and interview portions of my study, will tell me what they think I want to hear with respect to MRS at their institution. They may overinflate their use of MRS or not share their true struggles of adopting a new technology.

To address the threat of reactivity I included in my survey consent language about anonymity and truth for the benefit of future simulation leaders. To counteract reactivity during the interviews, the protocol contained information about the confidentiality and protection of the interviewees' identity as they and their institution will remain anonymous. As all participants in this study will remain anonymous during publication and there is no

benefit nor threat of harm for them to engage in the study, it does not seem likely that they would be motivated to misrepresent or overinflate their technology use.

Another threat to the credibility is dependent upon the number of respondents to the survey. As I was unable to procure a complete census, I cannot speak to MRS use by the population. However, my sample was relatively high and adequately representative of the population. See Chapter Four, Table 1: Population vs. Sample for details.

The final threat to the credibility of this study is my reliance on one leader per institution to report on the use of MRS. Although not a threat to the credibility of research question two focused on leader perceptions, it is a threat to research question one. It is possible that the identified leader of simulation did not have a complete understanding of the current use of simulation at their institution or does not report honestly. Attempts to mitigate this issue for survey respondents were taken by making the survey anonymous and vetting the individual's status as leader of simulation through multiple measures. In addition, I worked to mitigate this issue during the interview by collecting documents from the interviewees and their institutions that confirmed their statements.

Role

When I contacted individuals and collected data for this research I did so as a UCLA graduate student researcher. Nevertheless, I am the leader of simulation at my home institution, and this information is easily available through a Google search. It is reasonable to assume that some participants developed an understanding of my role. However, my institution is not a "big-player" within the community of simulation. I do not believe that my positionality caused any issues. In addition, I have no formal association with Mursion® or its partners, and thus I have no affiliation conflicts.

Chapter Summary

This study sought to discover the ways simulation is used in teacher preparation as well as how leaders of simulation perceive the use of MRS for teacher preparation. I conducted an explanatory sequential mixed methods design to complete this research. The study yielded quantitative and qualitative data garnered through survey. These data were analyzed with basic descriptive statistics and coded, which spoke to extent of simulation use, type of use and delivery, and perceptions. The study also yielded qualitative data from semi-structured interviews of the leaders of simulation in teacher preparation programs utilizing the technology in varying ways.

CHAPTER FOUR: PHASE ONE RESULTS—THE STATE OF SIMULATION IN TEACHER EDUCATION

Introduction

This chapter contains the results of phase one of the study—the survey. This chapter provides quantitative and qualitative data collected from the sample answering the following research questions:

RQ1: How is Mixed Reality Simulation being used in teacher preparation programs?

RQ2: How do the leaders of simulation at MRS using institutions perceive the technology for teacher preparation?

For a complete list of the research questions, sub-questions, and foci, see Chapter 3

Introduction

Characteristics of the Sample

The survey population aimed to be a census. A recruitment email was sent to leaders of simulation at the 52 institutions known to use MRS in teacher preparation (Appendix C: Recruitment, Reminder, and Thank You Emails). Of the 52 eligible points-of-contact, 42 took the survey. Of the 42, 40 respondents completed the survey, one completed 80% of the survey and one completed 12%. The survey respondent who completed 80% of the survey was kept in the sample, the respondent who completed 12% was excluded. In total, three recruitment and survey reminder emails were sent over a period of four weeks from October 9, 2020, to November 6, 2020 (Appendix C: Recruitment, Reminder, and Thank You Emails). Although not a true census, the survey response rate was high, at 41 of 52 institutions, just above 79%. The 79% was extremely similar to the population in regard to

demographics (location, Carnegie Class) and thus the sample was representative of the population. See: Table 1: Population vs. Sample

Table 1: Population vs. Sample				
	Population n= 52		Sample n= 41	
Location	Freq	%	Freq	%
West	6	12	6	15
South /Southeast	13	25	9	22
Northeast	22	42	18	44
Midwest	10	19	8	19
Carnegie Class	Population n= 52		Sample n= 41	
Doctorate-granting University	29	55	23	56
Masters College or University	15	28	11	27
Baccalaureate College	8	15	6	15
Not Classified	0	0	1	2

Describing Levels of Use in the Sample

Institutions were divided into low, medium, and high use categories based on a variety of key “extent of use” variables. These categories were created using a combination of the following variables: (1) percentage of courses with integrated simulation (See: Appendix A: Survey Instrument Question Q3.5_1), (2) percentage of students who experience simulation (Question Q3.5_2), and (3) the number of simulation hours used annually (Question Q3.6). Each of the three variables was analyzed individually and the survey respondents’ institutions were divided equally into three levels of use groups designated by cut scores at the 33rd and 66th percentile. Thus, institutions were determined low (1), medium (2), and high (3) across each variable (percentage of courses, percentage of students, and total hours used annually). The institutions’ scores across the three variables were then averaged and grouped into the three categories of low use, medium use, and high use institutions. At the end of the grouping, 12 programs were designated low use, 16 were designated medium use, and 13 were designated as high use institutions. It is vital to note

that MRS using institutions chose to adopt MRS for a variety of reasons and have differing goals and objectives. Classifications of use as low- medium- and high- are normative and do not connote absolute criteria nor hierarchy or value. The purpose of providing these classifications was to look more deeply at the diversity of use and experience across programs. High use institutions do not imply better use. For more details on the variables that influenced the categories of use, see Appendix D Table D: 1 Categories to Influence Use

Demographics of the Sample

MRS using programs are found across all regions of the United States, and range in size and class. Section three of the survey yielded data on the demographics of the survey population. In regard to geographic location (Q3.1, n=41), the survey confirmed that MRS can be found at institutions across the United States with more institutions utilizing the technology located in the Northeast (18; 44%). Nine institutions (22%) found in the South/Southeastern region of the US, eight (20%) in the Midwest, and six (14%) in the West for more details see Appendix D Table D: 2 Institution Location

The size of the education programs in the survey population (Q3.3, n=30) varied from 25-students to 3,200-students with a mean size of 753-students and a median

Table 2: Program Size				
What is the approximate size (number of students) of the education program at your institution?				
	Low Use n= 6	Medium Use n= 14	High Use n= 10	Overall n= 30
Mean	958.17	746.07	641	753.47
Median	906.5	325	175	250
Std. Deviation	946.48	743	985	846.802
Minimum	100	30	25	25
Maximum	2700	2000	3200	3200
Sum	5749	10445	6410	22604
25th Percentile	306.25	196	131.25	131.2
50th Percentile	906.5	325	175	250
75th Percentile	999	1475	812	1152.8

size of 250-students. Institutions identified as low use, trended larger, with a mean 906 students, while high use institutions trended smaller with a median size of 175. However, the institution with the largest education program in the survey population was in the high use category.

As for Carnegie class (Q3.2, n=41), 23 (56%) universities using the technology reported themselves as Doctorate-granting Universities, 11 (26%) reported they were Masters Colleges or Universities, six (15%) reported they were Baccalaureate Colleges and one (2%) did not report their classification. For details see Appendix D Table D: 3 Institution Classification

Respondents most often reported purchasing simulation hours directly from Mursion® or TeachLive™. In

regard to type of adoption/licensure (Q4.1; n=40), or how the institution gains access to the technology, 11 institutions in the population (27%) had site licenses; 25 (62%) purchased hours through Mursion®; 3 (8%) vended from another institution; and

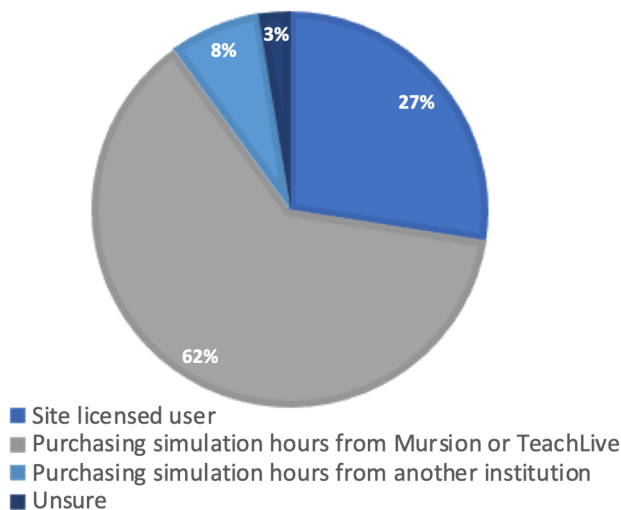


Figure 3: Type of Adoption

one institution (3%) was unsure (see: Figure 3: Type of Adoption). High use institutions were more frequently site licensed users (46%) than medium- or low- users of the technology. The majority of low use institutions (92%) purchase the technology from Mursion®. Appendix D Table D: 4 Type of Adoption.

Programs reported paying for MRS through funds from the Dean’s Office more often than other ways. When asked to report how their institution pays for the technology (Q4.4; n=41), 20 respondents (49%) reported using funds from the Dean’s Office. Thirteen respondents (32%) reported using funds from a grant, 8 respondents (20%) reported using student fees, and 10 respondents (24%) reported other. Within “other,” respondents reported using a variety of resources including campus quality fees, private gifts, curriculum development funds, and funds procured through the Coronavirus Aid, Relief, and Economic Security (CARES) Act. See [Table D: 5 Funding](#).

Extent of MRS Use

This section of the survey asked respondents to describe the extent to which they have integrated MRS into their programs. These questions focused on the number of hours, the percent of students exposed to the technology, and the percent of courses with MRS integration.

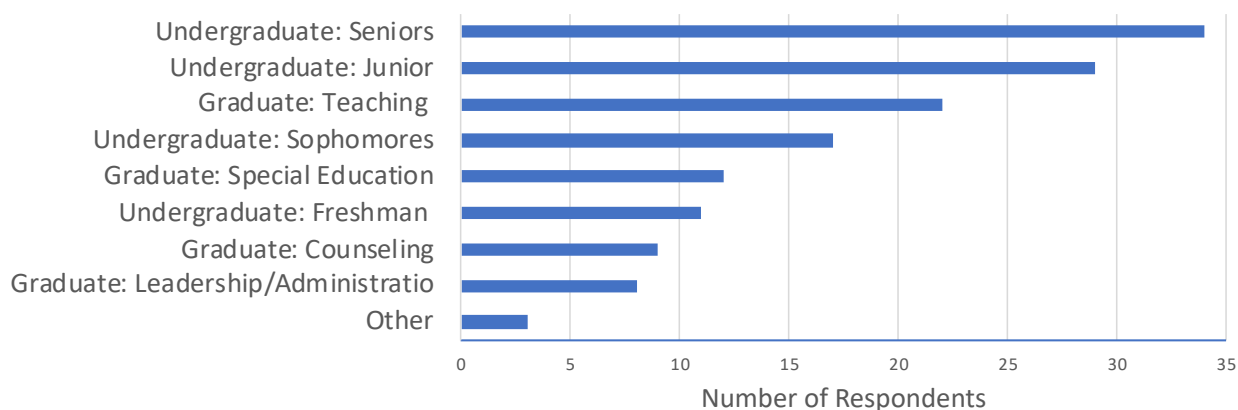
On average, 43% of teacher preparation students at the respondents’ institutions experience MRS each year. The survey asked respondents to report the percentage of students that were exposed to the technology each year (Q3.5_2). Respondents reported a range from 0% to 100%, see [Table 3: Percentage of Students Experiencing MRS](#) for details. Overall, the sample reported an average of 43% of their teacher education student body experiencing MRS at least once a year. Low use programs on average exposed 11% of their student body to the technology, with a median of 10% and a maximum of 50%, and a minimum of 0%. It is unclear whether the reporting of 0% is an accurate depiction, or respondent error as the two institutions which reported exposing 0% of their students, reported that they did use MRS with students in other questions, one reported that MRS was

integrated into 10% of coursework and both reported using more than the average hours annually. Institutions designated medium use reported an average exposure of 45% of their students, with a median of 40%, a minimum of 10%, and a maximum of 95%. High use programs exposed an average of 71% of their students to the technology at least once every year. They reported a median exposure of 78%, a minimum of 25%, and a maximum of 100%. Overall, five programs reported exposing over 90% of their students to MRS annually, with one program reporting 100% exposure. The leader of the 100% exposure program was interviewed in phase 2 of this study.

Table 3: Percentage of Students Experiencing MRS				
Approximately what percentage of students in your teacher education program experience at least one simulation at your institution each year?				
	Low Use n=12	Medium Use n=16	High Use n=13	Overall n=41
Mean	10.73	44.77	70.67	43
Median	10	40	77.5	40
Std. Deviation	14.53	27.62	23.47	32.95
Variance	211.22	763.02	23.47	1086.01
Skewness	2.2	0.82	-0.62	0.331
Std. Error of Skewness	0.22	0.616	0.63	0.39
Kurtosis	5.83	-0.482	-0.47	-1.26
Std. Error of Kurtosis	1.28	1.19	1.23	0.39
Minimum	0	10	25	0
Maximum	50	95	100	100
25th percentile	1	25	57.5	15
50th percentile	10	40	77.5	40
75th percentile	15	51	86.5	76.25

Teacher education programs reported exposing undergraduate juniors and seniors to MRS more frequently than other groups. In addition to asking about the percentage of students, the survey asked about the students exposed to the technology (Q3.4; n=41). The majority of programs across use levels reported exposing their undergraduate junior- (29; 71%) and senior-level (34; 83%) students to the technology, shown in [Figure 4: Students Exposed to MRS](#). Programs also frequently (22; 53%) reported exposing their

Figure 4: Students Exposed to MRS



graduate-level students in their teaching program. For additional details, see Appendix D

Table D: 6 Students. Table D: 6 Students

On average, respondents reported simulation integrated into 21% of their education courses. In regard to simulation integrated into the programs' courses, survey respondents (n=41; Q3.5_1) reported a wide range of use with most programs at the low end of use. Figure 5: Course Integration, shows that 69% of respondents (28) reported

integrating simulation into 0%-

20% of their education courses.

Of those, one institution reported

no simulation integrated into

coursework (0% integration). As

shown in Figure 6, 19% of

respondents reported having

MRS in 21% - 40% of their

courses, 10% of respondents

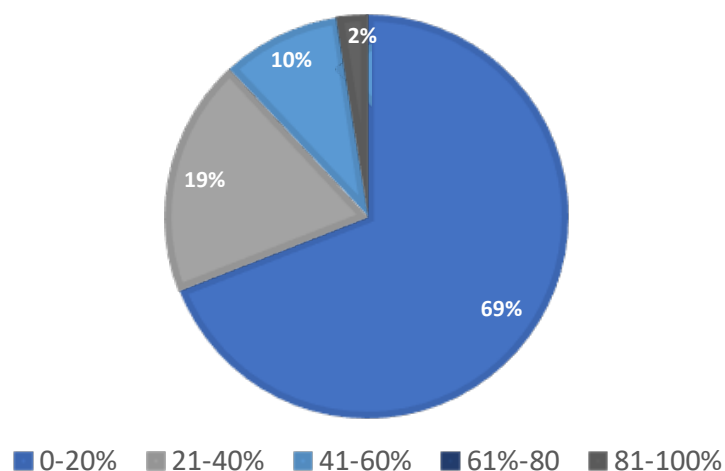


Figure 5: Course Integration

reported integrating MRS into 41- 60% of courses and 2% (one institution) reporting reported integrating simulation into 100% of their courses, no program reported integration between 61% and 80%. Although a teacher preparation program, the institute that reported 100% course integration is a non-profit alternative teacher preparation program and not part of a traditional university. Overall, the survey sample reported MRS integrated into an average of 21% of their program's courses with a median percentage of integration of 17%. See Appendix D Table D: 7 Percent of Course Integration

On average, programs reported using 88 hours of simulation annually, although the range of hours varies greatly. The survey asked respondents about the number of hours used every year (Q3.6; n=35). As shown in Table 4, the annual use of simulation hours ranged from a reported five hours annually to 1,200 hours. The respondent that reported five hours of annual use noted in the survey that they had planned a large increase in use this year, but that they were not able to do so because of COVID. Overall, MRS using institutions reported using an average of 88-hours per year. However, this average was skewed larger by the maximum, a single school outlier. The median number of hours used overall was 40 hours annually and the most frequent number of hours (mode) reported was 30 hours annually. Institutions designated as low use, averaged 31 hours annually, with a median of 30 hours, medium use institutions averaged 57 hours with a median use of 35 hours, and high use institutions averaged 180 hours annually with a median of 64 annual hours. In total, the survey respondents (n=34) reported using 3,002 MRS as their combined annual sum.

Table 4: Number of Hours Used Annually				
Approximately how many hours of simulation does your institution use annually?				
	Low Use N=11	Medium Use n=12	High Use n=11	Overall n=34
Missing	1	4	2	7
Mean	31.182	56.917	179.636	88.294
Median	30	35	64	40
Std. Deviation	14.365	65.307	343.231	203.494
Minimum	5	8	12	5
Maximum	50	250	1200	1200
Sum	343	683	1976	3002
25th percentile	22	27.5	35	30
50th percentile	30	35	64	40
75th percentile	41	52.5	135	60

Number of minutes used per student annually. In order to have a more complete understanding of the respondents' extent of use, multiple variables were analyzed together. Each programs' reported school of education size (Q3.3), was divided by their reported percentage of student exposure (Q3.5_2). This yielded the approximate number of students exposed to MRS annually at each institution. The number of students was then divided by the number of hours reported (Q3.6 converted to minutes). The numbers were then analyzed by use level. Low use institutions exposed each of their MRS-using students to an average of 18-minutes of simulation annually, medium use institutions averaged 37-minutes annually, and high use institutions averaged 88-minutes annually. Overall, the average student exposed to MRS experiences 55-minutes of simulation per year. It is important to note that 18 of 41 institutions were excluded from this analysis, as they were missing data from at least one of the three categories. Nine of the missing institutions came from the low use category. See Appendix D Table D: 8 Annual MRS Minutes Per Student

A few institutions vend the technology to other institutions; more are interested in pursuing that model. When asked if their institutions vend the technology to other institutions (Q4.2; n=40), seven institutions (18%) reported that they did vend the technology, an additional three indicated in the open-ended section answer that they were interested in vending the technology to other universities and programs in the future. See Appendix D Table D: 9 Vending.

Simulation Structure, Scenarios & Delivery

The next section of the survey asked respondents to describe how students experienced MRS. These questions focused on modalities, structure, scenarios, and environment.

More programs use simulation with individual students in front of a class or large group than other modalities. For the question about experiencing simulation (Q6.1, n=41), respondents were asked to select all that applied from the following modalities: individually in front of the class or large group; individually alone; in partners; in small groups; in small groups in front of a class or large group; or other with a fill in the blank section. Thirty-one programs (76%) reported that students experience simulation individually in front of a class or large group. This type of experience was the most frequently reported across use levels. Twenty-one programs (51%) reported students experiencing simulation individually alone. Nineteen programs (46%) reported exposing students to the technology in small groups. Seventeen programs (41%) reported students experiencing MRS in small groups in front of a class or large group. Fifteen programs (37%) reported students experiencing MRS in partners and two institutions (4%) selected “other,” listing: “remotely,” “online” as the students’ experience. Note: these modalities listed as

other were included as options for delivery in a separate question (Q6.2). As shown in [Table 5: MRS Student Experience](#), respondents from low, medium, and high use institutions all reported students experiencing MRS individually in front of a class or large group more frequently than other options. Respondents from medium and high use institutions reported students experiencing MRS individually alone more than respondents from low use institutions.

Table 5: MRS Student Experience								
How do students experience simulation? – select all that apply								
	Low Use n=12		Medium Use n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
Individually alone	3	25	9	56	9	69	21	51
Individually in front of class or large group	9	75	11	69	11	84	31	76
In partners	5	42	6	38	4	31	15	37
In small groups	5	42	8	50	6	46	19	46
In small groups in front of class or large group	6	50	5	31	6	46	17	41
Other	0	0	2	13	3	23	2	5
Other included: remotely, online								

Programs reported using simulation remotely during scheduled class time, in-person during scheduled class time, or remotely outside of scheduled class time. Along with being asked how students experience the technology, respondents (Q6.2; n=41) were asked how simulation is delivered to students and could select all that applied from the following: (1) in-person during scheduled class time, (2) in-person outside of scheduled class time, (3) remotely outside of scheduled class time, (4) remotely during scheduled class time, and (5) other (with a fill in the blank option). As shown in [Table 6: Simulation Delivery](#), remotely during scheduled class time was the most frequently selected (33; 80%), and in-person during scheduled class time was the second most frequently selected (29;

71%). Remotely outside of class time was also frequently selected (28; 68%). Eighteen institutions (44%) reported delivering simulation to students in-person, outside of scheduled class time, and one institution reported “other.” The other was described as: “during summer internships.” Notably, 11 of 12 (92%) respondents from low use institutions reported delivering simulation remotely outside and during scheduled class time. All 13 respondents (100%) from the high use institutions reported using simulation remotely during scheduled class time. It should be noted that this question was asked to respondents during the COVID-19 school shut-downs when most universities were participating in distance / remote learning. The question did not ask about “typical” delivery outside this time. It is possible that institutions reported delivery of simulation, “remotely during scheduled class time” at a high rate because of the school shut-downs and that this is not a typical mode of delivery.

Table 6: Simulation Delivery								
How is simulation delivered to students? -select all that apply								
	Low Use n= 12		Medium Use n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
In-person during scheduled class time	7	58	11	69	11	85	29	71
In-person outside of scheduled class time	3	25	6	55	9	69	18	44
Remotely outside of scheduled class time	11	92	12	75	9	69	28	68
Remotely during scheduled class time	11	92	9	56	13	100	33	80
Other	0	0	1	6	0	0	1	2
Notes: “other” included: "during summer internships" from a medium use institution								

When asked to describe how students experienced simulation (Q6.3; n=34), respondents elaborated on their survey answers in regard to the mode of delivery. One stated:

Traditionally we would take the mobile sim lab into a classroom and we would do them during class time. One at a time, students would come up, do the scenario, and then the next student would come up. With COVID, teachers have started to schedule them both inside and outside of class time over zoom.

This quote details how one school used a simulation lab in a social learning setting for MRS delivery during class time. It also demonstrates how socially distanced learning related to COVID-19 caused a shift in how the technology was delivered to students. Both of these situations were reported often by respondents.

Programs provide a variety of student feedback following MRS. The survey respondents were asked what types of feedback are provided to students during or after they experienced simulation (Q6.4; n=40). As shown in Table 7: Student Feedback, of the options available, “instructor feedback” was most often selected (38; 95%), followed closely by “peer feedback from fellow students” (37; 93%), and “self-reflection” (37; 93%). Data around feedback was fairly consistent across use levels, with 100% of medium use programs reporting the use of self-reflection and instructor feedback. Only one institution reported they do not provide students feedback after simulation.

Table 7: Student Feedback								
What types of feedback are given to students during or after they experience simulation? Select all that apply								
	Low Use n=12		Medium Use n =15		High Use n =13		Overall n=40	
	Freq	%	Freq	%	Freq	%	Freq	%
No feedback	0	0	0	0	1	8	1	3
Peer feedback from fellow students	10	83	14	93	13	100	37	93
Self-reflection	11	92	15	100	11	85	37	93
Instructor feedback	11	92	15	100	12	92	38	95
Other expert feedback (coach or mentor)	1	8	4	27	5	38	10	25
Other	0	0	1	6	1	3	2	5
Other included:					discussion in classroom	feedback from host avatar		

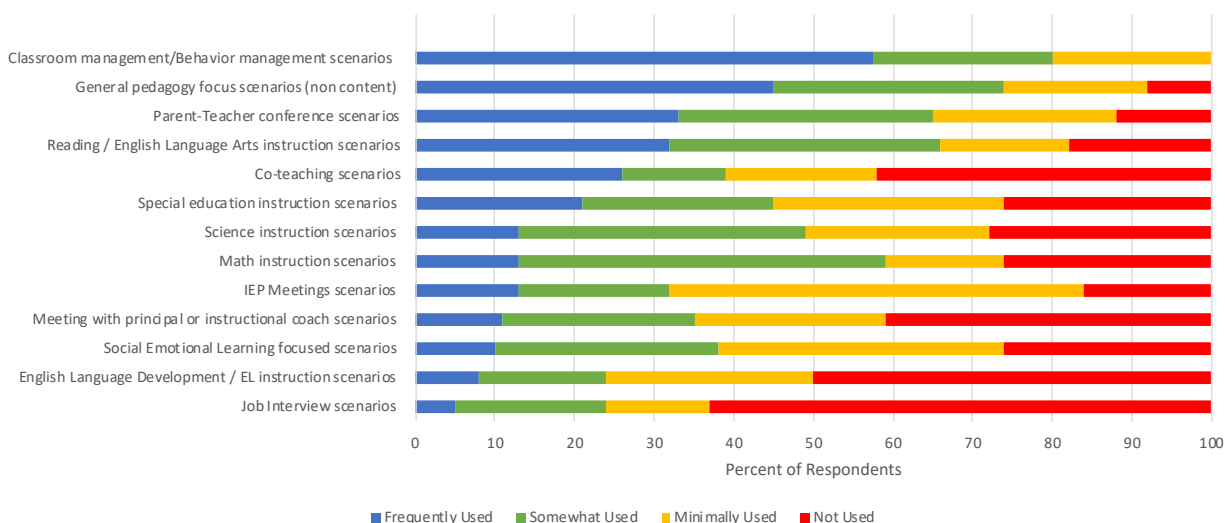
Most programs record simulations at least some of the time; recordings are more frequently used for students' self-reflection than for other purposes. Respondents were also asked about whether the simulations were recorded (Q6.5; n=40) and if so, how they were used (Q6.6; n=31). In total, fourteen respondents (35%) reported they always recorded the simulations, nineteen respondents (48%) reported they sometimes recorded the simulations, and seven (18%) reported they never recorded the sessions. The frequency of recording simulations was similar across use levels. As for how the recordings are used, 19 respondents (61%) reported the recordings are used for student self-reflection. Eight respondents (26%) reported using the recordings as a form of assessment, five (16%) reported using recordings as a tool for peer observation and peer feedback, four (13%) reported using the recordings in class discussions, and four (13%) reported using the recordings for research purposes. For more details, see Appendix D Table D: 10 Recording

Programs reported using classroom management scenarios more frequently than any other scenario. Respondents were then asked to report on the frequency of their institution's use of specific MRS scenarios (Q5.1). Thirteen specific scenarios were listed, and three "other" scenarios were offered with fill-in-the-blank spaces. As shown in Figure 6: Scenario Frequency, respondents were asked to rate their use of each scenario as either: *frequently used, somewhat used, minimally used, or not used*. The scenarios reported as most frequently used were "classroom management/behavior management scenarios." Notably, 100% of the programs that responded to this question (n=40) reported using classroom management scenarios; 23 of the 40 (58%) reported using those classroom management scenarios frequently. Thirty-five of the respondents (n=38; 92%) reported using "General

pedagogy scenarios (non-content).” Those scenarios were reported as frequently used by 17 of the 38 respondents (45%). “Parent-teacher conference scenarios” were reported as used by 34 of 39 (87%) respondents, 13 of the 39 (33%) reported parent-teacher conference scenarios as frequently used. “Reading/English Language Arts instruction scenarios” were reported as used by 31 of the respondents (n=38; 82%); 12 of the 38 (32%) reported using the scenarios frequently.

Content-focused scenarios, including science-, math-, and reading-focused scenarios were the scenarios most often reported as somewhat used. IEP meeting scenarios, Social Emotional Learning scenarios, and English Learner instruction scenarios were most often reported as minimally used. Job interview scenarios were the scenarios most often described as not used. In addition to the 13 scenarios, 21 respondents reported using “other” scenarios; those respondents listed and ranked the frequency of use of an additional 22 scenarios. See Appendix D [Table D: 11 Scenario Frequency 1](#) and [Table D: 12 Scenario Frequency 2](#) for the full list of responses and reports of frequency.

Figure 6: Scenario Frequency



Changes Over Time

The next section of the survey inquired about changes in MRS use over time, with open-ended questions yielding qualitative data on how the program began, what the goals are for the program, how those goals are assessed, and the respondents' beliefs about the future of the technology at their institution. This section also included questions yielding quantitative and qualitative data on the changes brought on by the COVID-19 pandemic.

Respondents most frequently referenced a grant as the reason their institution began using the technology. When asked qualitatively how MRS began at their institution (Q8.1; n=36), 19 respondents (53%) referenced a grant as a major catalyst or contributing factor to bringing the technology to their program. Five respondents (14%) referenced seeing or taking part in demonstrations as a contributing factor, and five respondents (14%) stated that the technology was brought to their program by one individual staff or faculty member familiar with and/or passionate about the technology. One described the beginning of the program this way,

I went to a demo session at a nearby institution and was impressed with the platform, but the equipment needed seemed cumbersome and the cost was astronomical. Then, XXX offered a grant that would pay for 50% of the cost a few years ago. I applied for that and used it for one year. When the grant money ran out, I found another grant on campus called, "Technology in the Classroom," and used that to offset the cost so we could afford to continue using it.

Here the respondent describes how they brought the technology to their institution after seeing it in a local demonstration. Although the respondent wanted to use the technology, they had to find a grant and then another grant to afford the technology.

Along with these common contributing factors, six (17%) respondents reported that factors related to COVID-19 caused their institution to take on the technology, and three respondents (8%) reported the technology coming to their institution through the Special Education Department.

Respondents most frequently referenced better preparing teachers as their primary goal for simulation moving forward; respondents referenced an increase in the use of the technology as how progress toward their goal was being assessed. When asked about their goals with the technology moving forward (Q8.3; n= 38), 19 (50%) respondents referenced better preparing teachers as their primary goal. One stated quite simply, “Our goal is to prepare teachers who are ready on day one.” Eight respondents (21%) reported expanding the program within teacher preparation and/or to other programs in the institution as their primary goal. One reported they were “trying to build a sustainable program by implementing simulation in programs not just in teacher prep but other departments as well.”

When asked how progress toward their goals were being assessed (Q8.4, n=35) seven respondents (20%) noted they were monitoring progress via an increase in the use of the technology. One stated,

At this time, we are simply measuring goals by amount of usage of the platform.

The first year, the platform was minimally used but this year it has increased. We will be seeking additional feedback from students and faculty but at this point, we are just looking at, "Is it being used?"

Here the respondent describes assessing their goal of increased use simply by observing if the technology is being used and if its use increases year to year.

Reporting a more formalized assessment method, six respondents (17%) described using surveys to monitor progress towards their purported goals. Coupling the two descriptions, one respondent stated, “We are measuring minutes of time per student in simulation and using surveys about perceptions of teaching & High Leverage Practices.” Five respondents (14%) said they monitored progress toward their goals in informal ways. Four respondents (11%) reported using student self-reflection as the primary mechanism for progress monitoring. Three respondents (9%) reported using a formal pre- post-analysis and three respondents (9%) stated they had ongoing formal research to assess progress toward their purported goals.

Respondents reported that they believed the future of simulation at their institution would include an increase in the technology’s use; many expressed concerns about the future of funding MRS. When asked about the future of the technology at their institution (Q8.6; n=37), 12 respondents (32%) stated they believed their institution would increase their use of the technology specifically in practical or clinically-based courses. One respondent stated, “I think it will become a staple in our courses that are geared specifically for pre-service teachers (Ed Psych, Methods, Pre-Prac Seminar, Practicum Seminar, English Learners).” Eleven respondents (30%) stated that funding was a concern for the future of the technology at their institution. One stated quite simply, “We are looking for donors for funding. So hopefully we can keep this work going!” Six respondents (16%) believed the future held expansion into other departments at their institution, five respondents (14%) believed their use of the technology would remain consistent, and two respondents (5%) said their use of the technology would likely decrease in the future.

COVID-19 caused changes in simulation frequency, content, and integration

This section of the survey collected quantitative and qualitative data on changes in use and reasons for the change of MRS due to COVID-19.

93% of respondents reported a change in MRS use due to COVID-19 school shutdowns. Of the respondents (n=40) who responded to the question about simulation usage changed during the school shutdowns related to COVID-19 (Q7.1), 37 (93%) answered yes. For details, see COVID-19 Table: 1 Usage. Those who answered yes were routed to a set of questions about what types of changes occurred. The following is a summary of those findings

Many respondents reported an increase in simulation frequency and an increase to the number of students exposed to the technology during COVID-19 shutdowns. Respondents were asked to report how the frequency of simulation had changed in relation to school shutdowns (Q7.2_1; n=35). As shown in Table 8: COVID-19 Use Frequency, overall, 26 (74%) of respondents reported an increase in simulation use. Three respondents (9%) reported simulation frequency stayed the same, and six respondents (17%) reported it decreased. The percentages were fairly stable across levels of use.

Table 8: COVID-19 Use Frequency							
Please report how simulation has changed in relation to school shutdowns related to COVID-19 - The frequency of simulation use							
	Low Use N=11		Medium Use N=13		High Use N=11		Overall N=35
	Freq	%	Freq	%	Freq	%	Freq %
Increased	8	73	10	77	8	73	26 74
Stayed the Same	1	9	0	0	2	18	3 9
Decreased	2	18	3	23	1	9	6 17

Similarly, when asked if the number of students exposed to the simulation had changed as a result of COVID-19 (Q7.2; n=36), 25 respondents (69%) reported an increase

in the number of students experiencing simulation, five (14%) reported the number stayed the same, and six (17%) stated the number of students exposed to the technology decreased. Low use institutions more frequently reported an increase in student exposure than medium or high use institutions. See [COVID-19 Table: 2 Students](#).

As for changes to the population of students exposed to simulations due to COVID (Q7.3_2; n=36), 21 respondents (58%) reported changes in the student population while 42% (15 respondents) reported the student population exposed to the technology stayed the same. These percentages were fairly stable across use levels, see: [COVID-19 Table: 3 Student Population](#).

Most respondents reported changes in student experience of simulation and some reported changes to scenario content due to COVID-19. Respondents were also asked about changes in the ways students experienced simulation (Q7.3_3; n=36) and if any changes had occurred in regard to student feedback (Q7.3_4; n=36). Twenty-nine respondents (81%) reported a change in the students' experience of simulation, and 16 (44%) reported a change in the way students received feedback. These percentages were fairly stable across use levels, though medium use institutions were less likely to report changes in modality or feedback. See [COVID-19 Table: 4 Student Experience](#) and [COVID-19 Table: 6 Feedback](#)

In regard to changes in the content of simulations changing due to COVID (Q7.3_1; n=36), 42% of respondents reported changes in the content of the scenarios, and 58% reported the content stayed the same. These percentages were fairly stable across use levels, with medium use institutions reporting changes least frequently (69%). See [COVID-19 Table: 5 Content](#) and [COVID-19 Table: 6 Feedback](#).

Respondents referenced unchanged clinical requirements as having a lot of influence on their reasons for changes in simulation usage during COVID-19. Along with asking about changes, respondents were also asked to report the reasons for the changes (Q7.4; n=36). They were asked to report to what extent factors lead to the changes on a Likert-type scale that included the following choices: *a lot*, *a moderate amount*, *a little*, *none at all*, and *unknown*. The two most common factors reported having led to changes in simulation *a lot* were: “Aiming to meet unchanged clinical requirements during K-12 shutdowns” (15; 42%) and “Aiming to provide remote practice during higher education shutdowns” (15; 42%). “Aiming to provide teaching feedback during higher education shutdowns was also frequently reported at the *a lot* level (12; 33%). Concerns about funding caused by factors related to COVID-19 were reported to have led to changes *a little* 33 times (92%). See COVID-19 Table: 7 Reason for Change for details of this data.

The respondents were then asked to describe why simulation usage had changed at their institution as a result of COVID-19 in an open-ended question (Q7.5; n=30). Half of the respondents (15 of 30) reported aiming to meet clinical hours or fieldwork requirements otherwise made impossible by the pandemic. One described their institution’s changes like this,

Prior to COVID - each program identified a course to add simulations. Most programs selected a prerequisite course for clinical placements. Once COVID occurred, all K-12 schools closed in March. Therefore, most students needed additional professional hours to become certified and we were advised simulations were accepted.

Here the respondent clearly describes using MRS to replace the required clinical hour needed for certification. Similarly, eight respondents (27%) mentioned COVID-19 causing a fundamental shift in how they were teaching teachers and using the simulations; one described the changes this way:

In the spring semester, we closed down the simulator due to difficulties setting up remote workstations, but they are up and running now. We are now offering more generic practice opportunities to replace missing field observations at a program level and fewer research simulations.

This respondent reported having to stop MRS at the beginning of COVID-19 shutdowns but then starting them back up in the fall. The respondent described using MRS to replace missed clinical practice and using less simulation for research during the shut-downs. Three respondents (10%) described how they felt the change to remote experiences of the technology (specifically over Zoom) weakened the student experience in their opinion.

Findings: The Perceptions of Simulation Leaders

Along with questions about the extent of their MRS use and changes in use over time, respondents were asked about their experience with simulation and their perceptions of various scenarios. This section of the survey was primarily aimed at collecting data to answer research question two in regard to how MRS leaders perceive the technology.

Experience

Respondents (n=39) were asked how they characterize their experience of simulation. As shown in Figure 8, and [Table 9](#):

Perception of Experience all but one of the respondents reported their experience with simulation as positive. The five possible

responses were on a Likert scale, labeled from *extremely positive* to *extremely negative*. The majority of respondents (24 of 39; 61%), rated their experience as extremely positive, 14 (36%) rated their experience as *somewhat positive*, and one respondent rated their experience as *somewhat negative* (3%). No respondents described their experience as *neutral: neither positive nor negative*, nor did any report their experience as *extremely negative*. Respondents from low use institutions and high use institutions were more likely to rate their experience as extremely positive than respondents from medium use institutions.

Figure 7: Perception of Experience

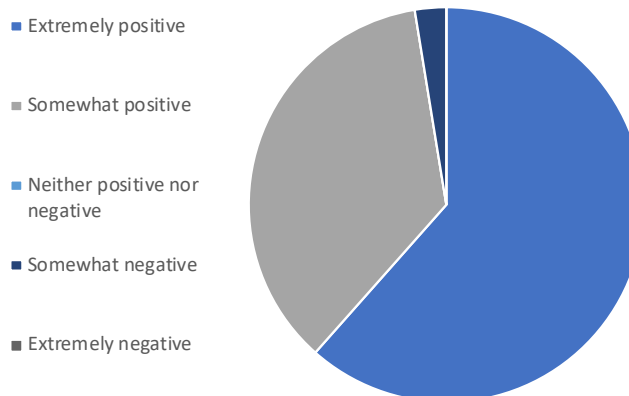


Table 9: Perception of Experience								
How would you characterize your experience of simulation at your institution?								
	Low Use n=11		Medium Use n=15		High Use n=13		Overall n=39	
	Freq	%	Freq	%	Freq	%	Freq	%
Extremely positive	9	81	6	40	9	69	24	61
Somewhat positive	2	18	8	53	4	31	14	36
Neither positive nor negative	0	0	0	0	0	0	0	0
Somewhat negative	0	0	1	7	0	0	1	3
Extremely negative	0	0	0	0	0	0	0	0

Positives

When asked what the most positive aspect of working with simulation is in an open-ended question (Q4.6; n=39), 19 (49 %) of the respondents mentioned opportunities for student practice, and 12 (31%) mentioned the benefits of the “safe space” MRS provided.

One respondent described the positives this way:

The ability to give students an opportunity to sharpen their skills in a low-stakes environment as well as the chance to observe their peers in a teaching role.

Interestingly, students actually find it to be "high stakes" because they are in front of others, so they take it very seriously.

Here the respondent describes the most positive aspect of working with MRS as being able to provide rehearsal to students. The respondent describes the low stakes practice environment while simultaneously reporting that students find the performance aspect of simulation high stakes. Six respondents (15%) mentioned the feedback and reflection opportunities MRS affords as highly beneficial, and six (15%) mentioned how the technology helped mitigate issues during COVID. Along these lines, one said, “... in the era of COVID-19, it has been a viable substitute/supplement for entering schools. It provides a low-risk option for practicing small episodes of teaching.” Here the respondent describes the positives of using MRS to replace clinical hours. In addition, four respondents (10%) mentioned the additional chances for observations of the teaching candidates and four respondents (10%) mentioned the creativity it afforded professors. Three respondents (8%) mentioned how the technology was able to create experiences otherwise unattainable.

Challenges

When asked what the most negative aspect of working with MRS was (Q4.7; n= 38), ten respondents (26%) mentioned the time commitment and administrative tasks, and ten (26%) mentioned difficulties with the technology. One stated:

Technology glitches can totally derail the session and student course schedules.

There have been years when the tech support was strong and workarounds were fast reducing the amount of simulation time lost.

Here the respondent describes the challenges of experiencing technology issues for students.

The respondent described a range in their experience in the response to fix the technical issues. Seven respondents (18%) stated that encouraging faculty buy-in was the most difficult aspect. Combining several commonly reported challenges, one respondent described the negative aspects this way:

Faculty who are set in their ways are skeptical of the tech and do not use it. The everyday tech issues with the simulation program. The administrative tasks associated with having a site license is immense for a faculty member with no assistance or load granted.

Here the respondent mentions all three of the most common challenges referenced by respondents: the technology issues, administrative tasks, and the difficulty building faculty buy-in. Specifically, the respondent references a lack of support from their institution. In addition to these burdens, six (16%) respondents mentioned the high cost of the technology. Respondents also mentioned inauthenticity or limitations of the avatar students (6; 16%), and three (8%) mentioned specifically they did not experience any negatives using simulation.

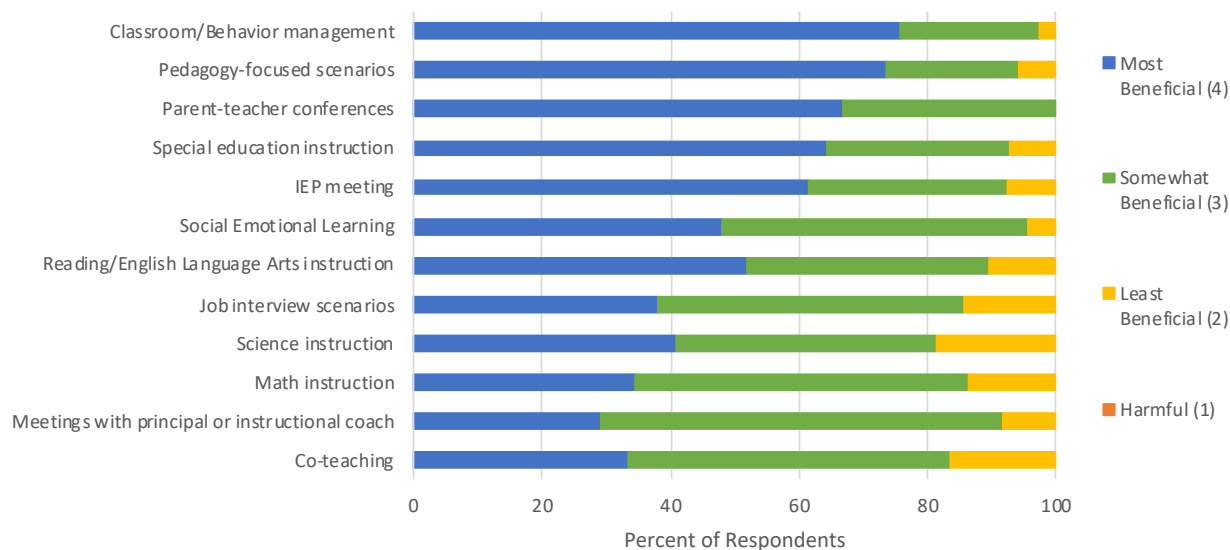
Scenario Perceptions

Respondents perceive classroom management, pedagogy-focused, and parent-teacher conference scenarios as the most beneficial for students; respondents do not perceive any common scenario as harmful. As demonstrated in Table 1: Population vs. Sample and Figure 8: Perceptions of Scenarios respondents (n=40) were asked to rank their perceptions of the benefit of each of the scenarios (Q5.3). Respondents could rate each scenario as *most beneficial*, *somewhat beneficial*, *least beneficial*, or *harmful*; they could alternatively report that they had *no experience* with the scenario. More respondents (28; 70%) rated classroom/behavior management scenarios *most beneficial* than any other scenario. Respondents also frequently rated pedagogy-focused scenarios (26; 65%) and parent-teacher conferences (20; 50%) as most beneficial. Notably, those three scenarios that were most often reported as *most beneficial* (Q5.3), were also the scenarios reported most often as *frequently used* (Q5.1).

In addition, 18 respondents (45%) reported special education instruction scenarios as *most beneficial*, and 16 respondents (40%) rated scenarios of IEP meetings as *most beneficial*. Across all the scenarios, respondents' perception of the benefits ranged, meaning no scenario was rated the same by all respondents. The Co-teaching, Meetings with principal or coach, Math instruction, and Science instruction scenarios were more frequently rated as *somewhat beneficial* or *least beneficial*. No respondents rated any scenario as harmful.

Table 10: Perception of Benefit-Scenarios															
How beneficial do you feel these scenarios are for teacher preparation students? n=40	Harmful		Least Beneficial		Somewhat Beneficial		Most Beneficial		No Experience		Unrated (Omitted)		Rating Summary		
Scenario	N	%	N	%	N	%	N	%	N	%	N	%	N	M	SD
Classroom/Behavior management	0	0	1	2.5	8	20	28	70	0	0	3	7.5	37	3.73	0.51
Pedagogy-focused scenarios	0	0	2	5	7	17.5	25	62.5	1	2.5	5	12.5	34	3.68	0.59
Parent-teacher conferences	0	0	0	0	10	25	20	50	5	12.5	5	25	30	3.67	0.48
Special education instruction	0	0	2	5	8	20	18	45	5	12.5	7	17.5	28	3.57	0.63
IEP meeting	0	0	2	5	8	20	16	40	9	22.5	5	12.5	26	3.54	0.65
Social Emotional Learning	0	0	1	2.5	11	27.5	11	27.5	10	25	7	17.5	23	3.43	0.59
Reading/English Language Arts instruction	0	0	3	7.5	11	27.5	15	37.5	5	12.5	6	15	29	3.41	0.68
Job interview scenarios	0	0	3	7.5	10	25	8	20	13	32.5	6	15	21	3.24	0.7
Science instruction	0	0	5	12.5	11	28	11	37.5	6	15	7	17.5	27	3.22	0.75
Meetings with principal or instructional coach	0	0	2	5	15	37.5	7	17.5	8	20	8	20	24	3.21	0.59
Math instruction	0	0	4	10	15	37.5	10	25	5	12.5	6	15	29	3.21	0.68
Co-teaching	0	0	4	10	12	30	8	20	10	25	6	15	24	3.17	0.7

Figure 8: Perceptions of Scenarios



Elaborating on these data, respondents were asked why certain scenarios were more beneficial than others in an open-ended question (Q5.4; n=33), seven of the respondents (21%) reported scenarios that would be otherwise impossible or highly limited for students to practice in real life is what makes certain scenarios more beneficial than others. For example, one described beneficial scenarios as ones that, "... allowed students to practice

the tasks which otherwise would not be available. For example, conducting IEP or parent-teacher meeting.” Another also described the value of scenarios otherwise impossible to replicate:

... controlling all the factors to ensure students have practice opportunities is impossible in field experiences. They are also really impossible to replicate within the classroom with role-play and other students because they don't have the knowledge or understanding to really challenge their peers in the role-play.

In both quotes, the respondents speak to the value of providing students practice with teaching situations they would not be able to otherwise experience. While one describes the value of practice in an IEP meeting (Individual Education Plan- a formal legal situation that student teachers are typically not allowed to witness or take part in), the other describes the value of controlled practice with situations that could not be guaranteed in student teaching nor easily replicated with rehearsal. Echoing the scaled responses about scenario benefit, five respondents (15%) mentioned classroom management scenarios as highly beneficially in their answers. One described why, “classroom management is something that is so frequently an area of growth for new teachers that I feel any opportunity to continue growth is valuable.” Five (15%) mentioned the realism of the scenario influencing its benefit. Four respondents (12%) mentioned benefit came when scenarios are focused on content instruction, and three (9%) mentioned scenarios being more beneficial when they are tied directly to coursework.

No Notable Differences Across Use Levels

Although this study identified some differences in use, delivery, and leader perceptions across low-, medium-, and high use levels, no differences were notable.

Perceptions of benefit, methods of delivery, and the student population exposed to the technology as well as changes in use during COVID-19, were fairly stable across use levels. In addition to analyzing the quantitative data by use level, I also analyzed the coded qualitative data in the survey by use level. No notable differences or trends were found in those data either.

Chapter Summary

Phase one of this explanatory sequential mixed method study described the use of MRS at most of the teacher preparation programs known to be using the technology in the United States. Although some variability was reported in terms of how the simulation is delivered and what scenarios are used, trends were identified. Most notably, in regard to extent of use, programs reported a wide range of hours, course integration, and student exposure with most programs reporting use on the low end across variables. In terms of structure, MRS is most often used with upper classman undergraduates and is most often being delivered in a social-learning, lab model where peers observe each other within the simulation. Classroom management scenarios were reported as most frequently used and were most often rated as highly beneficial. In addition to those trends, COVID-19 seems to have acted as a catalyst for simulation, with most programs reporting an increase in their MRS use during school shutdowns. Speaking to the potential of the technology to improve teacher preparation, a large majority (97%) of users of MRS reported their overall experience with the technology as positive with many of them praising its ability to better prepare teacher candidates through additional practice opportunities specifically with scenarios otherwise impossible to experience.

CHAPTER FIVE: PHASE TWO RESULTS –A RANGE OF USES

Introduction

Mixed Reality Simulation is an innovative technology used by 52 teacher preparation programs in the U.S. The technology provides valuable rehearsal opportunities to teacher candidates. For this explanatory sequential, mixed method design research I first collected quantitative and qualitative data from 41 of the institutions known to be using MRS in teacher preparation. That data was elaborated upon in chapter four. I used the analyzed survey data to select the sample for phase two. For this phase, I conducted one-on-one interviews with leaders of simulation from four of the institutions in the survey sample. This chapter contains mostly qualitative data from those interviews which represented a range of MRS uses. The data from the leaders of simulation at the four institutions collected in this phase elaborated on the unique circumstances, attributes, and goals of each distinctive case. Supporting materials were collected from the leaders' institutions including syllabi, simulation schedules, descriptive documents, conference proceedings, and articles. These materials were reviewed in order to triangulate the interviewee's statements and confirm the findings. In addition to that triangulation, all interviewees completed member checks of their corresponding sections of this chapter and confirmed the findings.

Purposeful Sample

Following the analysis of the survey data, four cases, based on the type of usage and MRS structures, were identified for further study. I invited a leader of simulation from each case to be interviewed. All four of the individuals had volunteered to participate in the qualitative phase of the study by including their contact information in the original survey (Q8.8). The definition of leader of simulation in this context referred to the individual staff

or faculty member at an institution responsible for the implementation of simulation at the site or someone immersed enough in the use of the technology at the site that they could thoroughly answer questions about MRS use at their institution.

The four use cases represented four institutions using simulation in varying ways with differing goals, circumstances, and structures. One of the cases examined represented typical use, and three demonstrated atypical use. The atypical use cases were identified as using the technology in interesting ways—having structures "special" and/or aspirational in the sample as concluded from the survey.

The first case identified was a program demonstrating typical use. The leader of simulation I interviewed had been involved with the institution's simulation since it began and is charged with its facilitation, coordination, financing, and growth. I determined this case to be a typical use institution through an examination of a variety of variables from the survey. First, the program's scores on the following questions were closest to the mean and/or mode: percentage of courses with integrated simulation (Q 3.5_1), percentage of students who experience simulation (Q 3.5_2), and the number of simulation hours used annually (Q 3.6). That analysis provided five possible "typical" use schools. I then analyzed the schools' teacher preparation program size (Q3.3) and Carnegie classification (Q3.2). I chose the one school with the teacher preparation program size closest to the mean size of the institutions in the sample, and the school that had the most frequently reported Carnegie class. In addition, I examined the quantitative and qualitative data provided by the respondent from this program and found that data to be representative of the typical answers provided. This university will be referred to in the narrative as "Typical U."

Following the identification of Typical U, I identified an institution using lower-than-average hours, but the institution still managed to expose 100% of its student population to the simulation annually. Since on average, institutions reported exposing just 43% of their student population to MRS, I was interested in learning more about this program's structure. In addition, as funding came up often as a concern for MRS using institutions, this program exemplified a lower-cost, higher-impact use model. The leader of simulation I interviewed from this institution was a faculty member responsible for bringing the technology to the school; an individual who was involved in all the decisions around how, when, and what simulations would be used, and is heavily involved in research with the technology. This institution will be referred to in the narrative as "Sim State."

Following the identification of the high student exposure, low hours case, I chose to interview a maximum use case. This institution reported using over 1,100 more hours than the average, presenting as an extreme outlier in terms of simulation hours used annually. As a desire for an increase in the use of the technology was the most frequently reported goal of the survey respondents, it was important to identify this program's structures, goals, and uses. This institution will be referred to in the narrative as "Max Use U." As I have a professional affiliation with the primary leader of simulation at Max Use U, I instead interviewed a post-doc heavily involved in the simulation facilitation and coordination, who was the coordinator of the technology for the university and was one of the primary individuals completing research with the technology.

And, finally, I chose to interview a leader of simulation at a university vending MRS to other universities and businesses through an established university program. Since a desire to vend the simulation came up multiple times in survey data, and vending (or selling)

technology to other universities and businesses as a way of revenue-generating is atypical in a university setting, this was an interesting case meriting further examination. This institution will be referred to as, “Vending State” and its revenue-generating program referred to as “RealiTach.” The leader I interviewed for this case was the chair of the teaching and learning department and the director of RealiTach.

The chapter reports on the complete findings of Typical U in relation to the research questions—seeking to deeply describe typical MRS use at institutions in the U.S. It then reports on the findings of the atypical programs in regard to the relevant research questions and sub-questions. That reporting will concentrate on the programs’ unique qualities. For Sim State, the primary focus will be on the structures they use to maximize the impact of their relatively small MRS hours buy-in. For Max Use U the findings will concentrate on how they use simulation across their program and the opinions of the simulation leader about those uses. The chapter will also describe how Max Use U grew their program and their experiences with their site license. For Vending State, the reported findings will focus on the structures, successes, challenges, and perceptions of vending the technology as well as the program leader’s opinions on the technology’s best modes of use.

Typical U

The data in this section was obtained through an interview with Typical U’s leader of simulation, Dr. Stephanie Herold (pseudonym). Dr. Herold manages MRS for the college of education and has been heavily involved with the facilitation and coordination of technology since the school began using it. As Typical U was found to be representative of many institutions using MRS, this section will seek to provide data toward both research questions and their sub-questions. To confirm the findings in this section, I used Typical U documents

containing simulation schedules, scenario descriptions, news articles, and other supplemental MRS documents provided by Dr. Herold and found on Typical U's public website.

Background

Typical U is a large, public, R1, doctoral-granting university in the southern region of the United States. The institution has a medium-sized school of education with approximately 500-students. Typical U began using MRS in its teacher preparation program around 2015. An early adopter of the technology, MRS was brought to Typical U by the former dean who had extensive experience with TeachLivE™ at the University of Central Florida, where the technology began. Typical U pays for simulation in their program through student technology fees, though they hope to find a different way to fund the program in the future. According to Dr. Herold, simulation at Typical U has remained mostly consistent in regard to the extent of its use, structure, and scenarios since its inception, outside of increases brought on by school closures during COVID-19.

Simulation Use: Extent and Structure

In the survey, Dr. Herold reported using 45 hours of simulation a year, integrating simulation into approximately 10% of their courses, and exposing approximately 30% of their students to MRS every year. Although these data were slightly lower than the mean of the survey sample, Typical U's data were representative of the mode. Also typical of the survey respondents, Typical U purchases its simulation hours directly from Mursion®. Typical U, in data collected from the survey, reported exposing mostly junior and senior level students to MRS, reported classroom management scenarios as most beneficial, believed MRS's most positive benefit lies in its ability to offer a safe space for practice, and

referenced cost, time, faculty buy-in, and technology issues as the most negative aspects of using simulation. These findings, derived from the survey were typical, more often referenced by respondents than other structures, issues, or perceptions.

The following will detail Typical U's use of increasingly complex scenarios in clinical courses where students experience MRS in a social learning model lab setting.

Structure

Simulation is embedded in “clinical” classes in the teacher preparation program. According to Dr. Herold, Typical U students in the teacher preparation program experience one simulation a semester in each of their fieldwork classes. These courses meet synchronously a few times a semester, with the majority of the student work being done on-site at schools observing classrooms and/or student teaching. The simulations coupled with the fieldwork courses differ slightly for students seeking elementary and secondary credentials. Recently a few more courses have added simulation, but Dr. Herold reported that these vary by professor, and are not consistent across the program.

Students at Typical U experience three increasingly complex MRS scenarios. The first simulation scenario that students at Typical U experience occurs in their first fieldwork course. It includes basic classroom management and questioning routines. As students enrolled in this course are new in the preparation program, the first scenario is, according to Dr. Herold, “very low stakes” and relatively easy compared to others the students will experience later. The next fieldwork course includes a scenario with a slightly more difficult classroom management situation and requires the students to teach a short lesson. The third scenario, used in the third field-work course, is a parent-teacher conference. The structure and content of simulation scenarios were originally chosen by the

course faculty who felt it was important to acclimate students to the simulation and then increase the rigor of the scenarios. Dr. Herold described:

There's a different scenario for each course so [the students] don't do the same one over and over. The first one is in their first field experience course. We have a very low [student] behavior problem; it's a simple introducing of the teacher to the class and they do a questioning thing... The second one, we increase the [student] behavior issues a little bit and they teach a short lesson. Then the third one is the parent-teacher conference... They do two with the classroom and then one with the parent.

Described here is an increasingly complex structure of the MRS scenarios experienced by the students. The complexity mimics how new students are often taught to teach—beginning with classroom management, then learning about specific teaching methods and pedagogical moves, and then learning the skills needed to be successful outside of instruction such as interpreting data and communicating with parents. Similar to a real classroom, success in the later, more complex scenarios, is dependent upon skills gained in the earlier ones. At Typical U teacher candidates use simulation to build their classroom management skills, then practice their instruction, then rehearse parent communication.

Simulation is delivered in a lab setting, in front of peers, during scheduled class time. The delivery of the simulation at Typical U takes place in what is called their “tech playground,” a lab setting where other technology for student practice is available. This type of MRS delivery was reported most often by survey respondents. According to Dr. Herold, outside of the COVID-19 school shut-downs, the field-work course’s faculty would book time in the tech playground then bring their class into the space during regular class time.

The simulations are run by a simulation specialist—a university staff member or graduate student, and the course professor.

Dr. Herold was clear that this type of MRS delivery includes social learning of both the student(s) in the simulation and those observing simulations. She described how during simulation students are often grouped in fours. Each group runs through a full simulation scenario in front of the class. Within the group, each student gets a few minutes individually in simulation, acting as one teacher. When the group finishes, time is taken to debrief and discuss, though according to Dr. Herold, the debrief lacks a singular structured feedback form or rubric. Dr. Herold described the social learning lab experience:

Everybody would recognize that they're all learning from each other. They're all learning from each other's mistakes. This is a wonderful opportunity for everybody to see the same thing happen over and over again, and all the kinks get worked out of it... I always enjoyed that process as we would stop and talk about, "What happened there? What went wrong?" And then, "How can we fix that?" And so, the next guy up would do it a little bit better.

This quote captures Dr. Herold's affinity toward a social learning model for MRS delivery. She describes how some students participate in simulation while others observe. The observing students learn from the missteps taken by the students in the simulator and collaboratively problem-solve ultimately resulting in better teaching in the simulator. In addition, Dr. Herold details how a facilitator asks the observing students specific questions to actively engage them in the process.

Along with peer engagement and facilitator feedback, Dr. Herold revealed that students are usually asked to write a reflection about their time in the simulation. Dr. Herold

noted that “They reflect on the process and how they felt about it, and what happened in their particular moment.” Along with the reflection, students are assessed by the professor and given a grade for their performance in the simulator.

Simulation: Perceptions

Along with conveying information about MRS structures Dr. Herold also described her perception of MRS –its benefits, strengths, and challenges within the institution. Specifically, Dr. Herold described a focus on building classroom management skills, the benefits of rehearsing parent-teacher conferences, and elaborated on the challenges she has experienced leading the technology at Typical U.

Scenarios

Fundamental classroom management skills acquired through practice in a “safe space.” Dr. Herold was asked about the specific skills the professors were aiming to develop with simulation. She responded that repeated exposure to student behavior issues, with a focus on the rehearsal of diffusing disruptive or off-task student behaviors, helps to build vital classroom management skills. She described the value of the first two behavior management scenarios: “that's the most important thing right there, they're practicing the skills that they've learned in classroom management. They're getting an opportunity to try out things.” In the survey, classroom management scenarios were most often reported as most beneficial by respondents and were reported as most frequently used. As classroom management skills are often described as difficult for new-to-the-profession teachers, a preference for extra practice in this area by Dr. Herold and most survey respondents makes sense.

Also aligned with many survey respondents, Dr. Herold described simulation as offering a safe space for students to practice. She described how professors often spoke to students about the simulation: “We always tell them that no matter what happens in this simulation, no one gets harmed here. If you lose your cool, this is the place to do it because you can't hurt these kids.” This quote describes how simulation can offer rehearsal opportunities for novices. In simulation, if a teacher candidate makes a mistake or reacts negatively, no real students are impacted. These perceptions of the value of the safe space and opportunities for practice echo the survey respondents’ views in phase one of the study.

Students find the parent-teacher conference scenario as most valuable. Although Dr. Herold believes classroom management scenarios to be most beneficial, she reported anecdotally that Typical U students claim the parent-teacher conference scenario to be the most impactful for them. Dr. Herold described how “they [the student] feel like that particular experience prepares them for facing a parent.” In the parent-teacher conference scenario used at Typical U, Dr. Herold described how students practice speaking to a parent, navigating difficult conversations, diffusing tension, and choosing the correct language for effective communication. Dr. Herold reported why she feels the parent-teacher conference scenario is successful:

... I don't think [students] really realize how many parents come in with a lot of baggage about school, a bad experience of their own that they're carting around still. Just a lack of familiarity with teacher lingo and the things that we spew as educators, that professional talk, that parents don't really get.

This description, similar to survey data from other respondents, exemplifies the most frequently reported reason leaders saw some scenarios as more beneficial than others—the

ability to provide practice in situations otherwise unattainable. Conducting parent-teacher conferences is not commonly part of teacher preparation and are not something easily rehearsed authentically. Unpredictable parents, navigating difficult conversations, and communicating hard-to-hear student data can be contentious and challenging experiences, especially for new-to-the-profession teachers. Rehearsing in simulation allows teacher candidates to practice the self-regulation and speaking moves necessary to be successful during these often-difficult interactions.

Experience

MRS technology issues, large time commitment, and building faculty buy-in.

Dr. Herold described Typical U's experience with simulation as "somewhat positive," overall. Although she finds the technology impactful for students, she reported a variety of challenges both in the survey and interview.

According to Dr. Herold, Typical U experienced technical difficulties with MRS early on. She described audio and visual problems as well as problems of connectivity. But she reported that these were addressed and mostly fixed over time. Other survey respondents reported similar technical difficulties early in their MRS adoption.

In addition to technical difficulties, Dr. Herold described the technology as time-consuming. She reported MRS as involving a lot of coordination of scheduling, managing space, students, and money. Initially, these tasks were placed on Dr. Herold and represented a heavy burden, as simulation was just one portion of a larger staff position. However, she noted that Typical U resolved these issues over time by hiring a graduate student to run some of this work, using technology to streamline the coordination, and passing some of the administration and coordination work over to the faculty members themselves.

Along with these issues, Dr. Herold reported initial difficulty getting faculty to use the technology. When asked about what she found to be the most difficult task as a leader of simulation, Typical U responded candidly, “Fighting with the faculty to get them to commit to it, to come on board, to see the value in it. That's been a long haul.” When asked about the faculty’s initial reception of the technology she described the burden of building faculty buy-in, stating that faculty did not want to give up the classroom time and seemed afraid to try it. To combat this issue, Dr. Herold took on the responsibilities of simulation herself, facilitating scenarios for faculty, often when they were away at conferences and needed “a substitute” to teach the class. She described how over time students shared their positive experiences with simulation, faculty took notice and began to implement simulation more regularly.

Demonstrations attract new faculty to using simulation. Although Dr. Herold found building faculty buy-in difficult, she reported that demonstrations successfully advertised simulation. She advised: “Just bringing them in to watch while someone works with them, works with the avatars, kind of gives them an idea of what the possibilities are.” Such advice aligns with many of the survey respondents’ answers to how the technology began in their program. The data from both sources indicate that providing demonstrations to faculty could grow the program over time.

Simulation Use: Changes Over Time

Although Dr. Herold described the use of simulation as fairly consistent once established, it increased significantly during COVID-19. She reported that students liked some of the new “distanced” structures of their MRS experiences. She also described where she thought the future of MRS was headed.

COVID-19 as a Catalyst

During COVID-19, Typical U increased its MRS to partially replace clinical practice. During the fall of 2020, Typical U replaced student teaching with a combination of teaching videos and MRS. Dr. Herold reported that Typical U increased its use of MRS so much in the fall semester of the 2020-2021 school year that by the time of the interview (November, 2020), the program had already used up all its annual contracted hours. They had also used up the prior years' "rolled over hours" that had gone unused in the 2019-2020 school year.

Typical U students enjoy simulation remotely. According to Dr. Herold, Typical U was in a distance learning model during much of the 2019-2020 and 2020-2021 school years. Subsequently, the teacher preparation program adjusted how students experienced the technology. Instead of completing MRS scenarios in front of a group of peers in a lab setting, students experienced MRS from their homes remotely via Zoom. Students were able to book time in the simulator with a small group (usually four members) and the graduate student facilitator. Students completed their scenarios one at a time. The sessions were recorded and sent to the corresponding course's faculty for review and feedback and would receive a grade. According to Dr. Herold, students described the change in experience as positive, citing that completing simulation with their friends, from the comfort of their home was less stressful for them than the lab model. Although Dr. Herold reported the social learning part of the simulation as one of the best parts of simulation, she found positives in this model as well.

The Future of MRS

Simulation may be a good “screening tool.” Thinking past COVID-19, Dr. Herold believes simulation could potentially help students interested in teaching, but not cut out for it decide the profession is not for them before they progress too far into their teacher preparation or career.

I do think that this is the ideal tool particularly in the early stages of their career as educators, when they first decide this is what they want to do, this is a great opportunity for them to see what it's really like.... We have had students bail early on because it was just the experience... Those are the people that probably are not cut out for education.

Here Dr. Herold explained how the life-likeness of the MRS experience provided a window into potential shortcomings or mismatches for the students' future careers. While Dr. Herold elaborated that MRS would not be used to exclude potential teachers she believes that the technology, coupled with other clinical experiences can help students recognize their weaknesses with teaching and change educational paths. Since many teachers leave the profession within the first five years, Dr. Herold believes a screening tool using MRS could potentially help to mitigate this issue.

Future Expansions. Dr. Herold hopes to expand Typical U's use of MRS, purchase a site license and begin to vend the technology to other programs and universities. She reported that her goal is to increase simulation across Typical U's school of education and beyond. While she would love to be able to offer more simulation to teacher candidates, the school does not currently have sufficient funds. According to Dr. Herold, Typical U faculty members are applying for grants to help fund future use. Dr. Herold reported that they were hoping to purchase a site license and expand the use of the technology. With a site license,

she plans to hire interactors from the campus theater department and have more flexibility with MRS. She stated: "...that is the long-term goal. We've always looked towards buying it. We've always wanted to have control of it ourselves and be able to just run it." Dr. Herold reported that issues around COVID-19 and subsequent decline in university funding have halted their efforts toward transitioning to this model for the time being. Typical U's desire to purchase a site license and vend the technology was also reported by seven other respondents in the survey.

Advice from the Simulation Leader

Program facilitators and a long-term plan for funding. In addition to simulation format and perceptions, I asked Dr. Herold for advice for other MRS programs. She stated: "My advice to people would be, get somebody that's really enthusiastic about it to sell it to the faculty...[and] to run it for them for a while...just show them how valuable it can be." She believes that having a dedicated and passionate facilitator is important to growing and running the program. Many survey respondents reported similar experiences.

Dr. Herold also advised others to have a permanent funding plan in place. She reported that Typical U pays for the program with student technology fees, but that the school leaders would prefer not to fund the program this way. She advised coming up with a structure for funding the program long-term beyond a finite grant.

Case Summary

From extent of use to delivery, from early perceptions to experiences during COVID-19, Typical U exemplified the structures, scenarios, and beliefs found in many of the institutions using MRS. Exemplary of the norm, Typical U uses MRS to support students' clinical practice, concentrates their simulations on building the social skills

required for such things as successful classroom management and parent-teacher conferences. Like the majority of MRS using programs, Typical U has low levels of MRS integration and delivers simulation in a social learning, lab setting where students observe their peers in the simulated teaching scenarios. During COVID-19 they switched their students' experience to online in small groups and reported an increase in students' comfort using MRS. Their explanations and depictions of the technology and its use may provide insight into the typical uses of MRS in teacher preparation nationally.

Sim State: Low Buy-in, High-Exposure

The data in this section was derived from an interview with a leader of simulation at Sim State, Dr. Kelly Rogers. A professor and coordinator of an educational leadership program in the school of education, Dr. Rogers has been involved with simulation at Sim State since it began and oversees simulation research at the institution. Along with her thorough knowledge of simulation use and research at Sim State, Dr. Rogers was involved in decisions about how the technology is used at the institution. To triangulate the findings in this section, I used documents containing simulation schedules, scenario descriptions, articles, rubrics, and MRS reflection forms provided by Dr. Rogers and from Sim State's public website.

Sim State was chosen for further analysis because of its relatively low buy-in (as measured through the number of hours of simulation purchased annually), yet high rate of student exposure. This section provides data toward answering the research questions with particular focus on the structures Sim State has that results in their low buy-in yet high use.

Background

Sim State is a public, masters-level university; it has a relatively small school of education made up of approximately 250-students. The university is positioned in a city in the northeastern United States. The university has an enrollment of 5,300 students, 91.5 percent of whom are matriculated within a degree track. Like Typical U, Sim State purchases their simulation hours directly from Mursion®.

Simulation Use: Extent and Structure

In the survey, Dr. Rogers reported that Sim State uses 64 hours of simulation a year, an amount less than average (88 hours). Despite the use of lower-than-average hours, Dr. Rogers reported integrating simulation into approximately 30% of their courses, a percentage slightly larger than the mean, and exposing 100% of Sim State's teacher preparation students to MRS every year, an amount well above typical use (43%). In fact, Sim State was the only school to report exposing 100% of their students to MRS. Although the smaller than average size of Sim State's program factors into its ability to expose all students to MRS, its size alone cannot account for the high rate of student exposure. According to Dr. Rogers, it is the structure Sim State uses that results in their high levels of use.

Structure maximizes impact at a lower cost. Sim State uses an established structure with simulations in order to maximize their hours. Dr. Rogers reported taking part in extensive curriculum mapping in order to maximize the impact of simulation hours with students. She reported doing this both because the faculty thought it best for students, and because they had limited funding for the technology. The activities included extensive curriculum mapping, use of simulation in their universally required core courses, and the

targeting of High Leverage Practices within simulations. This quote describes the deliberate curriculum mapping and integration into core coursework completed at Sim State; it differs from what many programs reported in the survey and other cases described:

I would use two words to talk about our simulations and that is that they're very intentional and they're very focused. By focused we might even say small scale... Intentional in that we've conducted curriculum mapping and targeted core courses that all students take, no matter what their major is.

Where other programs reported integrating simulation organically—allowing faculty to choose to adopt MRS, Sim State matched simulations to specific course content and mandated its use. Dr. Rogers described the curriculum mapping: studying the scope and sequence of the education courses and matching the content with the appropriate simulation, teaching protocol, and High Leverage Practice. All four core courses contain simulation experiences regardless of which professor teaches the course.

Twelve progressive simulations in core courses. The intentional structuring of MRS led to the integration of different simulation scenarios into the four, core teacher preparation courses. The core courses are universally required for all teacher preparation students irrespective of their focus. The first core course is typically an undergraduate sophomore course, the second and third courses are completed junior year, and the fourth is a senior-level course. Each core course uses the same scenario in three separate sessions across the semester in a progressively more complex arc.

The three simulation sessions in the arc are scheduled roughly at the beginning, middle, and end of the courses about four weeks apart from each other with the exception of the students' very first experience with simulation. The first simulation, beginning during

students' sophomore year, does not begin until approximately six-weeks into the semester. This delay in the start of simulation occurs in order to allow brand-new-to-teaching students the time to learn and develop the basic teaching skills they will need to be successful in the simulation.

According to Dr. Rogers, in each of the four simulations, the same scenario is used and the same High Leverage Practice (HLP) is focused on within each individual course with varying instructional foci. HLPs are a set of basic practices thought to be fundamentals of teaching and necessary to support student success. The course simulations are divided up and experienced in three separate sessions in an arc. Although the same scenario and High Leverage Practice is used, sessions become progressively difficult instructionally and also, with the intensity of the avatar(s). In order to be successful in the sessions, students must utilize increasingly complex pedagogical protocols to accomplish the HLP. The first scenario is focused on classroom management, the second on eliciting student thinking, the third is on higher-order thinking and questioning practices, and the fourth scenario is a difficult conversation with a parent.

Seen in Figure 9: Sim State Structure is the rollout of simulations by student level, course, and HLP. Each course has three simulations experienced by students in a progress arc. In the first course, students build classroom rapport by introducing themselves, guiding a classroom discussion, and then establishing rules and procedures. In the second course students focus on literacy and practice introducing, creating, and applying a graphic organizer. In the third simulation students focus on higher-order thinking skills—introducing content, leading a class discussion, and then developing an assessment. The last course, like Typical U's, is a parent-teacher conference, but Sim State's scenario focuses more on the

interpretation of student data. Also like Typical U, the order of scenarios mimics the progression of many teacher education courses beginning with what might be considered basic survival practices (classroom rapport and rules) then continuing on to basic pedagogical moves (such as the use of graphic organizers and higher-order thinking questions) then on to student data analysis, interpretation, and application. The fourth course's simulation, the parent-teacher conference, also includes a ramping up of the difficulty of the conversation. In the first session, the parent's reaction and behavior are described as easy, the second medium, and the third hard. Subsequently, the students' work in those sessions is progressively more intense and difficult.

Figure 9: Sim State Structure

Level	Course	HLP	Scenario & Description
Beginner/ Sophomore	Introduction to Education	Building Classroom Rapport and Forming Rules	Classroom Management: Middle School Classroom • Sim 1: Introduce yourself, establish rapport • Sim 2: Guide a discussion on class procedures • Sim 3: Guide a discussion to establish class rules
Intermediate/ Junior	Educational Psychology: Childhood and Adolescence I	Making a Literacy Strategy Explicit by Using Graphic Organizers	Eliciting Student Thinking: Upper Elementary or Middle School Classroom • Sim 1: Introduce a graphic organizer • Sim 2: Lead a Think/Pair/Share discussion developing the graphic organizer; use student responses to develop it • Sim 3: Lead a whole group discussion on completion of graphic organizer
Intermediate/ Junior	Educational Psychology: Childhood and Adolescence II	Higher-order Thinking Skills	Encouraging Higher-order Thinking and Questioning Practices: Middle School Classroom • Sim 1: Introduce content with varying levels of questions • Sim 2: Lead a class discussion using varying levels of questions (highest Bloom's taxonomy levels) • Sim 3: Develop a formative assessment to check for understanding and conclude lesson. Use higher-order thinking questions
Advanced/ Senior	Introduction to Special Education	Interpret the results of student work, including routine assignments, quizzes, tests, projects, and standardized assessments	Difficult Conversation with a Parent: Adult Avatar • Sim 1: Easy • Sim 2: Medium • Sim 3: Hard

Simulation lab benefits more students. Like the leader from Typical U, Dr. Rogers believes delivering simulation in front of peers benefits their learning. In the survey and interview, Dr. Rogers reported students typically experience MRS individually in front of their peers. She described how for each of the core courses' simulations, the professor takes their class to Sim State's "Simulation Lab" for a two-hour session. Class sizes are small, typically ranging from 11 to 18 students. She described the time as highly structured, with an established schedule that enables each student to practice in the simulator, one at a time. The smaller the class size, the more time individual students have in the simulator. Like Dr. Herold at Typical U, Dr. Rogers believes the "lab model" or social learning structure to be most beneficial for students.

Post-simulation feedback is crucial to student learning. Dr. Rogers reported giving and receiving feedback as the primary reason for completing MRS in the lab setting. At Sim State, feedback is provided to students immediately following their work in the simulator from multiple parties. Dr. Rogers described it as "debriefing from their professor and from the facilitator who's there...and from their peers in whatever time they have." Dr. Rogers stresses the resulting value in the after-action debrief: "It's all incredibly rich, that's why we say we love the doing part of it, but the debriefing and the deliberation are very powerful as well." Dr. Rogers shared that while much of their faculty and doctoral students' research originally focused on the efficacy of technology itself, they are currently more focused on the social aspects of the MRS learning process including the feedback and debriefing that occurs following scenarios. Dr. Rogers believes that the power of the simulation lies in the social processing and shared observations of the simulated teaching experience. Similar to what Typical U's Dr. Herold described, Dr. Rogers believes the social

nature and interaction of the students observing during the lab model is a mode of MRS delivery that benefits both the student in the simulation and those observing.

Simulation Use: Changes Over Time

Students more comfortable using MRS from home. Despite school shutdowns during COVID-19, Sim State still books MRS sessions during synchronous scheduled class time. Dr. Rogers says that they transitioned from their typical in-person lab format to a remote learning format. Students still complete the scenarios individually in front of their peers but do so from their homes. Like Dr. Herold at Typical U, Dr. Rogers reported that students found the change to remote delivery of MRS positive and less stressful. Their statements again emphasize the existence of stress experienced in simulation when it is “performed” in a lab model.

Simulation: Perceptions

Stress of the performance. Although a believer in the social learning aspects of the lab model, Dr. Rogers understands that the “performance” aspect of completing a simulation experience in front of their peers can be stressful to many students. Dr. Rogers is considering conducting research in the area:

I’m thinking about this stress is positive treatment, learning to see that stress can be positive because when you have stress, you might recognize the difference between your performance and where you want to be. That gap becomes very obvious when it’s in front of other people. I think it’s more about helping... for us, understanding simulations through a vulnerability lens and then what does that mean now for our students, how do we better prepare them?

In this quote, Dr. Rogers describes the stress students experience while rehearsing publicly in front of their peers. She sees the existence of stress as potentially positive to students' self-reflection and subsequent growth as teachers: The performance aspect of simulation perhaps heightens students' awareness of the students' own shortcomings and helps teacher educators better identify and meet their needs. The existence of stress experienced during simulation was reported by numerous survey respondents and all four leaders in phase two. Dr. Rogers, however, was the only leader to report stress as potentially positive.

Heightened emotional responses may add to the learning. Overall, Dr. Rogers described MRS as being a powerful tool in teacher education practice. She believes the lab setting is the best mode of MRS delivery for students, despite the stress they experience as she believes both the student performing and those observing benefit. Dr. Rogers concedes that students experience stress during MRS, but finds their emotional responses positive:

I think a highlight for me, and I would just say that some of this is through research and some of this is through just informal interactions is when I hear students say, "I was so scared to do this, and can you believe when that avatar did this? I tried this and it worked," or "I tried this, and it didn't work, but I'm going to try this next time."

Those heightened emotional responses, if they can be framed as growing experiences, are so powerful.

Dr. Rogers described the power of stress and emotional responses of students several times in the interview. Here she described how a student may experience fear before their performance in MRS, but their excitement following simulation often led to their own inquiry. She described positively students' ability to think critically about their actions within simulation, reflecting on what worked and what they might try next time. She, like

other leaders in the survey and interviews, believes the power of simulation goes beyond the act of rehearsal.

Case Summary

According to Dr. Rogers, Sim State intentionally structures MRS so that 100% of its teacher candidates experience twelve simulation sessions during their tenure. The simulations are delivered to sophomore, junior, and senior students in their four core education courses. Each of the courses uses a single MRS scenario in a progressively difficult arc of three sessions occurring at the beginning, middle, and end of the course. The four scenarios are focused on High Leverage Practices utilizing increasingly complex teaching protocols. This intentionality and structure of MRS clearly has led to their ability to maximize their hours.

Sim State delivers MRS to students in a lab setting where social learning, observation, and feedback are encouraged. Delivering simulation in this way actively involves the observing students in the simulation process and thus further capitalizes the MRS hours Sim State purchase in their relatively small buy-in. Dr. Rogers believes the social learning aspect to be vital to student learning despite students reporting that the performance produces stress. She believes the stress produced by the act itself may be beneficial to the teaching and learning process.

Max Use U

The data for this section was garnered from a leader of simulation at Max Use U—a post-doctoral researcher who is heavily involved in the growth, facilitation, coordination, and decision-making processes regarding simulation. She will be referred to as Dr. Lilah Gregory (pseudonym). The data collected in this section were triangulated with

supplemental materials supplied by Dr. Gregory or found on Max Use U's website including MRS schedules, scenario descriptions, usage reporting documents for funders, documents for supporting faculty's use of simulation, and other documents describing the use of MRS. This section reports mostly qualitative data on how Mixed Reality Simulation is being used at Max Use U. It targets extent of use, modalities, delivery, scenarios, and applications. It will also provide data on funding, and growing the program as well as the leader of simulation's perceptions on how MRS should be used.

Background

Max Use U is a large, R1, doctoral granting university in the southeastern region of the United States. It has a large school of education that includes undergraduate and graduate areas of study in teaching, education policy, and leadership as well as other areas of human development. Max Use U describes itself as an early adopter and heavy user of the technology. According to Dr. Gregory, the site began using simulation in the Fall of 2016 after an individual faculty member brought MRS to the institution for research purposes. The use of the technology began on a small scale, originally purchasing a "handful of hours" directly from Mursion®. Max Use U bought a site license in 2017 when it became financially prudent due to their increase in use. Max Use U was chosen for further examination due to its prolific use of simulation—reportedly using over 1,200 hours annually and integrating into more than 28 courses. Between 2015-2020, the program delivered over 3,100 simulation sessions and completed five distinct research studies.

Simulation Use: Coursework, Assessment, and Research

What makes Max Use U's use of simulation unique and more prolific than other programs in this study is its multiple uses of simulation across the school of education.

According to Dr. Gregory, not only is the technology embedded in coursework for student rehearsal as it is at Typical U and Sim State, it is also used as an assessment tool—tracking the growth of teacher candidates over time. In addition, the technology is also used extensively for research within the school of education.

Simulation in Coursework.

Simulation in methods-focused courses. Dr. Gregory reported using simulation in approximately 50% of the teacher preparation courses at Max Use U. She described how MRS is typically found in “practical” or methods-based courses and not often in theoretical courses: “courses like classroom management, ESL methods, et cetera, those we’re in most of.... But the ones that get more abstract like differentiated instruction, they’re not using it. It’s the more practical focused classes.” This description confirmed the survey findings as Max Use U reported perceiving practical scenarios such as classroom management, pedagogy-focused scenarios, and IEP simulations as most beneficial. It also is aligned with many other survey respondents’ views of the technology as beneficial for clinical practice.

A different student experience of MRS. Students at Max Use U experience MRS in a variety of ways that are normally up to the course’s professor. Unlike most programs, however, Typical U usually delivers simulation to students individually or in small groups and not in a lab model. According to Dr. Gregory, when Max Use U began using simulation, they did deliver in that model, but after several years and abundant collection of data on students’ dissatisfaction with the experience, Max Use U changed their MRS delivery to mostly remote via Zoom. Instead of coming to campus and “performing” in front of their peers, students usually log-in from their homes individually or in small groups to complete

simulation. Dr. Gregory described Max Use U's transition from the lab model to individual MRS delivery like this:

For the first couple of years when we did sessions in person, we got complaints about everything, "I drove 40 minutes each way to show up here for a 15 minutes simulation," or, "I can't stand all these people in the room who are watching me."

Last year we just switched to doing our session on Zoom, and all of a sudden, those comments all went away and we got comments about, "Gosh, I love being able to do this from the comfort of my bedroom. It takes all the worry about standing in front of students out of the equation."

Here Dr. Gregory describes anecdotal data collected from students about their displeasure with simulation in the lab model. Dr. Gregory said changing to remote delivery, which the school did prior to COVID-19, resulted in a more comfortable and accessible experience for students. This quote demonstrates how Dr. Gregory values student comfort and ease of access to MRS. Her prioritization of student comfort over the perception of the value of social learning with MRS is one of the ways her perceptions differed from the other leaders interviewed.

Individual remote. Unlike the opinions expressed by other simulation leaders in the survey and interviews, Dr. Gregory believes individual sessions are best for students. She described herself as "a huge proponent for doing our sessions over Zoom" and the individual Zoom sessions as having advantages:

I like individual sessions and I like them on Zoom because of the utility to the user...It's much less of a burden for students. You can do a Zoom session on your phone, in the parking lot at your placement. You have this enormous freedom and so

suddenly doing a simulation session is not this extra thing that's placed on you in an incredibly busy time of the semester.

Here Dr. Gregory describes the benefits of doing simulation remotely. Focusing on ease of access and student comfort, she further illuminates what she values in simulation.

Dr. Gregory went on to describe the difficulties doing simulation as a fishbowl (a specific social learning structure in the lab-model), stating that it is daunting for newer teachers:

Teaching in front of other people is intimidating, and this is especially true for your younger teacher candidates. What you're asking for is somebody to stand up in front of the class and put themselves on the line, while 15 people or 20 people or however many watch them and they get judged. What you're asking for is really hard.

Here Dr. Gregory describes the stress of performing in simulation in front of peers—especially for those newer to the profession. Similar to what was expressed by Dr. Rogers at Sim State, Dr. Gregory described the performance aspect of MRS as stressful to students. Unlike Dr. Rogers, Dr. Gregory did not express a belief that students' stress could be positive for their learning. Instead, she believed it a contributing reason to deliver simulation individually and remotely.

Short 10-15-minute sessions. Although students tend to experience simulation differently from the typical at Max Use U, the amount of time they spend in the simulator per simulation is similar to the amount reported by other cases. According to Dr. Gregory, students at Max Use U typically experience coursework simulation in short sessions of 10-minutes and always less than 15-minutes. She said: “We make them really short so that we can squeeze a lot of people in.” She described using short simulations in order to maximize the number of students who are exposed. Although the individual session lengths are similar

to what students at other programs experience, students at Max Use U typically experience a lot more of them during their tenure.

Professor choice over simulation. Unlike Sim State and Typical U, Max Use U reported allowing professors autonomy and choice over simulation in their courses. Simulation was not required in specific courses but rather could be included at the professors' discretion. According to Dr. Gregory, faculty are able to choose to use or not use the technology and can be open and creative with its content and delivery:

In terms of how the professors choose to use it in class, we have a really open model. Some professors want a one-off, some professors want the exact repetition. You teach a lesson that has an explicit component in March, and then you do a lot more learning about explicit instruction, and do that same exact simulated lesson again in April. But we give professors a lot of freedom around how they use it.

Here Dr. Gregory describes how professors choose which scenarios to use and the amount of simulation used in their courses. She described how some professors choose to bring in just one MRS experience per course while others use the same simulation multiple times in order to observe changes in student behavior. She went on to describe that professors may choose their mode of delivery to students as well when simulations are delivered. As such, some professors choose to deliver MRS in a lab model and others individually and remotely.

Simulation for Assessment and Research.

MRS to monitor student progress. Along with their MRS use in coursework, Dr. Gregory described how Max Use U utilizes the technology as part of their prolific assessment and progress monitoring of their students. She reported that Max Use U has for decades collected data on their teacher candidates at the beginning, middle, and end of their

teacher preparation program as well as beyond it. According to Dr. Gregory, Max Use U collects the data in order to monitor the progress of their teacher candidates and as part of their accreditation process. Dr. Gregory cited data collection methods including a multitude of surveys and inventories, classroom observations, video recordings of lessons, and student scores once the teacher candidate has graduated and is in practice.

Dr. Gregory reported that MRS for assessment and progress monitoring was added to Max Use U's data collection practices in 2017 and includes three five-to-seven-minute program simulations. Dr. Gregory described the progress monitoring simulations like this: "One is focused on classroom management, one on engaging with the parent and one is on running a text-based discussion—so providing quality feedback. They [teacher candidates] do them at the beginning of their program, the mid-point, and end." She went on to describe progress monitoring in more detail, reporting how it includes a pre-simulator survey that prepares students for the experience, the reading of background information on the parent and/or the child, and a corresponding written response and a post-simulation reflection. The written response asks students to answer how they feel the simulation went and what they could have done differently. Notably, the standard simulation scenarios used in the assessment are similar to the standard scenarios embedded into Typical U and Sim State's coursework. However, Max Use U was the only case examined that described using simulation to monitor student progress. No survey respondent mentioned this practice either.

MRS research on teaching and the impact of specific interventions. Along with using simulation in coursework and monitoring the progress of teacher candidates over time, Max Use U uses MRS to conduct research. Dr. Gregory described that the progress monitoring simulations are coupled with various interventions or controls as part of the

school of education's research efforts. For the research, the intervention often occurs for half of the group during their mid-point progress monitoring MRS program simulation. Dr. Gregory reported that using this method, Max Use U faculty and researchers have studied a variety of interventions including mental rehearsal, coaching, and scripts, and is interested in further researching self-reflection using the recordings of the simulations.

Simulation: Perceptions

Along with questions about Max Use U's use of MRS, Dr. Gregory was asked a variety of questions about her perceptions of simulation. This section details her opinions on simulation structure.

Simulations in a Progressive Arc

Although professors at Max Use U may use simulations as they see fit, Dr. Gregory believes simulations delivered in a progressive sequence or "arc" provide the best structure for student rehearsal and subsequent teacher development. She described the structure like this:

One of the things that I really like personally for course simulations is to actually build a sequence and an arc so that you're giving students repeated practice over the course of the semester, and you're giving them a chance to learn and to grow on specific course related skill...We might record a video for you, where you get to watch Jada in a small group, being...not the best-behaved student in the group. Then your first simulation, you're going to try to work with Jada and it's not going to go well. Then you're going to have time to work and reflect with your classmates. Then, you're going to have a one-on-one meeting with Jada, and you get to come up with a

behavior plan with her. Then you're going to do a third simulation where then you try to implement the behavior plan and re-run that same group.

Here Dr. Gregory delineates what she feels is the best structure to deliver simulation to students. Dr. Gregory prefers to develop a progressively more complex set of scenarios that mimics classroom instruction. In this quote she describes a classroom management scenario that includes working with a disruptive student, coming up with an individual behavior plan, and implementing the plan with the student. This arc of three simulation sessions detailed by Dr. Gregory is similar to that described by Sim State in that students are required to use an increasingly complex educational protocol in order to rehearse a high leverage practice. However, the use differs from Sim State in that Max Use U's arcs are described as more complex and require students to take part in activities both within and outside of the simulator.

Expert Feedback

As professors at Max Use U have discretion over simulation in their courses, Max Use U does not have a standard practice for providing students with feedback on their performance within the simulation. Dr. Gregory described a variety of common practices used in the program including peer feedback, self-reflection, and professor feedback. She reported feedback at Max Use U is most often given asynchronously in written format after the course professor (or other expert) watches a video of the simulation.

Dr. Gregory prefers feedback be given by an expert like a coach or faculty member. She explained how some professors at Max Use U watch and annotate their students' recordings of simulations, providing detailed minute-by-minute feedback on the instructional practices. Though Dr. Gregory noted that this type of feedback is only

reasonable in courses with small class sizes. Although provided with expert feedback, according to Dr. Gregory, students are not graded on their performance in simulation like they are in other programs. In addition, she cautioned MRS users relying on peer feedback, as she believes peer feedback can be “pretty traumatic” for teachers who are still developing and are insecure about their teaching and must be well framed in order to be effective. This statement differed from that of many leaders in the survey and interviews who described peer feedback as essential to the learning process.

Simulation Use: Site License

As mentioned in chapter four, institutions most often procure simulation in one of three ways. They may purchase simulation hours directly from Mursion®, as is the most common, or they may purchase a site license, or they may purchase hours from an institution with a site license. Each method comes with benefits, challenges, and differing price structures. Purchasing a site license represents the costliest method of MRS use, but often makes financial sense to those institutions with heavy simulation use or those who wish to vend the technology to other institutions or businesses. With the site license model, the institution purchases the rights to run the software on its own for an annual fee as well as other conditional fees. A site licensed program must also procure and pay for their own interactors and devices. They may utilize published Mursion® scenarios or create their own. Although costly, a site license often represents the most customizable and flexible use of the technology as programs are free to use the technology as they please. Eleven respondents to the survey reported having site licenses; several more reported they were interested in pursuing the model.

Site License Challenges

Technical Difficulties. Dr. Gregory reported that Max Use U purchased their site license in 2017. She reported that at the time they experienced a lot of technical issues with the software. Max U described the technical issues like this:

The software was glitchy, huge issues with time lax. You've got student's mouth moving, and then the words come out and they're just so disconnected that the candidates can't figure out what's going on. There was poor sound quality, just a lot of technical issues, a lot of the system just crashing and failing.

Here Dr. Gregory describes technical issues experienced, including issues with the audio and visual components of the simulation. These are similar to the issues described by Dr. Herold at Typical U. Like Dr. Herold, Dr. Gregory said the technical issues were addressed and despite those initial problems, it still made sense for them to move forward with the technology.

Interactors. As part of the site license structure, Max Use U hires their own interactors for the human in the loop (HITL) simulations. Dr. Gregory reported that the program has two interactors a male and a female. She described them as highly trained voice actors who are local actors from the community. The interactors were both trained by Mursion® and by Max Use U. The existence and importance of HITL interactors required for MRS came up numerous times during the interviews with leaders from multiple cases. While one described the coordination and financing of these professionals as very challenging, another reported she planned to hire students from the theater department to fill the role if they purchased a site license.

Cost. Dr. Gregory cautioned institutions to think deeply prior to getting a site license, as she described the cost and time commitment as significant. She described how

unless the program's use of MRS was substantial, it is not a cost-efficient model to pursue. Dr. Gregory listed many expenses associated with having a site license including paying for the license itself, equipment, paying the interactors, and any staff personnel. Dr. Gregory advised plainly, "if you're not getting over about 40 to \$50,000 a year of usage out of it, you should not be transitioning to the site license." In the survey, some programs expressed a desire to purchase a site license but also many referenced the cost of the technology as difficult to maintain. Dr. Gregory is clear in her advice--the high cost of having a site license and running simulation should be considered before pursuing the model.

Simulation Use: Strategies for Growth and Expansion

Dr. Gregory described a variety of strategies around funding and enticing faculty to use the technology in order to grow the program at Max Use U.

Funding

While other respondents reported using grants or internal funds to support their MRS use, Max Use U's MRS is funded by a foundation associated with its school of education. Dr. Gregory described how difficult fundraising in education can sometimes be since teacher education "just really hasn't changed that much in the last few hundred years." As simulation is an innovative and interesting new tool in teacher training, Dr. Gregory says it represents something more enticing for funders:

It's not that what we were doing before wasn't good, but that it just makes this difference in your sales pitch if you're doing development to be able to say, here's something that's new, here's something that we're doing that's innovative, here's why you should fund us because we're different.

Here Dr. Gregory describes how MRS may entice funders. It should be noted that another leader interviewed also reported her university using simulation as means to entice potential funders, but reported that the money was used for general funds and did not pay for the costs of simulation.

Faculty Buy-In

Dr. Gregory described how difficult it was to get faculty to use simulations. According to Dr. Gregory, there was not a lot of buy-in, and integrating the technology meant a lot of work on behalf of the professors. Dr. Gregory described how initially faculty were not interested in implementing the technology. She described how some used it minimally and describes a variety of challenges. Like other survey respondents, and like Dr. Herold from Typical U reported, Max Use U professors struggled with the technology and coordination aspects of MRS integration and required more help from a facilitator.

In response to faculty resistance, Dr. Gregory would offer to do the majority of the coordination and facilitation work for the faculty. These strategies helped grow the program in courses over time. Dr. Gregory reported in the interview how she would contact the professor teaching a “practical-type” course and invite them to use simulation. She said she would make it as easy as possible for the professors to choose to integrate the technology, never making faculty coordinate sign-ups or find the scenarios themselves, offering to complete the video uploads for them or giving them ideas on how to structure the assignments:

If you let them just come in from their position of strength, which is knowing the content and knowing their teaching candidates, they tend to get a lot of buy-in, because they want to teach the teaching candidates well. If you come in and you’re

asking them to do anything that's related to organization, to scheduling, to thinking about topics like hits and misses, it's not going to work.

Here Dr. Gregory provides advice about how to get faculty buy-in. She describes taking on as much of the work and coordination off of the faculty and making integration as easy on them as possible. That advice echoes what Dr. Herold stated from Typical U as she also reported doing the majority of the coordination and facilitation work herself in order to convince faculty to implement the technology.

Advice

Along with advice about growing the program with faculty, Dr. Gregory provided advice to universities thinking of starting MRS. She advised programs "start with small use cases... one or two classes. You're not going to want it program-wide." Dr. Gregory explained that once these focused simulations are established with one or two professors, that the faculty's own sharing of their experience with the technology will organically grow the use across the program. Dr. Gregory also advised faculty not to think of simulation as replicating a classroom environment, but rather as a tool for providing "honed and targeted practice." She advised all professors to concentrate on discrete practices for focus and assessment.

Case Summary

According to a leader of simulation in the program, Max Use U's prolific use of MRS is due to their use of the technology across coursework, student progress monitoring, and research. Dr. Gregory described that MRS is used mostly in practical instructional methods courses. At Max Use U, professors are free to choose when, where, and how

simulations are integrated into their courses, and a simulation specialist will facilitate, coordinate, and assist their use.

Although delivery of simulation varies across the program, MRS is often delivered to students remotely, in individual or small group settings. According to Dr. Gregory, MRS should be used to develop discrete and specific skills, that are focused on during simulation, and not used to rehearse broad instructional practice. To help fund their MRS use and site license, Max Use U uses novelty and innovative research capabilities to help fundraise. Dr. Gregory recommends having full-time positions aimed at helping faculty integrate simulation.

Vending State

The data in this section was garnered from an interview with Dr. Ruby Cameron (pseudonym), the Executive Director of the Center for Teaching and Learning in the College of Education and the director of RealiTeach (pseudonym) the MRS vending program at Vending State. This section focuses on answering the research question about how MRS is used with a specific focus on vending. The section will also provide data toward answering how leaders perceive the technology. The data collected from Dr. Cameron was triangulated with documents including scenario descriptions, and RealiTeach documents used in vending the technology gathered from RealiTeach.

Background

Vending State is a large, comprehensive, public, masters-level university in the western United States. According to Dr. Cameron, Vending State began using MRS through TeachLivE™ after one of its original creators gave a presentation to the special education

department through the Teacher Education Division (TED) of the Council for Exceptional Children.

Dr. Cameron reported that MRS at Vending State was originally championed by a single faculty member, now deceased, who will be referred to in the narrative by the pseudonym, Dr. Kerry King. Dr. Cameron described how shortly after Dr. King began using MRS in Vending State's Special Education Department, she earned a substantial grant to develop the technology for use in other programs. From this grant, the RealTeach program began. Originally RealTeach ran MRS for educational programs within Vending State, but over time they began to vend simulations to other universities. After Dr. King's passing, Dr. Cameron took over the leadership of RealTeach.

Simulation Use: Vending

Creation and Expansion

After earning and spending the "large single grant" to develop the technology at Vending State, Dr. Kerry King earned a grant to develop MRS for "the mental health arena" and began using that at Vending State as well. Despite the grants, MRS was expensive to run. Dr. Cameron explained why: "We have a full-time interactor, we have a full-time coordinator, we have other interactors, part-time interactors, the equipment, the software license that we have to pay for." In order to cover expenses, Dr. Cameron explained how Dr. King began selling the technology to local teacher education programs and hoped to turn it into a revenue generating program; thus, the RealTeach program at Vending State began.

According to Dr. Cameron, RealTeach currently vends MRS technology to a variety of local and international colleges as well as private businesses. Most of the college programs they work with use MRS in their teacher education, social work, marriage and

family therapy, and nursing programs. According to Dr. Cameron, during the 2019-2020 school year, RealiTeach trained over 2,000 students. Dr. Cameron reported that along with students, RealiTeach works with employees in private businesses. For businesses, RealiTeach provides simulation scenarios for salespeople to increase sales, managers to have critical conversations with employees, and workers to improve customer service.

Dr. Cameron described vending the technology to businesses as simply a means of paying the bills. A special education professor and child advocate, she stated that she wants to use the technology primarily to help train teachers to better teach students with disabilities. According to Dr. Cameron, vending outside the college of education helps to keep simulation running at Vending State. Eventually, she hopes to fully fund the technology with outside contracts in order to provide simulation to Vending State teacher preparation at a discounted rate or at no cost to the program.

Expansion Through Demonstrations

Despite their development into other schools and businesses, Dr. Cameron described growing RealiTeach and gaining new clients as extremely challenging. Specifically, she reported how hard it is to sell and explain the technology to new potential clients and faculty when they do not understand it:

RealiTeach is really difficult to explain. It's a tool for professional development and for training. But to explain to people where you say, it's immersive learning. They don't know what that is. It's an avatar, or is it just AI? No, it's mixed reality. What is that? ... it's very difficult to explain...

As Dr. Cameron elaborated here, explaining MRS in the abstract is difficult and confusing to those not familiar with the technology. She detailed how many prospective clients do not

understand what she means by immersive learning nor understand that the technology uses a combination of artificial intelligence and HITL interactors working the avatars. In addition, she explained how many do not have a full understanding of the methods and purposes of MRS for training. As a result of this confusion, Dr. Cameron stated she prefers to gain new clients through demonstrations. She believes it is the best route to build others' understanding of the technology:

If I can get a demo in front of someone, then I feel like their eyes are wide open, they're really excited about all the possibilities that they could use. Then it's all about funding. It's not about selling them on whether or not they're interested. It's about whether or not they can finance it.

Once potential clients see a demonstration, they can understand the capabilities of the MRS technology, she feels; then the only issue becomes whether or not the client can pay for it. Like many of the survey respondents and interviewees, Dr. Cameron believes demonstrations are best for exposing new faculty and clients to MRS. According to multiple sources in this study, demonstrations work to expand the use of the technology.

Vending Challenges

Dr. Cameron spoke highly of the promise and opportunity provided to her and Vending State by running RealiTeach. But she also spoke of the immense challenges for universities considering the model. Along with the difficulties of the expenses she described, Dr. Cameron reported challenges in having a site license, lacking university support, time commitment, the need for entrepreneurial business knowledge and skills, and difficulties managing interactors.

University support and business knowledge. One challenge Dr. Cameron reported was not having ample support at the university level. She described Vending State as originally enthusiastic about RealTeach but not providing sufficient support to keep it running. Like Dr. Gregory at Max Use U, Dr. Cameron said Vending State often touted the technology and used it to generate funds from donors. Unlike Dr. Gregory however, Dr. Cameron reported that those funds did not ultimately come to RealTeach but instead stayed with the university at large.

According to Dr. Cameron, not until Dr. King explained how much work was involved in running RealTeach and threatened to stop running it, did the university begin to provide support. According to Dr. Cameron, Vending State used general funds together with the office of research and sponsored projects, and the provost to provide a full-time buyout for Dr. King's faculty position to help alleviate the financial and time burdens. The funding allowed Dr. King to concentrate on the expansion of RealTeach.

Dr. Cameron described the position of leader of RealTeach as a difficult and full-time job requiring a variety of skills not normally present in teacher educators. In fact, Dr. Cameron, an established expert in the field, with a PhD, an MA, and an EdS, went back to school for an MBA in order to have the knowledge and skills necessary to run the RealTeach program. This description of the time commitment involved in coordinating and facilitating MRS is aligned with the descriptions of many survey respondents and the interviewees from Max Use U and Typical State: running simulation at an institution is a demanding and complex job.

Interactors: scheduling and cost. According to Dr. Cameron, one of the more challenging aspects of running RealTeach is managing the interactors. As described in Max

Use U's section, interactors are the trained HITL professionals necessary for this type of MRS technology. Dr. Cameron described her experience:

I think most people [with site licenses] have part-time interactors, this is an actor who needs to make money, who needs to have a job. So, if you aren't booking sessions and you're not really sure what's going to happen because sometimes universities think, I can just call and say, "Can I use it next week on Thursday from 4:00 to 7:00?" Well, if an actor has gotten a gig or if they get a gig, even between now and then, and that gig pays more, it's hard for them, which is why I think Dr. King really wanted us to have a full-time interactor that we could count on.

Here Dr. Cameron describes the unreliability of part-time interactors, a phenomenon she does not think others consider. She describes how actors working as HITL interactors can be unreliable or difficult to schedule especially when they are working multiple acting jobs. To help combat scheduling issues, Dr. Cameron reported that RealiTeach employs one full-time interactor. Dr. Cameron described this as essential to having reliable sessions. To meet the diverse needs of their clients, RealiTeach also employs several part-time interactors, including bilingual interactors, which they pay an hourly rate. Dr. Cameron explains how these expenses can add up:

One of the things people don't realize is just for a two-hour session, I have to pay my interactors for four hours because they have to drive to campus... they have to do a tech check, they have to get themselves ready. There has to be some prep time for them to review the scenario, make sure they know what they're doing, we have to pay for parking on campus et cetera.

Here Dr. Cameron describes the unforeseen costs of HITL interactors. She describes how in a two-hour session; the interactors work and are subsequently paid for four hours plus expenses. Dr. Cameron cautioned other programs considering pursuing a site license about this added expense.

Equipment, space, and resources. Coupled with the difficulties and expenses employing interactors, Dr. Cameron shared a variety of other considerations and expenses. She reported the necessity of acquiring and maintaining university space for the work and the employees as well as purchasing a variety of technical equipment. “There's also space. You have to think about, where will you put your interactors? Where will their equipment be?” Dr. Cameron’s questions allude to the vast considerations necessary for having a site license and vending the technology. Dr. Gregory also spoke about the interactors and space necessary to run simulation, but as MRS at Max Use U is well supported she did not report it to be as big of a challenge.

A partnership approach. Dr. Cameron reported that other universities were interested in the vending model. She reported recently talking to another local university that was in the process of buying a site license and hoping to vend. She said she was honest with them about how expensive and challenging the site license can be, but also supportive and helpful with the institution’s endeavor. She described sharing her practices and scenarios with the university. She reported that she hopes to connect with the leaders of vending programs in order to share practices, cost structures, and other information, and in order to be collaborative and not compete. “I would like to be able to say, we'll do these kinds of scenarios, you do those, and we help each other. I would love that, but we're not there yet.” Here Dr. Cameron describes her desire for a partnership approach with other MRS vending

institutions. She reported that she hoped programs could divide clients in order to specialize in specific scenarios. She believes sharing resources would be more beneficial than competing.

Simulation: Perceptions

As an early adopter of the technology and as a witness to how multiple programs use MRS, Dr. Cameron has a clear point of view about how the technology should be used with students. Like many survey respondents and interviewees, Dr. Cameron believes in a social learning lab model for MRS delivery. Dr. Cameron takes the social learning aspect of MRS delivery further than others in the study as she describes multiple structures to actively involve observing students in the learning.

Social Learning Lab Model and “The Brain”

According to Dr. Cameron, the lab model has been used at Vending State since MRS began. Dr. Cameron described the structure as a professor typically bringing in an entire class, having one student in simulation or the “action seat” at a time for roughly ten minutes. According to Dr. Cameron, this means that only about six people interact directly with MRS during a session. While an individual student is in the “action seat” however, Dr. Cameron described how the other students are highly active participants. Observing students are expected to watch, take notes, think about the teacher candidate’s past, present, and future actions, and are prompted to provide during-action and after-action support and feedback.

Dr. Cameron refers to the active observers in the class as “The Brain.” When facilitating MRS, Dr. Cameron calls upon “The Brain” to provide feedback and guidance along with the professor. Dr. Cameron describes the process:

After they're [the student] in the action seat, we [the faculty/facilitator] will be the ones to say, "Okay, Brain. So, what did you see Owen doing well?" We always start with positives. We get good things, we reiterate it. We tie it back to the content that they've learned. "Yes, he paused, didn't he? Until he was giving that wait time that many of our students with special needs really need in order to process. Excellent, I like how you saw that. Then we would say, "Now, where could he go next? Or what are some other things that you noticed?" Then it allows the students to say, "I did notice that he keeps calling on Ryder because Ryder's talkative, but he's never calling on Ethan," that kind of thing. So, we help them come up with a couple of things, not overwhelming, not too much, not overly negative. Then let the person go back, keep trying.

In this detailed description, Dr. Cameron describes how the facilitator or professor encourages the active learning of "The Brain" post-simulation. She describes how professors first call on students in "The Brain" to identify positives for the student in the "action seat" which directly involves them in the learning. She describes facilitating the process by encouraging "The Brain" to provide specific feedback and next steps. The quote references specific instructional moves, such as "wait time," which she draws attention to for purposes of student learning. Dr. Cameron's emphasis on the active involvement of "The Brain" is similar to the descriptions provided by the interviewees at Sim State and Typical U as it focuses on the social learning aspects of MRS delivery in the lab model. The emphasis on the observing students differed from the opinions expressed by the leader at Max Use U.

Pause, "The Brain," and student stress. In order to capitalize on the social learning model and "The Brain," Dr. Cameron believes in having students in the "action

seat” pause the session. Using this feature, students may stop the simulation at any time in order to gather their thoughts or consult with “The Brain.” Dr. Cameron believes pausing encourages more active participation of “The Brain” while also lessening the pressure and stress placed on the individual student. Dr. Cameron reported that pausing the simulation invites more diversity of thought around what instructional moves or words might work best in the scenario. She describes the value of “The Brain” and pausing:

We love saying that “The Brain” is our gold...If you're in the action seat, it's not scary at all because you don't have to really know what you're doing. You could talk for a second, a minute, it doesn't matter. You can say, “pause session,” and turn to your brain. They're the ones who have to be working, they're the ones who have to be thinking.

Here Dr. Cameron describes the value she perceives in the active learning structure and the pause. She describes how coupling the pause capabilities of MRS with the collaboration of “The Brain” reduces students’ experience of stress. She described the advantage of being able to pause to discuss with their peers the implications, roles, and specific words used. As pause and discussion is not possible in real-life student teaching, Dr. Cameron reported she believes this to be the most valuable part of simulation, “Being able to pause. Being able to call somebody on something right away, you can't do that with a real class.” Dr. Cameron was the only leader interviewed to discuss pausing. Her beliefs differed from what the leader at Max Use U described as best for students as Dr. Cameron believes the social learning and active involvement of “The Brain” are what makes MRS a powerful learning tool. Although more detailed and structured, this method of MRS delivery is similar to what was reported by most survey respondents and the interviewees at Typical U and Sim State.

Scenarios, Feedback and Benefits of the Lab Model

Scenarios. Dr. Cameron reported that the best scenarios are ones that force students to think deeply and collaboratively with “The Brain.” She said that these scenarios are often on important topics that may not be covered directly in coursework. Common scenarios used by RealiTeach include those focused on classroom management, having a critical conversation with a co-teacher, conducting an IEP meeting, and eliciting student thinking. Dr. Cameron also reported that RealiTeach had developed some newer scenarios. These are focused on social-emotional learning and trauma-informed teaching.

Feedback. Dr. Cameron went on to describe how important it was to provide students with rehearsal and real-time feedback. Comparing MRS to being a university supervisor observing a student teacher during clinical practice she said:

I'm watching and I'm immediately taking notes and I can debrief right after the class.

But right after the class is too late. They [the teacher candidate] don't remember exactly what was happening in that moment. To be able to pause and say, “what's happening right now?” or “The rest of you, are you seeing it?” I just find brilliant.

Here Dr. Cameron describes providing immediate feedback to candidates in simulation as more impactful than providing feedback after observing candidates while student teaching. She continues to press the importance of pausing for mid-session discussion and feedback. It is clear from the quote that she believes this function beneficial to student learning.

Benefits. Although not a replacement for student teaching, Dr. Cameron believes the pause and discussion capabilities of MRS delivered in a social setting are more beneficial. According to Dr. Cameron, in the social learning model with simulated teaching practice, all the students present can observe, discuss, actively participate and debrief.

Dr. Cameron also believes this model of MRS delivery is most beneficial as it gives teacher candidates opportunities to see each other teach, “It’s so helpful when teachers get a chance to watch their peers. We know that we have lots of data on that and research on that, but we just don’t [do it]. Teachers always say they don’t have the opportunity, so this is a really nice way for them to do that.” Here Dr. Cameron describes how MRS can also be used as a mechanism to enable peer observation of teaching during preparation—a practice known to be beneficial.

Case Summary

Vending State sells MRS sessions to university programs and businesses through an established university program, RealiTeach. According to the leader of simulation—Dr. Cameron, vending the technology is time consuming, and expensive. In order to do so successfully, she advises others to have a full understanding of the costs and benefits and have ample business knowledge. According to Dr. Cameron, RealiTeach vends the technology to cover expenses and hopes to eventually be able to fund simulation at Vending State mostly or fully through outside contracts.

Dr. Cameron believes the social learning lab-based model is the best way to deliver simulation to students. She believes that the active involvement of the other students in the room, which she refers to as “The Brain,” as well as the ability to pause MRS scenarios to debrief is where the power in simulation lies. Though both Typical U and Sim State also reported valuing the social interaction and observation gained in the lab model and Max Use U expressed the value of post-simulation feedback, Dr. Cameron was the only leader interviewed to focus on MRS’s pause capabilities as a vital MRS structure.

CHAPTER SIX: DISCUSSION

Introduction

Practice and rehearsal are vital components of teacher preparation. Yet meaningful practice, observation, and feedback opportunities are often difficult to provide to students during their education. Mixed Reality Simulation is a technology that provides rehearsal experiences for teacher preparation students. It can also be used as a mechanism to provide real-time coaching, feedback, and mentoring to developing teachers. This explanatory sequential mixed methods study investigated how MRS is being used in teacher preparation programs in the United States and how the leaders of simulation at those institutions perceive the technology for teacher training. In phase one, a survey was sent to leaders of simulation at all teacher preparation programs in the United States known to be utilizing MRS. The survey yielded quantitative and qualitative data describing the state of the field. Phase two of the study included in-depth interviews of simulation leaders from four MRS-using teacher preparation programs. In this chapter, I summarize the findings, detail the significance of those findings, discuss the limitations of this study, suggest directions for further research, and present recommendations concerning the use of MRS in teacher preparation programs.

Summary of the Findings

How is MRS being used in teacher preparation programs?

During phase one of the study, quantitative and qualitative data were collected from the sample (n=41). In regard to extent of use and structure, the survey found: On average, 43% of teacher preparation students at MRS using institutions experience the technology each year; undergraduate juniors and seniors were more likely to use it than other students.

On average respondents reported using 88 hours of simulation annually and integrating MRS into 21% of their education courses, though most programs (69%) reported integrating MRS into 0-20% of courses. Most respondents (76%) reported using MRS with individual students in front of a class, this was more often than other modalities. Following their time in MRS, students most often receive feedback from an instructor (95%), or from their peers (93%) or are provided an opportunity for self-reflection (93%). Many respondents reported recording sessions (80%); they reported most frequently using the recordings for student self-reflection. Among the various scenarios, classroom management scenarios were reported as used by all of the respondents (n=40; 100%). Classroom management scenarios were also most often reported as frequently used (56%). In addition, the research found that COVID-19 caused changes in simulation frequency, content, and integration, with most programs (93%) reporting an increase in MRS use as a result of school shutdowns and limits to opportunities for clinical practice.

Phase two of the study included interviews with a purposeful subsample (n=4) drawn from the survey sample. One individual from an institution exemplifying typical MRS use was interviewed, and three from institutions found to have atypical or “special” MRS use were interviewed. This data demonstrated that institutions were using MRS to provide practice and rehearsal to students in simulation as well as a mechanism to facilitate conversation and discussion about instructional practices. It confirmed the finding from the survey data, that programs were delivering simulation to students in a variety of ways, including in a social learning lab setting (76%), individually (51%), and in small groups (46%). Phase two also elaborated on the scenarios and structures used by specific institutions, confirming that many programs use MRS mostly for clinical-type education

courses. Aligned with the survey data, the use cases in phase two reported classroom management, practical methods-based, and parent-teacher conference-type scenarios as the most widely used. This phase of the study also found that simulation uses at some institutions go beyond coursework and include use as a student progress monitoring tool and for research on teaching and learning as well as a tool to generate revenue by vending to other programs and attracting funders.

How do leaders of MRS perceive the technology for teacher preparation?

The survey found that a vast majority of leaders of simulation (97%) described their experience with MRS as positive. The study found that most leaders of simulation (70%) believed classroom management-type scenarios to be the most beneficial to students. It also found that leaders perceive MRS's ability to provide rehearsal with experiences otherwise impossible as its most beneficial characteristic. As for challenges with the technology, many respondents referenced the time commitment, technology issues, and building faculty buy-in with the technology as the most difficult aspects of MRS.

Many leaders described a lab model of MRS delivery—in which an individual student rehearses publicly in an MRS scenario in front of their peers—as the best way to deliver simulation to students. In the interviews and survey the benefits of the lab model most often referenced were: being able to facilitate real-time discussions about teaching, enabling more peer observation of teaching, and actively involving observing students in the simulation. The stress experienced by students performing in front of peers was most often referenced as a negative of the lab model. Overall, three of the four leaders interviewed reported that the benefits of delivering simulation in the social learning model outweighed

the negatives; one of the three felt that the stress of the performance may be positive to student learning.

Significance of the Findings

Low MRS Use and Structures Needing Research Alignment

The data collected in this study suggest that many institutions are using Mixed Reality Simulation in ways not aligned with current research in the field. In regard to extent of use, most of the institutions designated as low use and some of the institutions designated as medium use are likely using simulation with students far less than the established threshold for instructional change. In addition, many institutions are not concentrating MRS use on specific teaching skills, and are not providing research-aligned feedback.

Respondents in the survey reported an average use of 88-hours of simulation a year, an average exposure rate of 43% of the institution's student population, and an average program size of 753 students. When calculated by use level, low use institutions provided an average of 18 minutes of simulation per year, and medium use institutions averaged 37 minutes. These exposure amounts are not consistent with what previous research found to be impactful. Dieker, Straub, Hughes, Hynes, and Hardin (2014) found a change in specific crucial teaching behavior after four, 10-minute sessions in the simulator. Currently, most MRS-using institutions (19 of 23 reporting, 83%) are not reaching this threshold for change. More research is needed on the impact of MRS at lower use levels.

Along with using simulation less than the level previously shown to enact change, the data collected in this study suggests that some institutions are not targeting specific moves within simulation. Some institutions reported using simulation for general teaching practice and to mimic classroom exposure rather than to target the development of specific

teaching skills. To date, MRS has been shown to improve specific teaching skills when targeted in simulated scenarios (Dieker, Straub, et al. 2014). While additional teaching exposure and general practice with MRS may be beneficial to students, at present, there is no empirical evidence that using simulation in this manner will improve teaching practice.

In addition to the minimal exposure and the general use found at some programs, many programs did not report structuring feedback to students in ways supported by research. Most programs did not report using consistent progress monitoring tools, formal feedback structures, nor reported officially tracking student teaching development over time. While most programs reported video-recording simulation as at least some of the time, 61% of those programs reported using the recordings for students' self-reflection. While this study found the self-reflection practice to be common among programs (93%), the use of self-reflection after MRS classroom management scenarios has in fact been found to be far less effective for improving to teachers' perceptions and skill development than instructional coaching (Cohen, et al., 2020).

Similarly, while some programs reported coupling simulation with live in-the-moment instructional coaching and/or expert feedback, some programs reported providing students with only after-action written feedback or opportunities for self-reflection following their time in MRS. In contrast to this practice, Cohen et al (2020) found pairing coaching with MRS as an impactful teaching strategy resulting in significant improvement to teachers' skills and perceptions of students. In addition, only a few programs reported using MRS's pause capabilities in order to coach students or provide feedback. The lack of the use of pause is misaligned with research as Davis, Kloser, Wells, Windchitl, Carlson, and

Marino (2017) found that using the pause capabilities is an impactful strategy to improve outcomes during teacher rehearsal in MRS.

In order to be aligned with current research in the field, low and medium use institutions need to increase their extent of use. Programs would also need to focus simulations on the development of specific teaching skills and should consider pairing MRS with instructional coaching and integrating the use of the “pause.”

A Focus on Classroom Management

While this study suggests some uses of MRS in teacher preparation may not be consistent with research, it found programs’ use of MRS for classroom management practice aligned. All survey respondents (n=40) reported using classroom management-type scenarios; 57% of them reported using them frequently. In addition, respondents more frequently (70%) rated classroom management-type scenarios as most beneficial to students. Classroom management, often referred to as behavior management or class climate, involves teaching skills such as building rapport, establishing routines and procedures, and building caring relationships with students. As much research exists on the importance of these management skills for student achievement and teacher satisfaction and retention (Aloe, Amo, & Shanahan 2014; Brouwers & Tomic, 2000; Ingersoll & May, 2012), it is fitting that most programs are using MRS in this manner.

Underscoring the importance of this finding, Dawson and Lignugaris/Kraft (2016) found repeated practice in MRS with structured feedback improved specific classroom management skills in the simulator, and those skills transferred to the classroom. Emmer and Stough (2010) advised teacher education provide preparation in classroom management in context and through rehearsal aligned which is how most MRS-using programs described

using classroom management scenarios. In fact, Emmer and Stough (2010), cited a 1987 study on the use of simulations for building classroom management skills (Murphy, Kauffman, & Strang). Interestingly, that research, conducted over thirty years ago, found simulated teaching experiences using “microcomputer” technology resulted in significant positive changes in teaching behavior including an increased use of appropriate management responses by teachers and a decrease in the amount of time spent dealing with pupil misbehavior. As institutions most often reported using simulation to practice classroom management skills, this use is aligned with current and historic research in the field.

Individual Practice Vs. Social Rehearsal

Beyond the research alignment and misalignment of MRS use discovered, the study identified common methods of simulation delivery across programs. It also identified differences in the perceptions of those delivery modes. While survey responses reported that most institutions (76%) deliver simulation to students individually in front of a class or large group, many also deliver simulation to students individually alone (51%). Predictably, individual delivery was more common (69%) at high use institutions, and rare at low use institutions (25%). While delivering MRS individually alone is more focused on providing candidates with opportunities to practice a specific teaching skill, delivering simulation individually in front of peers is often centered around the social aspects of the rehearsal.

The social rehearsal model of delivery where individual students in the “action seat” perform simulated teaching in front of their peers is often referred to as a lab model, or under certain structures, a fish-bowl. The qualitative data from the survey and interviews provided insight into variations of this type of MRS delivery across institutions. Many leaders using the lab model reported involving the active participation of peers; many

leaders reported the “performance” aspect of this model created a high stakes situation for students. One program reported using MRS’s pause feature regularly in order to provide real-time support and facilitate the learning of the observing peers, and one leader reported she believed that the stress students experienced in this model may be positive for their learning. In fact, many leaders referenced the social aspects of rehearsing MRS in the lab model—including the peer observations, discussions, collaborative problem solving and the ability to provide real time feedback—as being more impactful to students than the MRS experience itself.

Oppositely, those that deliver MRS to students individually alone (51% of respondents) seem less focused on social rehearsal and more focused on using MRS to provide opportunities for candidate practice. This delivery mode usually involves an individual student completing a simulation scenario in isolation remotely or in-person. Sometimes this mode was described as having a facilitator present in the session to give feedback, one school reported feedback was provided from the avatar. More often these scenarios were reported as recorded and then given to the course professor for review and also reported as involving after-action feedback provided in written form and/or self-reflection.

It seems that leaders structure the delivery of MRS based on their perceptions of what makes simulation most effective. Those leaders that believe simulation’s power lies in its ability to provide candidates a safe space for repeated practice may prefer to deliver it individually alone. On the other hand, those leaders that believe the social learning aspects provided by involving peers and discussion during MRS are most important, prefer to deliver simulation in a lab model.

Although many leaders spoke about the power of providing simulation in a social learning model, it is important to note that the lab model may not be the most common MRS delivery based solely on the perception of benefit. The model is also the most cost-efficient and requires the fewest resources. For those programs without a site license, and/or with limited funds for MRS, the lab model is likely the only delivery model they can use.

Practice Over All Other Uses

Most institutions reported using MRS primarily for student practice and rehearsal. In the survey, many leaders referenced simulation as an enhancement for clinical practice and as a safe space for rehearsal. Many leaders cited MRS as a suitable replacement for on-site teaching observation and practice during the COVID-19 school shutdowns. Although it is possible others are using MRS in this way, only one leader reported in the survey (and confirmed in the interview), that their institution was using simulation to systematically track student progress over time.

Along with using MRS to provide practice, just seven survey respondents (17%) referenced using MRS for research purposes. Although not asked specifically about research, seven respondents mentioned conducting research in the qualitative portion of the survey. While some respondents are researching the effectiveness of simulation as a method of training, others use MRS as a mechanism to observe a change in teaching behavior in a controlled environment. It should be noted that only institutions that are using MRS practically with students in teacher preparation programs were eligible for this study. As noted in chapter three, 13 institutions that are using simulation solely for research were not included. Subsequently, several more institutions using MRS as a tool for research exist, but the study found few programs are using it as both a tool for training and for research.

Site License and Vending

Along with practice and research, the study found more than half of the institutions with site licenses were vending the technology. Of those institutions identified as site licensed users (n=11; 27%), seven (17% of the sample, and 64% of site licensed institutions) reported vending the technology to other institutions and businesses. As the expense of a site license was reported as substantial, vending was referenced as a way to help cover the high costs. While the two leaders I interviewed from the site licensed institutions reported their overall experience with simulation as positive, both described the site license as expensive, time-consuming, and requiring abundant resources. The leader vending the technology described even more complications and expenses. Both leaders encouraged others to pursue the site license and vending model, but only after a thorough cost-benefit analysis.

No Notable Differences Between Use Levels

As reported in chapter four, a few small differences were found in the quantitative or qualitative data when analyzed by level of use. However, outside of the differences in MRS delivery typically found at low and high use institutions, no notable differences were discovered. This finding points to a more universal experience with the technology that is not dependent on the amount of MRS used by the institution.

COVID-19 as a Catalyst

The study found that 93% of programs experienced a change in MRS use during the COVID-19 pandemic. Of those, the majority (74%) saw an increase in the use of MRS. Many leaders reported integrating technology into new courses, and over half reported exposing more students to the technology during COVID-19. Many leaders lauded the technology's ability to replace clinical hours during school shut-downs. They most often

pointed to unchanged clinical requirements and a desire to provide practice to students that would normally be involved in student teaching experiences as reasons for the increase. Along with the survey respondents, all four interviewees reported an increase in MRS use during COVID-19. In fact, one leader reported using all of the institution's annual contracted hours in the first half of the first semester of the school year. As many leaders described MRS as a way to provide otherwise impossible experiences to students, that is exactly what the technology did during COVID-19. Since many leaders described growing the technology at their institutions organically through demonstrations and faculty just "going for it," the amplified and widespread use of MRS during COVID-19 may act as a catalyst for increased use once the pandemic is over. Faculty that had not integrated the technology before school shutdowns, may see promise in the technology and want to keep it as a permanent part of their coursework.

Limitations

In phase one of this mixed methods study, limitations in validity and reliability lied with the survey instrument. As it was an original questionnaire without previously established information on its validity, it presented inherent limitations. Respondents may have understood questions or response options in different ways, had difficulty recalling or retrieving certain information about their program, or not had a total understanding of their institutions' use.

Along with issues with the validity of the survey instrument, my study was subject to the threat of reactivity in both phase 1 and phase 2. It is possible that simulation leaders—participants in both the survey and interview portions of my study, told me what they thought I wanted to hear with respect to MRS at their institution. They may have

overinflated their use of simulation or may not have shared the true struggles of adopting the technology.

Another limitation to the credibility is due to the number of respondents to the survey. As I got 41 of 52 possible known-simulation users, I do not have data on a full census so cannot make conclusions about the population with certainty.

My reliance on one survey respondent and one interviewee from each site is also a limitation. For both the survey and the interviews, I relied on one perspective to describe the institution's use. Steps were taken to confirm the data collected from the interviewees—including the collection and review of documents and member checks. However, it is possible that the views reported by these single leaders did not in fact represent the views of MRS users of the entire institution. The reliance on one perspective was particularly a limitation for research question one, as these individuals, though simulation leaders, may not have been privy to all the ways simulation is being utilized at their institution. As research question two asked specifically about the perceptions of simulation leaders, and these individuals are leaders of simulation at their institutions, as defined in the study, the data collected around that question was appropriate.

In addition, the study was conducted mostly in 2020, a unique year in the midst of a global pandemic. It cannot be denied that the unprecedented circumstances of 2020 may have influenced some of the data collected. In particular, due to the increase in simulation use during COVID-19, there is some uncertainty as to whether these increases will be sustained once in-person instruction resumes.

Recommendations for Further Research

Mixed Reality Simulation is an emerging innovation with much still to discover about the power of the technology to prepare teachers. Considering the range of use found in this study, I recommend further research in a few critical areas.

Delivery & Student Experience

As a variety of delivery modes were reported by respondents, and perceptions on the benefits of those deliveries were divergent, research on the most effective delivery modes of MRS is needed. Most notably, the differences in the impact of MRS in social rehearsal vs. individual practice should be examined.

In addition, research should investigate the effects of a variety of variables often found in the lab setting. Particularly interesting to consider is the potential impact on those not engaged in simulation but actively observing during the lab model. The effects of discussion and peer-feedback should be researched concentrating on both their impact on students in simulation and the students observing. Research on if observing others in MRS prior to going in the simulation, results in a more successful performance in the simulator is needed. Research should also be conducted on if observation of MRS impacts the development of classroom teaching skills.

Similarly, the use of “The Brain” as described by the leader at Vending State, is an area of research that needs to be investigated. Does the active involvement of the observers during MRS result in a more successful MRS experience for the individual in the simulation? How does that individual perceive their performance with observers compared to their performance without them? How does a candidate perceive their social rehearsal

with and without peer feedback? I believe the structures described in the use of “The Brain” are a fertile research ground.

Outside of looking at social rehearsal vs. individual practice, research should also look at remote vs. in-person delivery. During the COVID-19 school shutdowns, most students experienced MRS remotely from their homes. Three of the four interviewees described this change in experience as positive for students. I recommend a study looking at the impact and/or perceptions of impact of remote vs. in-person delivery of MRS. Particular focus should be given to student stress levels across the two delivery environments. If student stress levels are in fact lowered when MRS is delivered remotely, as interviewees described, is something lost or gained in the experience when the students’ stress level is lowered while remote?

Student Stress and Stress Mitigation

In regard to MRS differences in delivery, the existence of student stress during simulation came up repeatedly in both the survey and the interviews. The existence of stress was most often tied to the social learning lab model of MRS delivery. While survey respondents often referred to MRS as a “low stakes” or a “safe space” for practice, they also often described students’ views of MRS as “high stakes” or “stressful” especially when experienced in front of their peers. While one leader interviewed believed this stress was detrimental to students learning and thus preferred delivering simulation individually, another leader chose to mitigate the stress through the facilitation of active involvement of the observing students and the use of the pause button, yet another believed the stress experienced during the simulation was positive for learning. It is clear that research on the

impact of student stress during MRS as positive, as well as research on the various actions used for student stress mitigation during MRS, should be examined.

Simulation Impact on Overall Teacher Quality

Though MRS has been shown to improve specific teaching skills when targeted in simulation and improve teacher self-efficacy, its impact on the wider field of teacher education is still unknown. Research investigating if MRS using institutions produce “better teachers” is needed as there are many unknowns along these lines. Following up on the research conducted in this study, a study examining if teachers prepared at MRS using institutions have better student outcomes once in the classroom is needed. Similarly, one investigating if teachers from the identified MRS using institutions stay in the profession longer than those from other institutions is needed.

As many factors contribute to the success of a teacher preparation program these studies may make more sense as a quasi-experiment stemming from individual institutions where MRS use is assigned to one of the groups and that group is monitored over time using multiple measures. Since this design requires providing drastically different learning experiences for students at the same institution, it has inherent ethical issues.

If the use of MRS does in fact impact the quality of teacher produced by the preparation program, another vital question to consider is at what threshold does the impact occur? In order for programs to make sound financial and structural decisions about MRS use, they should have a thorough understanding of the threshold required for impact.

Simulation as Progress Monitoring and Screening Tool

Outside of its use for practice and rehearsal, the study found that at least one program is using MRS for progress monitoring of their students. I suggest research on the

technology's ability to accurately monitor changes in instructional practice over time is needed as well as research on correlations between observations of progress in MRS and subsequent teaching performance in a classroom.

In addition to progress monitoring, the use of MRS as a screening tool for students considering pursuing teaching careers should be examined. Mehta & Doctor (2013) described how a rigorous screening tool could help strengthen the teaching profession and subsequently improve student outcomes. MRS may provide a realistic experience for students that could be used to screen potential candidates for entry. Considering many teachers leave the profession after completing preparation but within their first five years of teaching, exploration of finding a screening tool for preparation programs is merited.

Personal Suggestions for Practice

I began using Mixed Reality Simulation via TeachLivE™ to train in-service teachers and instructional leaders in 2013. In 2017, I began using Mursion® at my home institution with undergraduate and graduate students in the teacher preparation program. I currently lead the small MRS pilot program for the school of education. In 2018, I conducted action research examining how MRS leaders grow the use of the technology within their institution. From those personal experiences and the three years spent completing this study, I have formed a specific lens with which to view MRS for training teachers. It is with that lens I offer these recommendations for the use of MRS by teacher preparation programs.

Maximize Impact Through Structure and Delivery

Programs should map MRS to specific courses, concentrate on specific scenarios aligned to their students' learning needs and HLPs, mandate its use, and deliver simulation in a way that maximizes exposure for the program's unique circumstances.

Consistent Integration into Courses

The study found inconsistencies across and within MRS using programs in regard to the number of students exposed to the technology and the percentage of courses the technology was integrated. While some programs' MRS use was mapped to their curriculum and fixed into specific courses and thus experienced by all, most, or specifically determined teacher preparation students, other MRS using programs left integration decisions up to individual faculty. When MRS use is left up to faculty there are tremendous differences in the student experience of the technology. In those programs some students may practice often with MRS while others may never experience it simply due to differences in enrollment or faculty course assignments. Not only is this inconsistency unfair to students, but it also represents a barrier to studying the long-term impact of MRS across teacher preparation programs.

To combat this inconsistency, programs seeking to integrate simulation should do so systematically. Programs should work with faculty to align MRS to core methods courses and mandate their consistent use within the program. A consistent structure will result in similar student experiences within the teacher preparation program. As MRS best matches clinical practice and rehearsal, it seems clinical courses, such as specific teaching methods courses, and/or courses designed to guide students through clinical practice (observation and student teaching) are the best fit for the technology's mandated integration. Given the variability currently found in the field, this type of consistent integration could also enable a more systematic study of the technology's impact on the teaching profession.

Practical Methods Scenarios Aligned with Students' Needs

Along with consistent clinical course integration, programs should choose scenarios aligned with their preservice teachers' learning needs. Most programs reported using classroom management scenarios most frequently, and leaders of simulation most often rated these scenarios as most beneficial. As classroom management is an often-cited need for new teachers, the use of these scenarios seems to be a strong choice to start. Integrating these basic classroom management, rapport building and procedure establishing scenarios into early teacher education courses will help students establish the foundational skills they need to be successful in clinical practice. Placing these scenarios early in the preparation program may also help students decide if teaching is truly what they want to do.

Following practice with classroom management scenarios, programs should be more scientific about the scenarios and the subsequent skills they seek to build in their candidates. Although concentrating scenarios on specifically determined High Leverage Practices seems to be a logical focus, programs could instead use multiple data sources to decide which skills their students need to develop and subsequently which MRS scenarios to use. If MRS is embedded consistently into clinical courses, it seems formative data from master teachers, observations, and self-reflection could guide faculty's choices around the best scenarios to use for their specific students. This type of data-informed decision making for instruction mimics the good teaching practices many in teacher education are striving to teach candidates. Faculty should be determining the needs of their students through multiple measures and then using specific simulation scenarios as a tool for intervention and extra practice. For example, if a majority of mentor teachers and/or faculty supervisors are noting that student teachers need development with specific student discourse moves, the clinical course faculty can choose to use scenarios focused on facilitating student discourse. They

can then use data from the simulation coupled with reports from mentor teachers and supervisors to determine if the simulation intervention was successful. As a huge proponent of modeling good teaching to make good teachers, I suggest the use of multi-measures data to determine the use of MRS scenarios.

Delivery to Maximize Impact for Program's Circumstances

Along with consistent MRS use within a program and data-informed choices around which simulation scenarios to use, programs should deliver MRS to students in a way that maximizes its impact on their program's unique circumstances. While some programs, such as that at Max Use U, have the resources to allow small group and individual use of MRS, most do not. Programs that have fewer resources often can only purchase simulation in typical 2-hour sessions and should attempt to maximize the impact of those purchases. Since the students in these programs will experience less time in simulation, programs should capitalize on the social learning aspect of simulation when delivered in a lab model.

Although more research is needed on the impact of this social learning focused model, it is the mode of delivery I use in my courses. Anecdotally, I can attest to the models' efficacy for student learning. As reported by many of the use cases, when facilitated well, a social learning structure of MRS delivery can be highly beneficial even to students not actively interacting with the MRS. While individual students are interacting in the simulator, observing students are engaged and active participants. They often guide the student in the "action seat" with in-the-moment, and post-simulation feedback as well as collaboratively problem-solve difficult issues that arise during the simulation. Schools with limited funds for simulation hours should deliver MRS in this manner in order to maximize the potential impact of the simulator.

Use the pause. Whether simulation is delivered in the social learning model or individually with students and a facilitator, it is my belief that the use of the “pause” is imperative. Technology is best used when we capitalize on its unique features that enable otherwise impossible situations. A pause capability is (regrettably) never available in real life. As teachers, we do not get the chance to pause a lesson that is going poorly, or pause a student who is disrupting. We do not get opportunities in student teaching, or regular classroom teaching to stop, think, collaborate, problem-solve, and then subsequently adjust our behavior and start again. We do not ever get a chance to teach the same exact lesson to the same exact students twice, but try different methods and get different outcomes. We do not get to pause a conversation with a parent or colleague that is getting contentious and try again using different words. With Mixed Reality Simulation, and specifically with the use of the pause, all these possibilities are available. Pausing is a unique attribute to MRS rehearsal. Much of the power of simulation, in my opinion, lies in its capability to pause social interaction.

Simulation to Normalize Peer Observation and Feedback for Teachers

In addition to providing the unique opportunity to pause, MRS may be able to help normalize other teacher training methods critical to their development. Programs that have the means to deliver simulation in small groups and/or individually to students may desire to do so to minimize students’ feelings of stress when performing in front of their peers. However, those programs may want to consider the benefits of the social learning model and its potential for impact on the teaching profession as a whole.

Outside of student teaching, it is very rare that teachers get a chance to observe other teachers in practice. It is true that there is a lack of opportunities for peer observation for

both pre-service and in-service teachers. That said, peer-observation based professional development practices such as instructional rounds, peer instructional coaching, and especially lesson study has long been established as impactful development methods for teachers (Stigler, 1999). Taking part in peer observation and lesson study experiences however can be stressful for teachers and are often difficult for instructional leaders to facilitate. If MRS is amply used and delivered in a social learning model in teacher preparation, it may work as a mechanism to help normalize peer feedback and observation. It could support the creation of teachers with more collaborative approaches to their instructional practice and teachers more comfortable with peer observation and feedback. Perhaps in doing so, it would serve to normalize those collaborative practices with in-service teachers as well.

Spread the Technology with a Facilitator and Demos

For those programs and individuals looking to implement or increase MRS into their teacher preparation program, the study revealed two distinct important practices—the importance of a designated facilitator and the use of demos to entice faculty to use and spread the technology. MRS programs should employ a knowledgeable and enthusiastic facilitator. This individual should have thorough knowledge of MRS technology, as well as an understanding of effective teaching and learning practices, adult learning theory, and basic research capabilities. The individual should be charged with the scheduling and coordination of simulation, working with faculty to choose or develop the best scenarios for their content area, co-facilitating simulations with the course faculty, and co-investigating research. These individuals should also be able to provide students with meaningful feedback on their simulation performance as well as facilitate the learning of the student

observers. As someone who has held this role as an “extra” on top of a full-time position, I can say with certainty this position needs support from the university. Depending on the extent of MRS use at the institution, facilitation of MRS should be a halftime or full-time position in order to be effective.

Along with a facilitator to run the technology, programs should provide faculty with demonstrations in order to encourage MRS use. In my experience, and as referenced by many respondents and interviewees, demonstrations are the best way to grow the technology’s use. Demonstrations allow faculty to develop a more thorough understanding of the technology than when the technology is explained in the abstract; they allow faculty to imagine the possibilities for themselves and thus organically create more buy-in.

As echoed by many respondents and interviewees, I suggest coupling demonstrations with a designated facilitator. These two elements will help alleviate the pressure on faculty to take on something new and unknown. While the demonstrations help faculty gain an understanding of the technology and the capabilities, a facilitator makes the technology more accessible and less burdensome. Together demonstrations and a facilitator may help to spread the technology’s use within a program.

Just Try It

Along these lines, as a long-time facilitator and as someone who has provided a lot of MRS demonstrations, I encourage teacher preparation programs considering integrating MRS into their program to just do so. I fell in the love with the possibilities of the technology after seeing it at a demonstration in 2013. I have spent eight years witnessing student “ah-ha” moments and their personal teaching break-throughs while in a simulation scenario. I have observed as teacher candidates excitedly and collaboratively prepare for

their time in simulation—discussing notes and observations about [avatar] students as if they are real, panicking about their ideas for interventions, or discussing the best way to share student achievement data with a parent. I have watched as new-to-the-role instructional leaders build their confidence and competence in their leadership skills while in simulation. As a teacher and instructional leader myself, it is easy to sense how much impact and value it could have on the field if integrated widely.

Policy Recommendations

In order to consider wide scale adoption at the institutional level, state agencies should allow MRS practice to count toward clinical hours. As noted in chapter 1, in 2020, education policies around the country adjusted to allow MRS to replace clinical hours during the pandemic (California Commission on Teacher Credentialing, 2020). Many state agencies, as many survey respondents, cited the technology's ability to provide practice that was otherwise impossible during the school shutdowns. I believe such policies should remain moving forward. Just as nurses can replace up to 50% of their required clinical hours with simulated practice (Bradley et. al., 2019), credentialing agencies should allow some level of replacement of clinical hours for teachers.

To be clear, I do not believe MRS to be a thorough substitute for student teaching. I do believe that it should to be allowed in particular situations. MRS should be considered a suitable replacement for clinical hours if teacher candidates need practice with particular situations, students, or circumstances that are difficult to facilitate or guarantee during student teaching. For example, MRS could provide practice with an IEP, a vital meeting that student teachers are not usually allowed to take part in. Similarly, MRS could provide practice for teaching a particular type of student that the student teacher does not have

access to at their placement (such as one with as a specific learning disability, or an English Learner student when a university and its partner schools are located a homogenous English-speaking area, or with specific types of disruptive behavior that experience with cannot be guaranteed in student teaching). I believe MRS practice within these otherwise impossible situations should be allowed to count toward clinical hours.

Conclusion

Mixed Reality Simulation is a technology that provides students in teacher preparation programs valuable opportunities for practice. Though promising, MRS is not widely used. This study examined how MRS is being used in teacher preparation programs in the United States and how the leaders of MRS perceive the technology. More research is needed but there are some things we can say about MRS using teacher preparation programs:

- As of the fall of 2020, MRS is being used in 52 programs in the United States to train teachers.
- Most programs have low integration. Most respondents reported integrating simulation into 20% or less of their courses. On average of MRS institutions use simulation with 43% of their teacher preparation students and average 88 hours of annual use.
- Most or all programs use classroom management-type scenarios. Most respondents report these scenarios as most beneficial to students.
- Most programs deliver MRS to students in a lab model. Many encourage the active participation of the observing students.

- Most programs record simulations at least some of the time. Recordings are most often used for student self-reflection.
- COVID-19 increased the extent of MRS use in most programs and may be a catalyst for increased use going forward.
- Most leaders describe their experience with MRS as positive and often reference the technology's ability to provide a "safe space" for practice and its ability to provide rehearsal with situations otherwise impossible as its most positive benefit.
- Many leaders described challenging experiences with technology including the administrative workload or time commitment involved in facilitating MRS, technology issues, and difficulty building faculty buy-in.

Although there were threats to reliability of this study impacting its generalizability, steps were taken to mitigate them. It is my hope that this accumulation of knowledge will help improve the use of MRS within the early adopter teacher preparation programs as well as inspire those considering the powerful innovation to take it on.

Appendix A: Survey Instrument

Simulation in Teacher Education

Start of Block: Informed Consent

Q1.1

You are invited to participate in a study being conducted by Ashley Ireland, a doctoral student at UCLA. The purpose of the study is to examine the ways in which simulation is being used in teacher preparation programs. Participation should take approximately 10-15 minutes to complete. Your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty. You will receive a \$5 gift certificate for participating in this research study. Your responses may help us learn more about simulation for teacher preparation and training. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life. The data from this survey will be kept confidential, and any information institution identifying or personal identifying information will be destroyed. If you have any questions, comments, or concerns about the research, contact Ashley Ireland the principal investigator, at (XXX) XXX-XXXX. If you have questions about your rights as a research subject, or you have concerns or suggestions and you want to talk to someone other than the researchers, you may contact the UCLA OHRPP by phone: (310) 206-2040; by email: participants@research.ucla.edu or by mail: Box 951406, Los Angeles, CA 90095-1406. Please select your choice below. You may print a copy of this consent form for your records. Clicking on the “Yes” button indicates that:

You have read the above information

You voluntarily agree to participate

You are 18 years of age or older

Q1.2 Do you agree to take this survey?

☐ Yes (1)

☐ No (2)

End of Block: Informed Consent

Start of Block: Screener

Q2.1 Is simulation used in your teacher education or teacher preparation program?

☐ Yes (1)

☐ Maybe (2)

☐ No (3)

Skip To: Q2.2 If Q2.1 = 2

Skip To: Q2.3 If Q2.1 = 3

Skip To: End of Block If Q2.1 = 1

Q2.2 Simulation includes a virtual or mixed reality technology students use to experience simulated teaching scenarios. Simulation may be called by a variety of names including TeachLivE™, Mursion®, SIMPACT, TeachME. Is simulation used in teacher preparation program at your institution? If you have recently began a contract but have not yet begun implementation you may still click yes and take part in the survey.

☐ Yes (1)

☐ No (2)

Skip To: End of Survey If Q2.2 = 2

Q2.3 Although simulation is not used in your teacher education or preparation program, have you recently begun a contract or are you beginning to implement simulation at your institution?

- ☐ Yes (1)
- ☐ No (2)

Skip To: End of Survey If Q2.3 = 2

End of Block: Screener

Start of Block: Demographics

Q3.1 In what U.S. region is your institution located?

- ☐ West: CA, OR, WA, ID, NV, UT, WY, MT, CO, AK, HI (3)
- ☐ South/Southeast: AR, LA, MS, AL, GA, OK, TX, FL, SC, NC, WV, VA, KY, TN, DC (7)
- ☐ Midwest: ND, SD, NE, KS, MO, IA, MN, WI, MI, IL, IN, OH (10)
- ☐ Northeast: ME, NH, MA, VT, NY, PA, MD, DE, NJ, CT, RI (9)

Q3.2 What classification best describes your institution?

- ☐ Doctorate-granting University (1)
- ☐ Masters College or University (2)
- ☐ Baccalaureate College (3)
- ☐ Associates College (4)
- ☐ Special Focus Institution (5)
- ☐ Tribal College (6)
- ☐ Not classified (7)
- ☐ Do not know (8)
- ☐

Q3.5 Please report percentages for each question:

0 10 20 30 40 50 60 70 80 90 100

Approximately what percentage of the teacher education courses at your institution have integrated simulation? ()	
Approximately what percentage of students in your teacher education program experience at least one simulation at your institution each year? ()	

Q3.6 Approximately how many hours of simulation does your teacher preparation program use in a typical academic year?

☐ Approximately hours: (1) _____

☐ Do not know (2)

End of Block: Demographics

Start of Block: Level of Adoption / License

Q4.1 What level of simulation adoption best describes your institution?

☐ Site licensed user (1)

☐ Purchasing simulation hours from Mursion® or TeachLivE™ (2)

☐ Purchasing simulation hours from another institution (3)

☐ Unsure (4)

Q4.2 Do you sell or vend simulation hours to other institutions?

☐ Yes (1)

☐ No (2)

Display This Question:
If Q4.2 = 1

Q4.3 If you sell or vend simulation hours to another institution (or institutions) we would like to know in what ways they are using simulation. Please provide the institution's names and points of contact (emails are helpful) so that we may ask them to take part in this study.

Q4.4 How are simulations funded?

☐ Dean's Office (1)

☐ Grant (2)

☐ Student Fees (3)

☐ Other (4) _____

☐ Don't Know (5)

Q4.5 How would you characterize your experience of simulation at your institution?

- ☐ Extremely positive (1)
- ☐ Somewhat positive (2)
- ☐ Neither positive nor negative (3)
- ☐ Somewhat negative (4)
- ☐ Extremely negative (5)

Q4.6 What has been the most positive aspect of working with simulation?

Q4.7 What has been the most negative aspect of working with simulation?

End of Block: Level of Adoption / License

Start of Block: Simulation Use- Content

Q5.1 How frequent is the use of these scenarios?

	Frequently Used (1)	Somewhat Used (2)	Minimally Used (3)	Not Used (4)
Classroom management/Behavior management scenarios (1)	☐	☐	☐	☐
Co-teaching scenarios (2)	☐	☐	☐	☐
Science instruction scenarios (3)	☐	☐	☐	☐
Math instruction scenarios (4)	☐	☐	☐	☐
Reading / English Language Arts instruction scenarios (5)	☐	☐	☐	☐
General pedagogy focus scenarios (non content) (6)	☐	☐	☐	☐
Social Emotional Learning focused scenarios (7)	☐	☐	☐	☐

Q5.2 How frequent is the use of these scenarios?

	Frequently Used (1)	Somewhat Used (2)	Minimally Used (3)	Not Used (4)
Job Interview scenarios (1)	☐	☐	☐	☐
Meeting with principal or instructional coach scenarios (2)	☐	☐	☐	☐
Special education instruction scenarios (3)	☐	☐	☐	☐
IEP Meetings scenarios (4)	☐	☐	☐	☐
Parent-Teacher conference scenarios (5)	☐	☐	☐	☐
English Language Development / EL instruction scenarios (6)	☐	☐	☐	☐
Other (please enter any scenario used that is not listed) (7)	☐	☐	☐	☐
Other (please enter any scenario used that is not listed) (8)	☐	☐	☐	☐
Other (please enter any scenario used that is not listed) (9)	☐	☐	☐	☐



Q5.3 How beneficial do you feel these scenarios are for teacher preparation students?

Most beneficial	Somewhat beneficial	Least beneficial	No experience	Harmful
_____ Classroom management / Behavior management scenarios (1)	_____ Classroom management / Behavior management scenarios (1)	_____ Classroom management / Behavior management scenarios (1)	_____ Classroom management / Behavior management scenarios (1)	_____ Classroom management / Behavior management scenarios (1)
_____ Pedagogy-focused scenarios (2)	_____ Pedagogy-focused scenarios (2)	_____ Pedagogy-focused scenarios (2)	_____ Pedagogy-focused scenarios (2)	_____ Pedagogy-focused scenarios (2)

_____ Parent- teacher conference scenarios (3)	_____ Parent- teacher conference scenarios (3)	_____ Parent- teacher conference scenarios (3)	_____ Parent- teacher conference scenarios (3)	_____ Parent- teacher conference scenarios (3)
_____ Co- teaching scenarios (4)	_____ Co- teaching scenarios (4)	_____ Co- teaching scenarios (4)	_____ Co- teaching scenarios (4)	_____ Co- teaching scenarios (4)
_____ IEP meeting scenarios (5)	_____ IEP meeting scenarios (5)	_____ IEP meeting scenarios (5)	_____ IEP meeting scenarios (5)	_____ IEP meeting scenarios (5)
_____ Science instruction scenarios (6)	_____ Science instruction scenarios (6)	_____ Science instruction scenarios (6)	_____ Science instruction scenarios (6)	_____ Science instruction scenarios (6)
_____ Math instruction scenarios (7)	_____ Math instruction scenarios (7)	_____ Math instruction scenarios (7)	_____ Math instruction scenarios (7)	_____ Math instruction scenarios (7)
_____ Reading/ English Language Arts instruction scenarios (8)	_____ Reading/ English Language Arts instruction scenarios (8)	_____ Reading/ English Language Arts instruction scenarios (8)	_____ Reading/ English Language Arts instruction scenarios (8)	_____ Reading/ English Language Arts instruction scenarios (8)
_____ Special education instruction scenarios (9)	_____ Special education instruction scenarios (9)	_____ Special education instruction scenarios (9)	_____ Special education instruction scenarios (9)	_____ Special education instruction scenarios (9)
_____ Meetings with principal or instructional coach scenarios (10)	_____ Meetings with principal or instructional coach scenarios (10)	_____ Meetings with principal or instructional coach scenarios (10)	_____ Meetings with principal or instructional coach scenarios (10)	_____ Meetings with principal or instructional coach scenarios (10)
_____ Job interview scenarios (11)	_____ Job interview scenarios (11)	_____ Job interview scenarios (11)	_____ Job interview scenarios (11)	_____ Job interview scenarios (11)
_____ Social Emotional Learning focused scenarios (12)	_____ Social Emotional Learning focused scenarios (12)	_____ Social Emotional Learning focused scenarios (12)	_____ Social Emotional Learning focused scenarios (12)	_____ Social Emotional Learning focused scenarios (12)
_____ Other (please enter any scenario used that is not listed) (14)	_____ Other (please enter any scenario used that is not listed) (14)	_____ Other (please enter any scenario used that is not listed) (14)	_____ Other (please enter any scenario used that is not listed) (14)	_____ Other (please enter any scenario used that is not listed) (14)
_____ Other (please enter any scenario used that is not listed) (15)	_____ Other (please enter any scenario used that is not listed) (15)	_____ Other (please enter any scenario used that is not listed) (15)	_____ Other (please enter any scenario used that is not listed) (15)	_____ Other (please enter any scenario used that is not listed) (15)
_____ Other (please enter any scenario used that is not listed) (16)	_____ Other (please enter any scenario used that is not listed) (16)	_____ Other (please enter any scenario used that is not listed) (16)	_____ Other (please enter any scenario used that is not listed) (16)	_____ Other (please enter any scenario used that is not listed) (16)

Q5.4 Why were certain scenarios more beneficial than others?

End of Block: Simulation Use- Content

Start of Block: Simulation Use- Modalities

Q6.1 How do students experience simulation? Select all that apply.

- ☐ Individually alone (1)
- ☐ Individually in front of class or large group (2)
- ☐ In partners (3)
- ☐ In small groups (4)
- ☐ In small groups in front of class or large group (5)
- ☐ Other (6) _____

Q6.2 How is simulation delivered to students? Select all that apply.

- ☐ In-person during scheduled class time (1)
- ☐ In-person outside of scheduled class time (2)
- ☐ Remotely (over a platform such as Zoom or Skype) outside of scheduled class time (3)
- ☐ Remotely (over a platform such as Zoom or Skype) during scheduled class time (4)
- ☐ Other (5) _____

Q6.3 Please detail how students experience simulation within your program:

Q6.4 What types of feedback are given to students during or after they experience simulation? Select all that apply.

- ☐ No feedback (1)
- ☐ Peer feedback from fellow students (2)
- ☐ Self-reflection (3)
- ☐ Instructor feedback (4)
- ☐ Other expert feedback such as coach or mentor (5)
- ☐ Other: (6) _____

Q6.5 Are the simulations recorded?

- ☐ Never (1)
- ☐ Sometimes (2)
- ☐ Always (3)

Q6.6 If simulations are recorded, how are the recordings used?

End of Block: Simulation Use- Modalities

Start of Block: Simulation Use-COVID-19

Q7.1 Has simulation usage changed during the school shutdowns related to COVID-19?

- ☐ Yes (1)
- ☐ No (2)

Skip To: Q7.2 If Q7.1 = 1

Skip To: End of Block If Q7.1 = 2

Q7.2 Please report how simulation has changed in relation to school shutdowns related to COVID-19

	Increased (1)	Stayed the Same (2)	Decreased (3)
The frequency of simulation use (1)	☐	☐	☐
Number of students using simulation (2)	☐	☐	☐

Q7.3 Please report how simulation has changed in relation to school shutdowns related to COVID-19

	Changed (1)	Stayed the Same (2)
The content of the simulations used (1)	☐	☐
The student population using simulation (2)	☐	☐
The way (mode) students experience simulation (3)	☐	☐
The feedback students receive during or after simulation (4)	☐	☐

Q7.4 To what extent did each of the following factors lead to changes in simulation use?

	A lot (1)	A moderate amount (2)	A little (3)	None at all (4)	Unknown (6)
Changes in state policy around clinical practice (or student teaching requirements) (1)	☐	☐	☐	☐	☐
Aiming to meet unchanged clinical requirements during k-12 school shutdowns (2)	☐	☐	☐	☐	☐
Aiming to provide remote practice during higher education shutdowns (3)	☐	☐	☐	☐	☐
Aiming to provide teaching feedback during higher education shutdowns (4)	☐	☐	☐	☐	☐
Aiming to provide student teaching hours (5)	☐	☐	☐	☐	☐
Difficulty staffing simulation due to higher education shutdowns (6)	☐	☐	☐	☐	☐
Difficulty accessing equipment to run simulation during higher education shutdowns. (7)	☐	☐	☐	☐	☐

Concerns about
funding caused
by factors
related to
COVID-19 (8)

☐☐☐☐☐

Other (9)

☐☐☐☐☐

Q7.5 Please describe why simulation usage has changed at your institution as a result of COVID-19?

End of Block: Simulation Use: COVID-19

Start of Block: Open-ended

Q8.1 How did simulation begin at your institution?

Q8.2 Were you involved in the beginning of simulation at your institution?

☐ Yes (1)

☐ No (2)

Q8.3 As a leader of simulation at your institution, what are your proposed goals of using simulation in the program?

Q8.4 In what ways, if any, is progress toward those proposed goals measured?

Q8.5 How did you and/or do you encourage other faculty to use simulation in their courses?

Q8.6 What do you foresee as the future of simulation usage at your institution?

Q8.7 Is there anything else you would like to say in regard to simulation?

Q8.8 We are planning to conduct follow-up interviews for this study. If you are interested in learning more about the interviews, please supply your contact information:

End of Block: Open-ended

Appendix B: Interview Protocols

Simulation Research: Interview Protocol Interview Protocol- Typical “Typical U”

1. How long have you worked at UXX?
2. What is your primary role? What program do you teach within?
3. When and how did you start working with simulation?
 - a. Who brought it to the program?
 - b. What was the original intent?
 - c. How was it received?
4. Can you please describe how MRS is used at UXX?
 - a. *Confirm survey findings and or inquire about divergence from the norm*
 - i. Modalities
 - ii. Student populations
 - iii. Scenarios
 - iv. Usefulness
 - v. Recordings/feedback
 - vi. Courses
5. Describe your role and work with simulation in your program:
 - a. Are you involved in growing (or trying to grow) the MRS program?
6. How do faculty at UXX learn about simulation?
 - a. In your experience, why do faculty choose to bring simulation into their coursework?
 - b. When a faculty member initially expresses interest in bringing simulation into their course, how do you work with them?

- c. Have you found particular types of faculty or faculty from particular programs are more likely to use simulation at UXX? If so, who are they, and why do you think they are more likely to use it?
- 7. What do you attribute to successfully convincing faculty and staff to use simulation?
 - a. Get at Surprises
 - b. Get at barriers
- 8. How has UXX paid for the cost of simulation technology?
 - a. Has payment changed?
 - b. Has cost changed, why
 - c. Plans for financially sustaining the program
- 9. What hurdles have you encountered when helping faculty to bring in simulation?
- 10. Is the university conducting research with simulation?
- 11. What advice do you have for someone seeking to implement simulation at their university?
- 12. What is the plan for the future of simulation at UXX?
- 13. What do you envision as the future for simulation in teacher preparation?

Simulation Research: Interview Protocol
Interview Protocol- Atypical Maximum Use Case
“Max Use U”

1. How long have you worked at UXX?
2. What is your primary role?
3. When and how did you start working with simulation?
 - a. Who brought it to the program?
 - b. What was the original intent?
 - c. How was it received?
4. Describe how MRS is used at UXX
 - a. *Confirm survey findings and or inquire about divergence from the norm*
 - i. Modalities
 - ii. Student populations/Programs
 - iii. Scenarios
 - iv. Usefulness
 - v. Recordings/feedback
 - vi. Courses
 - vii. Research
 - viii. Goals/Assessment
5. Describe your role and work with simulation in your program
6. Are you involved in trying to spread the simulation to more faculty members at UXX? How do faculty at UXX learn about simulation?
 - a. In your experience, why do faculty choose to bring simulation into their coursework?

- b. When a faculty member initially expresses interest in bringing simulation into their course, how do you work with them?
 - c. Have you found particular types of faculty or faculty from particular programs are more likely to use simulation at UXX? If so, who are they, and why do you think they are more likely to use it?
- 7. What do you attribute to successfully convincing faculty and staff to use simulation?
 - a. Get at Surprises
 - b. Get at barriers
- 8. How has UXX paid for the cost of simulation technology?
 - a. Has payment changed?
 - b. Has cost changed, why
 - c. Plans for financially sustaining the program
- 9. What hurdles have you encountered when helping faculty to bring in simulation?
- 10. Is the university conducting research with simulation?
- 11. What advice do you have for someone seeking to implement simulation at their university?
- 12. What is the plan for the future of simulation at UXX?
- 13. What do you envision as the future for simulation in teacher preparation?
- 14. Is there anything else you'd like to say in regard to simulation?
- 15. Is there anyone else you'd recommend me to speak to further gain an understanding of how simulation is used at UXX?

Simulation Research: Interview Protocol
Interview Protocol- Atypical Low Hours, High Use
“Sim State”

1. How long have you worked at UXX?
2. What is your primary role? What program do you teach within?
3. When and how did you start working with simulation?
 - a. Who brought it to the program?
 - b. What was the original intent?
 - c. How was it received?
4. What is the current status of simulation at UXX?
 - a. *Confirm survey findings and or inquire about divergence from the norm*
 - i. Modalities
 - ii. Student populations
 - iii. Scenarios
 - iv. Usefulness
 - v. Recordings/feedback
 - vi. Courses
5. Describe your role and work with simulation in your program:
6. How do faculty at UXX learn about simulation?
 - a. In your experience, why do faculty choose to bring simulation into their coursework?
 - b. When a faculty member initially expresses interest in bringing simulation into their course, how do you work with them?

- c. Have you found particular types of faculty or faculty from particular programs are more likely to use simulation at UXX? If so, who are they, and why do you think they are more likely to use it?
- 7. What do you attribute to successfully convincing faculty and staff to use simulation?
 - a. Get at Surprises
 - b. Get at barriers
- 8. How has UXX paid for the cost of simulation technology?
 - a. Has payment changed?
 - b. Has cost changed, why
 - c. Plans for financially sustaining the program
- 9. What hurdles have you encountered when helping faculty to bring in simulation?
- 10. Is the university conducting research with simulation?
- 11. What advice do you have for someone seeking to implement simulation at their university?
- 12. What is the plan for the future of simulation at UXX?
- 13. What do you envision as the future for simulation in teacher preparation?
- 14. Is there anything else you'd like to say in regard to simulation?
- 15. Is there anyone else you'd recommend me to speak to further gain an understanding of how simulation is used at UXX?

Simulation Research: Interview Protocol
Interview Protocol- Atypical Vending
“Vending U”

1. How long have you worked at UXX?
2. What is your primary role? What program do you teach within?
3. When and how did you start working with simulation?
4. Describe how RealiTeach works? How is the vending structured?
5. How did vending begin?
 - a. Who started it? Why
 - b. What was the original intent?
 - c. How was it received?
6. Outside of the schools you vend to, What is the current status of simulation use at UXX?
 - a. *Confirm survey findings and or inquire about divergence from the norm*
7. Describe your role and work with simulation in your program
8. For RealiTeach How do you gain more clients? Grow your network?
 - a. In your experience, why do faculty choose to bring simulation into their coursework?
 - b. When a faculty member initially expresses interest in bringing simulation into their course or program, how do you work with them?
 - c. Have you found particular types of faculty or faculty from particular programs are more likely to use simulation? If so, who are they, and why do you think they are more likely to use it?
9. What do you attribute to successfully convincing faculty and staff to use simulation?

- a. Get at Surprises
 - b. Get at barriers
10. How has UXX paid for the cost of simulation technology?
- a. Has payment changed?
 - b. Has cost changed, why?
 - c. Plans for financially sustaining the program
11. What hurdles have you encountered vending this technology?
12. What advice do you have for someone seeking to begin vending MRS?
13. What is the plan for the future of RealiTeach?
14. What do you envision as the future for simulation in teacher preparation?
15. Is there anything else you'd like to say in regard to vending simulation?
16. Is there anyone else you'd recommend me to speak to further gain an understanding of how simulation is used in RealiTeach?

Appendix C: Recruitment, Reminder, and Thank You Emails

Professor <<LAST NAME>>,

I hope you are well. My name is Ashley Ireland and I am a graduate student researcher at the University of California, Los Angeles. I am conducting a research study on the use of Mixed Reality Simulation at teacher preparation programs across the country. It is my understanding that you are involved in this work at <<INSTITUTION>>.

The study includes an online survey that will take about 15-minutes to complete. In addition, some participants will be asked to take part in a follow-up interview. Both the survey and interview will seek to learn the ways in which simulation is being used at your institution--specifically to train teachers. It will include questions about scenarios, delivery, level of adoption, as well as the perception of impact and purpose.

The survey should be completed by someone who is knowledgeable about (and perhaps manages or coordinates) the school's use of simulation. If you are not familiar with your school's use of simulation but have a colleague who is, I would be very grateful if you would forward this email to that individual and copy me.

Please let me know if you have any questions or concerns as I'd be happy to discuss it with you further.

I hope to receive your response in the next 2-weeks. As a small token of gratitude for your time and effort, you will be provided with a \$5 Amazon.com gift card for completing the survey.

The survey can be found here: <<LINK>>

Thank you for your consideration, Ashley

Ashley Ireland

Graduate Student Researcher

School of Education & Information Studies

University of California, Los Angeles

(XXX) XXX-XXXX or (XXX) XXX-XXXX

Survey Reminder Email

Professor <<LAST NAME>>,

I hope you are well. I am following up on the research study I am conducting on the use of simulation in teacher preparation programs across the country (often via Mursion®, TeachLive, SIMPACT, etc.).

As I described in my previous email, the study includes an online survey that will take about 15-minutes to complete. The survey is seeking to learn the ways in which simulation is being used at your institution--specifically to train teachers. It includes questions about scenarios, delivery, level of adoption, as well as the perception of impact and purpose. You are receiving this email because you have either not taken the survey or began it but have not yet completed it.

If your institution does not use, or is no longer using simulation, please let me know by replying to this email. If your institution just started using simulation, you may still take the survey.

If you have any questions or concerns, I'd be happy to discuss this work with you further.

I hope to receive your response this week. As a small token of gratitude for your time and effort, you will be provided with a \$5 Amazon gift card for completing the survey.

The survey can be found here:

Thank you for your consideration, Ashley

Ashley Ireland

Graduate Student Researcher

School of Education & Information Studies

University of California, Los Angeles

(XXX) XXX-XXXX or (XXX) XXX-XXXX

Survey Final Call Email

Professor <<LAST NAME>>,

I hope you are well! As you know, I am conducting a research study on the use of simulation in teacher preparation programs across the country (often via Mursion®, TeachLivE™, SIMPACT, etc.). I'm writing to let you know that I will be closing the survey window at the end of this week, on **Friday, November 6th**. If you have not yet responded (or have started the survey but not yet completed), I would be so grateful to hear from you. So far, most respondents have completed the survey in 20-minutes or less. I know your time is precious and so really appreciate your consideration of this request. Your perspective would make an important contribution to this effort to understand current simulation use in programs across the U.S. (including how simulation is being used, and perceptions of its effectiveness). If you choose to participate, you will be provided with \$5 Amazon gift card, a small token of gratitude for your help.

Here's the link: <<LINK>>

If you started previously but did not complete, the link above should allow you to pick up where you left off. If you have any problems with the link—or other questions about the survey—please contact me.

If <<INSTITUTION>> has not used, or is no longer using simulation, I would be grateful if you would let me know by replying to this email. That way, I can remove <<INSTITUTION>> from the study's sampling frame. If your institution just recently started using simulation, you may still take the survey.

Thank you for your consideration,

Ashley

Ashley Ireland

Graduate Student Researcher

School of Education & Information Studies

University of California, Los Angeles

(XXX) XXX-XXXX or (XXX) XXX-XXXX

Survey Thank you Email

Professor <<LAST NAME>>,

I hope you are well. Thank you for taking the time to participate in my survey on MR simulation in teacher preparation.

As a small token of gratitude for your time and effort, please find a \$5 [Amazon](#) gift card code below.

<<CODE>>

Thank you for your time, Ashley

Ashley Ireland

Graduate Student Researcher

School of Education & Information Studies

University of California, Los Angeles

(XXX) XXX-XXXX or (XXX) XXX-XXXX

Interview Recruitment Email

Hello <<NAME>>,

I hope you are well. My name is Ashley Ireland and, as you know, I am a graduate student researcher at the University of California, Los Angeles. You recently took part in a research study into the use of Mixed Reality Simulation in teacher preparation I am conducting.

Based on your answers to the survey questions, I would like to ask you to participate in a 1-hour follow-up interview over Zoom. The interview will seek to learn more about the ways simulation is being used at <<INSTITUTION>>. It will include a variety of questions about scenarios, delivery, level of adoption, vending, as well as the perception of impact and purpose.

If you are willing to take part in a follow-up interview, please reply to this email so that I may go forward with scheduling. As a small token of gratitude for your time and effort, you will be provided with a \$10 Amazon.com gift card.

Thank you for your time and consideration, Ashley

Ashley Ireland

Graduate Student Researcher

School of Education & Information Studies

University of California, Los Angeles

(XXX) XXX-XXXX or (XXX) XXX-XXXX

Appendix D: Additional Tables

Table D: 1 Categories to Influence Use

Variables to Influence Categories: Levels of Use									
	Q3.5_1_PERCENTAGE OF COURSES			Q3.5_2 PERCENTAGE OF STUDENTS			Q3.6_1_TEXT_AMOUNT OF HOURS		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
Valid	12.0	15.0	13.0	11.0	13.0	12.0	11.0	12.0	11.0
Missing	0.0	1.0	0.0	1.0	3.0	1.0	1.0	4.0	2.0
Mean	6.8	21.1	35.0	10.7	44.8	70.7	31.2	56.9	179.6
Median	7.5	19.0	31.0	10.0	40.0	77.5	30.0	35.0	64.0
Mode	10.0	10.0	20.0	1.0	20.0	25.0	30.0	30.0	30.0
Std. Deviation	4.6	23.2	13.9	14.5	27.6	23.5	14.4	65.3	343.2
Variance	21.2	536.6	192.7	211.2	763.0	551.0	206.4	4265.0	117807.9
Skewness	0.1	3.2	0.3	2.2	0.8	-0.6	-0.4	2.7	3.2
Std. Error of Skewness	0.6	0.6	0.6	0.7	0.6	0.6	0.7	0.6	0.7
Kurtosis	-1.0	11.1	-0.9	5.8	-0.5	-0.5	-0.6	8.1	10.2
Std. Error of Kurtosis	1.2	1.1	1.2	1.3	1.2	1.2	1.3	1.2	1.3
Range	15.0	95.0	45.0	50.0	85.0	75.0	45.0	242.0	1188.0
Minimum	0.0	5.0	15.0	0.0	10.0	25.0	5.0	8.0	12.0
Maximum	15.0	100.0	60.0	50.0	95.0	100.0	50.0	250.0	1200.0
25th percentile	3.0	10.0	25.0	1.0	25.0	57.5	22.0	27.5	35.0
50th percentile	7.5	19.0	31.0	10.0	40.0	77.5	30.0	35.0	64.0
75th percentile	10.0	20.0	49.0	15.0	51.0	86.5	41.0	52.5	135.0
^a More than one mode exists, only the first is reported									

Table D: 2 Institution Location								
In what US Region is your institution located?								
	Low Use n=12		Medium Use n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
West	1	8	3	19	2	15	6	14.6
South /Southeast	2	17	2	13	5	38.5	9	22.0
Northeast	8	67	5	31	5	38.5	18	43.9
Midwest	1	8	6	37	1	8	8	19.5

Table D: 3 Institution Classification								
What classification best describes your institution								
	Low Use n=12		Medium Use n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
Doctorate-granting University	5	42	9	56	9	69	23	56
Masters College or University	4	33	4	25	3	23	11	27
Baccalaureate College	3	25	2	12	1	8	6	15
Associates College	0	0	0	0	0	0	0	0.0
Special Focus Institution	0	0	0	0	0	0	0	0
Tribal College	0	0	0	0	0	0	0	0.0
Not classified	0	0	1	6	0	0	1	2
Do not know	0	0	0	0	0	0	0	0.0
Other	0	0	0	0	0	0	0	0.0

Table D: 4 Type of Adoption								
What level of simulation adoption best describes your institution?								
	Low Use n= 12		Medium Use n=15		High Use n=13		Overall n=40	
	Freq	%	Freq	%	Freq	%	Freq	%
Site licensed user	1	8	4	27	6	46	11	28
Purchasing simulation hours from Mursion® or TeachLive™	11	92	8	53	6	46	25	63
Purchasing simulation hours from another institution	0	0	3	20	0	0	3	7
Unsure	0	0	0	0	1	8	1	2

Table D: 5 Funding								
How are simulations funded? - select all that apply								
	Low Use n=12		Medium Us n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
Dean's Office	8	67	4	25	8	62	20	49
Grant	4	33	6	38	3	23	13	32
Student Fees	2	17	4	25	2	15	8	20
Other	3	25	5	31	2	15	10	24
Don't Know	0	0	0	0	0	0	0	0
	Campus Quality Fees Private Gift Curriculum Development Funds		Budget Department Revenue from self- supporting programs Dept. Budget Provost Support Outside Contracts		Care's Act Foundation			

Table D: 6 Students								
Which students experience simulation?								
	Low Use n=12		Medium Use n=16		High Use n= 13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
Undergraduate: Freshman	1	8	5	31	5	38	11	27
Undergrad: Sophomores	1	8	7	44	9	69	17	41
Undergrad: Junior	6	50	12	75	11	85	29	71
Undergrad: Seniors	9	75	14	88	11	85	34	83
Graduate: Teaching	7	58	7	44	8	62	22	53
Graduate: Leadership	2	17	2	13	4	31	8	20
Graduate: Special Education	4	33	4	25	4	31	12	29
Graduate: Counseling	3	25	4	25	3	23	9	22
Other	1	8	1	6	1	8	3	7
Other included:	"Social Work, MFT, Journalism, Nursing"		"High School Students"		Not stated			

Table D: 7 Percent of Course Integration				
Approximately what percentage of the teacher education courses at your institution have integrated simulation?				
	Low Use n=12	Medium Use n=16	High Use n=13	Overall n=41
Mean	6.83	21.13	35	21.35
Median	7.5	19	31	17
Mode	10	10	20	10
Std. Deviation	4.609	23.164	13.88	19.618
Skewness	0.68	3.16	0.33	2.01
Std. Error of Skewness	0.637	0.58	0.616	0.374
Kurtosis	-0.98	11.08	-0.94	5.57
Std. Error of Kurtosis	1.23	1.12	1.19	0.73
Minimum	0	5	15	0
Maximum	15	100	60	100
Variance	21.24	536.55	192.67	384.85
25th percentile	3	10	25	10
50th percentile	7.5	19	31	17
75th percentile	10	20	49	30

Table D: 8 Annual MRS Minutes Per Student				
	Low Use	Medium Use	High Use	Overall
Valid	2	12	9	23
Missing	10	4	4	18
Mean	18.58	37.17	88.86	55.78
Median	18.54	21.36	23.415	21.38
Std. Deviation	3.65	56.9	212.09	136.91
Minimum	16	12.63	15.36	2.151
Maximum	21.17	80	654	654
Note: Data was missing from one of the three extent of use variables (percent of student exposure, amount of MRS annual minutes, number of students) for 18 respondents and 10 of the missing respondents were from low use institutions.				

Table D: 9 Vending								
Do you sell or vend simulation hours to other institutions?								
	Low Use n=12		Medium Use n=16		High Use n=13		Overall n=41	
	Freq	%	Freq	%	Freq	%	Freq	%
Yes	1	8.3	2	12.5	4	30.7	7	17
No	11	91.6	14	81.2	9	69.2	34	82.5

Table D: 10 Recording								
Are simulations recorded								
	Low Use n=12		Medium Use n=15		High Use n=13		Overall n=40	
	Freq	%	Freq	%	Freq	%	Freq	%
Never	2	8.33	4	18.75	1	15.39	7	17.0
Sometimes	6	16.67	7	12.5	6	38.46	19	46.0
Always	4	66.67	4	31.25	6	38.46	14	34.0

Scenario Frequency											
How frequent is the use of these scenarios ? n=40	Not Used (1)		Minimally Used (2)		Somewhat Used (3)		Frequently Used (4)		Unrated (Omitted)		Rating Summary
Scenario	N	%	N	%	N	%	N	%	N	%	N M
Classroom management/Behavior management scenarios	0	0	8	20	9	22.5	23	57.5	0	0	40 3.46
General pedagogy focus scenarios (non content)	3	7.5	7	17.5	11	27.5	17	42.5	2	7.5	38 3.19
Parent-Teacher conference scenarios	5	12.5	9	22.5	12	30	13	32.5	1	5	39 2.92
Reading / English Language Arts instruction scenarios	7	17.5	6	15	13	32.5	12	30	2	7.5	38 2.86
IEP Meetings scenarios	6	15	20	50	7	17.5	5	12.5	2	7.5	38 2.62
Math instruction scenarios	10	25	6	15	18	45	5	12.5	1	5	39 2.56
Special education instruction scenarios	10	25	11	27.5	9	22.5	8	20	2	7.5	38 2.46
Science instruction scenarios	11	27.5	9	22.5	14	35	5	12.5	1	5	39 2.39
Co-teaching scenarios	16	40	7	17.5	5	12.5	10	25	2	7.5	38 2.29
Social Emotional Learning focused scenarios	10	25	14	35	11	27.5	4	10	1	5	39 2.29
Meeting with principal or instructional coach scenarios	15	37.5	9	22.5	9	22.5	4	10	3	10	37 2.11
English Language Development / EL instruction scenarios	19	47.5	10	25	6	15	3	7.5	2	7.5	38 1.86
Job Interview scenarios	24	60	5	12.5	7	17.5	2	5	2	7.5	38 1.7

Table D: 11 Scenario Frequency 1

Table D: 12 Scenario Frequency 2

Q 5.1 & 5.2: Simulation Scenario Frequencies					
How frequent is the use of these scenarios?	Frequently Used	Somewhat Used	Minimally Used	Not Used	Missing
Classroom management/Behavior management scenarios (1)	23	9	8	0	1
Co-teaching scenarios	10	5	7	16	3
Science instruction scenarios (3)	5	14	9	11	2
Math instruction scenarios (4)	5	18	6	10	2
Reading / English Language Arts instruction scenarios (5)	12	13	6	7	3
General pedagogy focus scenarios (non content) (6)	17	11	7	3	3
Social Emotional Learning focused scenarios (7)	4	11	14	10	2
Job Interview scenarios (1)	2	7	5	24	3
Meeting with principal or instructional coach scenarios (2)	4	9	9	15	4
Special education instruction scenarios (3)	8	9	11	10	3
IEP Meetings scenarios (4)	5	7	20	16	3
Parent-Teacher conference scenarios (5)	13	12	9	5	2
English Language Development / EL instruction scenarios (6)	3	6	10	19	3
Other (please enter any scenario used that is not listed) (7)	18	4	1	19	0
Counseling Simulations	1				40
DEI work			1		40
Eliciting Student Responses	2				39
Functional Behavioral Analysis		1			40
HLPs	1				40
Intro to Content	2				39
Social Studies	1	1			39
Taking on role of principal	1				40
Trauma Informed		2			40
Classroom Management**	2				39
Custom Scenarios		1			40
Nursing Telehealth	1				40
Teacher/ Student interactions	1				40
Higher Order Thinking Questioning	1				40
Mental Health					40
PBIS Strategies	1				40
Social Work/ Human Services Simulations	1				40
Intake Interviews Social Work	1				40
Leading Discussions	1				40
Managing Behaviors*	1				40
Principal / Parent	1				40
Interviewing Nurses for DNP and Anesthesia Program	1				40
Notes:					

Appendix E: Additional COVID-19 Tables

COVID-19 Table: 1 Usage					
Has simulation usage changed during the school shutdowns related to COVID-19?					
	Low Use		Medium Use		Overall n=40
	Freq		Freq		Freq %
Yes	11		14		37 90.24
No	1		1		4 9.76

COVID-19 Table: 2 Students								
Please report how simulation has changed in relation to school shutdowns related to COVID-19								
- Number of students using simulation								
	Low Use		Medium Use		High Use		Overall	
	Freq	%	Freq	%	Freq	%	Freq	%
Increased	9	81.81	9	69.23	6	54.55	25	69.44
Stayed the Same	1	9.09	0	0	4	36.36	5	13.89
Decreased	1	9.09	4	31.77	1	9.09	6	16.67

COVID-19 Table: 3 Student Population								
Please report how simulation has changed in relation to school shutdowns related to COVID-19 - The student population using simulation								
	Low Use		Medium Use		High Use		Overall	
	Freq	%	Freq	%	Freq	%	Freq	%
Changed	6	54.55	8	61.54	7	63.64	21	58.33
Stayed the Same	5	45.45	5	38.46	4	36.36	15	41.67
Notes								

COVID-19 Table: 4 Student Experience								
Please report how simulation has changed in relation to school shutdowns related to COVID-19 - The way (mode) students experience simulation								
	Low Use		Medium Use		High Use		Overall	
	Freq	%	Freq	%	Freq	%	Freq	%
Changed	8	36.35	4	30.77	6	54.55	29	80.56
Stayed the Same	5	63.64	9	69.23	5	45.45	7	19.44

COVID-19 Table: 5 Content								
Please report how simulation has changed in relation to school shutdowns related to COVID-19 - The content of the simulations used								
	Low Use		Medium Use		High Use		Overall n=36	
	Freq	%	Freq	%	Freq	%	Freq	%
Changed	4	36.35	4	30.77	6	54.55	15	41.67
Stayed the								
Same	7	63.64	9	69.23	5	45.45	21	58.33
Notes:								
Notes:								

COVID-19 Table: 6 Feedback								
Please report how simulation has changed in relation to school shutdowns related to COVID-19 - The feedback students receive during or after simulation								
	Low Use		Medium Use		High Use		Overall	
	Freq	%	Freq	%	Freq	%	Freq	%
Changed	6	54.55	5	38.46	5	45.45	16	44.44
Stayed the Same	5	45.45	8	62.54	6	54.55	20	55.56
Notes:								

COVID-19 Table: 7 Reason for Change					
To what extent did each of the following factors lead to changes in simulation use?	A lot	A moderate amount	A little	None at all	Unknown
Changes in state policy around clinical practice (or student teaching requirements)	3	7	7	16	2
Aiming to meet unchanged clinical requirements during k-12 school shutdowns	15	10	4	5	2
Aiming to provide remote practice during higher education shutdowns	15	6	4	8	3
Aiming to provide teaching feedback during higher education shutdowns	12	6	7	9	2
Aiming to provide student teaching hours	8	5	5	16	2
Difficulty staffing simulation due to higher education shutdowns	3	0	4	23	5
Difficulty accessing equipment to run simulation during higher education shutdowns.	2	1	5	22	5
Concerns about funding caused by factors related to COVID-19	3	1	33	20	5
Other:	1	0	1	0	6
“reduced field placements prior to clinical practice”	1				
“Concerns about putting students together in a small space during the pandemic”			1		

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