Book Chapter

Pre-Service Teachers' Coping and Anxiety within Mixed-Reality Simulations

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Abstract

The purpose of this study was to investigate the impact of time in Mixed-Reality Simulations (MRS) on anxiety levels and coping for pre-service teachers (PSTs). A convergent parallel mixed-methods design was utilized. For each pair of matched observations on both levels for both surveys, no statistically significant difference was found. Three finding statements emerged from the qualitative data: (a) participants experienced anxiety surrounding the mixed-reality simulations from many different sources, (b) participants' anxiety surrounding the mixed-reality simulations manifested itself in a variety of ways, and (c) participants implemented different coping skills to attempt to manage the anxiety they were experiencing surrounding the mixed-reality simulations. A comparison of the quantitative and the qualitative findings revealed two mixed-method findings: (a) pre-service teachers can benefit from experiencing anxiety within a mixed-reality simulation setting and (b) mixed-reality simulations provide pre-service teachers with the opportunity to develop their coping skills. Implications for the potential benefits and impact of time spent within a mixed-reality simulator on pre-service teachers' anxiety and adaptiveness in coping are addressed.

Keywords

Mixed-Reality Simulations; Anxiety; Coping; Adaptiveness in Coping; Pre-Service Teacher Preparation

Introduction

Teachers and pre-service teachers face stressors in many different aspects of their career and training [1-5]. Teachers experiencing high amounts of stress within their career may experience lower morale and reduced effectiveness and commitment, which can potentially result in teacher burnout [6-9]. Pre-service teachers also experience stress from a variety of sources in their lives, including expectations of self, expectations of parents/students, evaluation, life stress, academic stress, and stress revolving around classroom management [1,10-13]. These stressors, when not dealt with effectively through adaptive coping [14-18], can lead to anxiety or anxiety disorder, depressive symptoms, and cognitive symptoms, which can have negative impacts on the teacher or pre-service teachers' experience [19-21] and can potentially lead to burnout [7] or may impact pre-service teachers' confidence in their ability to teach [21]. Being able to successfully utilize adaptive coping and coping strategies has been found to protect against stress and positively impact teacher burnout [2,22,23]. Pre-service teachers need training on identifying and utilizing positive and productive coping strategies to cope with stress and anxiety [20,22].

Social-emotional cognitive skills, such as coping within anxiety-oriented situations, are vital for dealing with stress and anxiety [4,23-25], yet the ability for in-service and pre-service teachers to adapt and cope with stressors to avoid anxiety is not typically included as a primary focus of teacher education programs. Pre-service teachers need more training on developing coping strategies [20,22,26,27]. The inclusion of mixed-reality simulations in teacher education programs may have potential for exposing pre-service teachers to anxiety-inducing situations to positively impact their adaptiveness in coping [28,29].

Research has indicated links between pre-service teacher anxiety, coping skills, and positive and negative emotions [2,16,30-34]. The intent of this study was to investigate the impact of time in mixed-reality simulations on anxiety levels and coping for pre-service teachers through a convergent parallel mixed-method design. This study therefore aimed to contribute to the conversation surrounding the development of pre-service teachers' coping skills and anxiety management within the context of a mixed-reality simulator.

Related Literature

The related literature is grounded in theories and empirical research related to stress, anxiety, coping, adaptiveness in coping, and mixed-reality simulations. These theoretical concepts are investigated within the context of education and, specifically, pre-service teachers.

Stress

Stress is a negative emotional state that is experienced by an individual when the demands of a particular situation appraised as a threat or potential loss exceed the resources that the individual must have in order to deal with the situation and can lead to psychological or physical illness [25,35-38]. For stress surrounding an individual's job, the critical components in determining the intensity of the stress are an individual's perceptions and beliefs to interpret the stressor and an individual's perceived resources for coping with the stress [38].

In the field of education, which revolves around human interaction [39], stress is typically unavoidable. Stressors for teachers may include life stress; academic stress; and stress regarding expectations, classroom management, or evaluations [1,10-13]. These stressors, when not dealt with effectively through adaptive coping [14-18], can lead to anxiety or anxiety disorder, depressive symptoms, and cognitive symptoms, which can have negative impacts on the teacher or pre-service teachers' experience [19-21] and can potentially lead to burnout [7] or

may impact the pre-service teachers' confidence in their ability to teach [21].

Anxiety and Coping

For the purposes of this study, anxiety will be viewed through the lens of state anxiety as an individual's doubting of their ability to cope with the situation that is causing them stress [40]. Pre-service teachers' anxiety towards appointment and socio-economic life affects their contentment levels negatively [21].

Coping has been defined in a variety of ways but typically revolves around the methods that people use to deal with stress and reduce or amplify the effects of adverse life events [16]. Coping can also be simply viewed as a response to a stress event [41], as a means for approaching and managing stressful situations [35], or as a set of cognitive and affective actions that arise in response to a particular stressor [42]. Coping includes both the cognitive and the behavioral responses to stressful situations [14]. Coping strategies have been defined as "conscious volitional efforts to regulate emotion, cognition, behavior, physiology, and the environment in response to stressful events or circumstances" [43] and are typically actions or cognitive practices used to attempt to manage stress-inducing situations [3,4,16.25,35]. Lazarus and Folkman [38] identified two types of coping strategies: problem-focused coping strategies and emotion-focused coping strategies. Both strategies are used to reduce stress but focus on different aspects of the situation. Problem-focused coping strategies promote efforts on changing the situation itself, while emotion-focused strategies are not used to alter the situation at all. Emotion-focused coping strategies are only employed to alter the emotions associated with the stressor [15].

Adaptiveness in coping focuses primarily on the quality of coping rather than the strategies utilized for coping [4]. Adaptiveness, according to Kohn et al. [4], constitutes coping to reduce stress or to at least prevent the stress from becoming worse and might be a more effective predictor for coping ability than coping strategies. The determination of an adaptive coping

response must account for long-term developmental consequences, the subjective experience, and unique personal and situational qualities [15]. Flexibility in responding to situations is a key component of adaptiveness because the quality is dependent upon the context of the situation [4,16,44] as well as judgement, determination, and self-control [4,44]. The ability to successfully utilize adaptive coping has been found to positively impact a person's ability to regulate stress-inducing situations [2,23,25], teacher burnout [2,23], and emotional exhaustion [45]. Proactive coping, which has been defined as "an orientation toward managing possible stressors in the future" [2], has also been shown to protect against teacher burnout [2,23]. It has been shown to improve classroom management by aiding teachers in being mindful and prepared to face problems in the classroom. This decreases the likelihood of an event being perceived as threatening and becoming a stressor [2].

Mixed-Reality Simulations

There is a body of literature developing on applications of mixed-reality simulations in teacher education [30-32,34,46-52]. Educational simulations are like reality, but offer a controlled environment where learners experience different aspects of reality that would otherwise be impossible outside of experiencing them in real life [53-55]. Simulated learning experiences provide an opportunity for individuals to experience "repeated trials involving high stakes situations without risking the loss of valuable resources" [47]. This repetition of practice allows novices within a field the opportunity to apply the skills learned throughout their coursework to realistic situations and environments [56-59]. Simulations have been used in a multitude of fields including health care, the military, and aviation [29] and provide numerous benefits to the education of pre-service teachers [29,31,49].

Simulations offer numerous benefits to the education of pre-service teachers [29,31,49]. Simulated learning experiences in teacher education provide an opportunity for individuals to experience "repeated trials involving high stakes situations without risking the loss of valuable resources" [47]. Pre-service

teachers develop their classroom skills and reflect on their implementation without needing to be placed into a classroom with students and causing a negative impact on others [29,49].

Mixed-reality simulations (MRS) are blended simulated learning experiences. Within the MRS platform, the participant is faced with a screen containing avatars, which can represent students in a classroom, school administrators, or families, depending on the situation that was created, while a simulation specialist controls the actions and voices of the avatars and interacts with the participant [50]. For pre-service teachers, these simulations, which include a mixture of real and virtual realities, allow for learning experiences that place them in the role of a teacher, where they can practice communication and classroom skills [46] and can allow them to experience these simulations while being observed by their peers. This experience of performing the simulations within a public setting among peers can amplify the emotional discomfort, stress, and anxiety of the participants and, as a result, coping with these uncomfortable feelings is a germane pursuit in understanding the outcomes of simulations [30,34,52]. Therefore, MRS can be used to introduce pre-service teachers to stressors that would be faced by in-service teachers and aid those pre-service teachers in managing real-life stressful situations [31].

MRS within the Context of the Study

In this study, the MRS platform was Mursion®. Mursion® is a virtual reality training platform that can be used in various fields to practice and master core skills. In pre-service teacher education, Mursion® offers an opportunity to rehearse instruction or conferencing [60]. Mursion® utilizes a "human-in-the-loop" approach combining digital puppetry with basic artificial intelligence. This technology allows for a human actor to directly control an avatar's facial expressions and hold conversations between students and avatars [61]. For the purposes of this study, a scenario based on developing rapport between participant-teacher and avatar-students was created by Mursion®. A second scenario provided a parent–teacher conference aimed at using data to communicate student progress, as developed by

Mursion®. Student participants faced the avatar classroom and held conversations related to building rapport or conducting a parent–teacher conference within the Zoom conferencing platform. Their classmates watched the simulation simultaneously with the performance.

Materials and Methods
Research Design

This study followed a convergent parallel mixed-method design in which the quantitative and qualitative data were collected in parallel, separately analyzed, and then compared and synthesized [62]. A within-subjects method was used to investigate the measures of coping and anxiety of pre-service teachers within a curriculum that utilizes mixed-reality simulations for the quantitative part of the study for research questions one and two. Additionally, an exploratory collective case study design [63] was used to investigate the impact of curriculum embedded with mixed-reality simulations on the pre-service teachers' perceptions of coping and anxiety within the different levels, for research question three for the qualitative part of the study. Research question four compared the quantitative and qualitative data. The four research questions that guided this study were:

- Using the Personal Functioning Inventory (PFI), is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (Level 1 = 30 min of simulation and Level 2 = 60 min of simulation)?
- Using the Zung Anxiety Self-Assessment Scale, is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (30 min of simulation and 60 min of simulation)?
- How are the perceived coping and anxiety levels of pre-service teachers impacted by time within a mixed-reality simulator?
- How do the qualitative and quantitative results converge or diverge?

Settings, Subjects, and Sampling Procedure

The target population for this study was pre-service teacher candidates enrolled in two courses at the university, which included the use of a mixed-reality simulator as a component of the coursework. The sample was drawn from students enrolled in a four-course sequence in either an educational psychology course (designation was EDU2) or a special education course (designation was EDU4), both of which offered simulator experiences with a mixed-reality simulator. This study utilized convenience sampling [64] from undergraduate students at a northeastern university in the United States. A total of 16.4% of the population were included in the sample, and all participants in the quantitative portion of the study were included in the qualitative portion. These undergraduates were pre-service teachers (PSTs) enrolled in the university's PST preparation program. This education program has four courses for pre-service teachers that utilize mixed-reality simulations (MRS). These four courses were required for PSTs at the university and must be taken in sequence.

The group of participants for this study were enrolled in either the second or the fourth course in this sequence, and the participants were separated into two levels based on enrollment in these two courses. These levels are referred to as Level 1 and Level 2, respectively. Level 1 consisted of 3 PSTs who had approximately 30 min of experience with the MRS by the end of their course.

The participants in Level 1 completed approximately 15 min in the mixed-reality simulator as part of a single course prior to this study. The course that the participants in Level 1 were enrolled in, which will be referred to as EDU2, was the first part of a two-part course in educational psychology that the PSTs at the university are required to take. The simulations that the pre-service teachers enrolled in EDU2 took part in were focused around creating and utilizing a graphic organizer utilizing the student responses as an upper elementary teacher. The participants in Level 1 experienced three simulations as part of the curriculum for EDU2 that were approximately five minutes

each and focused on different aspects of the graphic organizer [65].

Level 2 consisted of 7 PSTs who had approximately 60 min of experience with the MRS by the end of their introduction to special education course. The participants in Level 2 experienced approximately 45 min in the mixed-reality simulator as part of a three separate courses prior to this study. The participants in Level 2 participated in three separate five-minute sessions of the Mixed-Reality Simulations throughout the course. These simulations were designed to be a parent–teacher conference scenario that the pre-service teacher led. The goal of the parent–teacher conference for the pre-service teachers was to establish rapport with the parent, discuss the child's academic progress, and create a plan for the student moving forward [66]. An image of an upper elementary classroom's avatars is demonstrated in Figure 1. Table 1 depicts the course levels of the teacher education program using mixed-reality simulations; the two course levels of the sample are bolded.

Figure 1: Upper elementary classroom.

Table 1: The program course levels of the teacher education program using mixed-reality simulations; the two course levels of the sample are bolded.

Mixed-Reality Simulation Levels of the Sample						
Course	Level	MRS Sessions			Cumulative Exposure	Sample Size
EDU1	-	1 (5 min)	2 (5 min)	3 (5 min)	15 min	-
EDU2	**1**	**4 (5 min)**	**5 (5 min)**	**6 (5 min)**	**30 min**	**3**
EDU3	-	7 (5 min)	8 (5 min)	9 (5 min)	45 min	-
EDU4	**2**	**10 (5 min)**	**11 (5 min)**	**12 (5 min)**	**60 min**	**7**

Instrumentation and Data Collection

The study utilized five instruments for data collection: two quantitative instruments and three qualitative instruments. The Personal Functioning Inventory (PFI; Kohn et al. [44]) and the Zung Anxiety Self-Assessment Scale [67] were used for the quantitative instruments. The Student Demographic Questionnaire (SDQ), the Exit Survey (ES), and the Mixed-Reality Simulation Anxiety and Coping Observational Protocol (MRSACOP) were used for the qualitative instruments. The three qualitative instruments were all researcher-created. Data were collected at four distinct points in time. The PFI, Zung SAS, and SDQ were all given prior to the participants' first session within the mixed-reality simulator. The second administration of the PFI and the Zung SAS occurred after the participants' second session within the MRS. During the second sessions within the MRS, the first researcher observed the participants and utilized the MRSACOP. The third administrations of the PFI and the Zung SAS were given with the ES after the third and final session within the MRS for the participants.

Table 2 demonstrates the alignment of research questions to question type, instrument, and the constructs being measured.

Table 2: Alignment of research question, type of instrument, and constructs.

Research Question	Question Type	Data Sources Used	Constructs
1. Using the Personal Functioning Inventory (PFI), is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (Level 1 = 30 min of simulation and Level 2 = 60 min of simulation)?	Quantitative	PFI	Adaptiveness in Coping
2. Using the Zung Anxiety Self-Assessment Scale, is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (30 min of simulation and 60 min of simulation)?	Quantitative	Zung SAS	Anxiety
3. How are the perceived coping and anxiety levels of pre-service teachers impacted by time within a mixed-reality simulator?	Qualitative	SDQ, MRSACOP, ES	Adaptiveness in Coping, Anxiety
4. How do the qualitative and quantitative results converge or diverge?	Mixed Methods	PFI, Zung SAS, SDQ, MRSACOP, ES	Adaptiveness in Coping, Anxiety

Table 3 demonstrates the timeline for data collection and analysis.

Table 3: Timeline for data collection and analysis.

Level	SDQ, PFI, Zung First Administration	MRS *	MRS (Including Observations)	PFI, Zung Second Administration	MRS	PFI, Zung Third Administration, Exit Survey
1	O	Session 1	Session 2	O	Session 3	O
2	O	Session 1	Session 2	O	Session 3	O

* MRS = Mixed-Reality Simulation.

Data Analysis

The first and second research questions were the quantitative research questions. These questions were meant to be used to analyze the impact of the independent variables, PSTs with two levels and time (before simulation 1, after simulation 2, and after simulation 3), on the dependent variables, PFI and Zung Anxiety Self-Assessment Scale scores, respectively. The independent variable was at the nominal level, and the dependent data variable was at the interval level. Only non-parametric tests for the quantitative data were considered due to the sample size. Paired-Samples Sign Tests were used because the data met the four necessary assumptions for this test: (a) the independent variables were at the categorical level, (b) the dependent variables were at the interval level, (c) the paired observations were independent of each other, and (d) the difference scores were from a continuous distribution. The Paired-Samples Sign Test [68] analyzed these data to determine if there were significant median differences between Time 1 and Time 2, between Time 2 and Time 3, and between Time 1 and Time 3.

The third research question was the qualitative research question and was focused on the participant's perceptions of anxiety and coping. The primary sources of data for the second research question came from the demographic survey, the exit survey, and the observational protocol. Thematic analysis was used with all the data sets. This allowed the data to be categorized and examined for points of comparison [69].

The fourth research question was the mixed-method research question. The qualitative and quantitative data strands were integrated through typology development and data consolidation to determine to what extent the findings of the data sets converged [62].

Threats and Trustworthiness
Threats to Internal Validity

History was a concern for the internal validity of this study because throughout the duration of the semester and the data

collection process, other events can occur that will have an impact on the participants that could impact the dependent variables [70]. This was a low threat because all the data were collected within the same semester in the same format and all the participants completed the simulations simultaneously as part of the same university's program. Potential threats to history were monitored throughout the study by the researchers.

Maturation was a low-risk threat to this study because the study was conducted over a relatively short period of time. Threats to maturation were monitored throughout the study by the researchers. Instrumentation was a low risk to this study because the PFI and Zung Anxiety Self-Assessment Scale have established validity and reliability. Experimental mortality was a high risk to this study due to potential resurgences of COVID-19, technical difficulties, and natural loss of participants over time due to life circumstances. Thirty-four participants were removed from the study due to failure to complete all the administrations of the quantitative and qualitative instruments.

The Hawthorne Effect was a low threat, as the nature of the course that participants were enrolled in necessitates the observation of their simulation sessions by a professor and fellow classmates within the simulation laboratory. The participants, having prior experience with the mixed-reality simulator, were familiar with being observed within this environment. Pretest sensitization was a moderate threat to the study because the Zung Anxiety Self-Assessment Scale and PFI are both instruments that rely on self-reporting. The researchers were mindful of this threat when analyzing the results of the study.

Trustworthiness

The four types of trustworthiness, as outlined by Krefting [71], were addressed within this study. Data triangulation was one of the primary means of establishing trustworthiness for this study. Qualitative data were collected from all the participants within the study from the Student Demographic Questionnaire (SDQ) and the Exit Survey (ES). Further qualitative data were collected

during the observations during the participants' second sessions within the mixed-reality simulator utilizing the Mixed-Reality Simulator Anxiety and Coping Observational Protocol. Data collected from the individual responses were compared to responses from the other qualitative and quantitative measures. Dense description was also used by the researchers when discussing the methodology and context of the study to provide transferability and to allow for potential repeatability of the study [71]. A data audit was conducted by researchers one and two with consideration to the research process and findings, and an outside reader was used as a dependability audit [71].

Results
Research Question One

Using the Personal Functioning Inventory (PFI), is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (Level 1 = 30 min of simulation and Level 2 = 60 min of simulation)?

Descriptive statistics regarding the PFI are provided in Table 4.

Table 4: Descriptive statistics for the PFI.

Level	Administration	*n*	Mean	*sd*	Median	*Skew*	Kurtosis *
Level 1	1	3	105.33	6.66	102	1.69	-
	2	3	102.33	8.96	107	−1.71	-
	3	3	114	27	114	0	-
Level 2	1	7	96.71	16.65	96	−0.37	−0.33
	2	7	92.71	15.89	86	1.23	0.89
	3	7	96.71	18.01	91	1.47	2.08

* For Level 1, the Kurtosis could not be calculated because $n < 4$.

Paired-Samples Sign Tests were conducted to determine if significant differences existed in participants' scores on the Personal Functioning Inventory (PFI) between each pair of two different administrations (Time 1 to Time 2, Time 2 to Time 3, and Time 1 to Time 3). Each matched pair was analyzed by subtracting the score from the earlier administration from the score from the later administration for each participant. Positive

results from this process indicated a self-reported increase in adaptiveness in coping, whereas negative results indicated a self-reported decline. For instances where the difference between the two scores was zero, the result of "N/A" was attributed and the result was not included in the overall calculation.

There was also no statistically significant difference found for Level 1 of the independent variable on scores for the PFI for Time 1 ($Mdn = 102$) to Time 3 ($Mdn = 114$), $p = 1.0$. One of the participants self-reported a decline in adaptiveness in coping while two self-reported an increase. No statistically significant difference was found for Level 2 of the independent variable on scores for the PFI for Time 1 ($Mdn = 96$) to Time 2 ($Mdn = 86$), $p = 1.0$, with three participants self-reporting increases in adaptiveness in coping and three participants self-reporting decreases, while one participant reported no overall change. There was also no statistically significant difference found for Level 2 of the independent variable for scores on the PFI for Time 2 ($Mdn = 86$) to Time 3 ($Mdn = 91$), $p = 0.125$, with six participants self-reporting increases in adaptiveness in coping and only one participant self-reporting a decrease in adaptiveness in coping. Additionally, a statistically significant difference was not found for Level 2 of the independent variable for scores on the PFI for Time 1 ($Mdn = 96$) to Time 3 ($Mdn = 91$), $p = 1.0$, with four participants self-reporting an increase in adaptiveness in coping and the other three participants self-reporting a decline.

Research Question Two

Using the Zung Anxiety Self-Assessment Scale, is there a statistically significant difference over time (before simulation 1, after simulation 2, and after simulation 3) on pre-service teacher scores by level (30 min of simulation and 60 min of simulation)? Assumptions for the Paired-Samples Sign Test were met. Descriptive statistics for the Zung Anxiety SAS are provided in Table 5.

Table 5: Descriptive statistics for the Zung SAS.

Level	Administration	*n*	Mean	*sd*	Median	*Skew*	Kurtosis *
Level 1	1	3	39.33	8.50	36	1.49	-
	2	3	34.67	13.43	29	1.56	-
	3	3	38.33	19.73	29	1.65	-
Level 2	1	7	45.71	9.25	48	−0.32	1.23
	2	7	45.43	10.58	48	−0.69	−1.18
	3	7	47.57	14.62	49	−0.08	−0.30

* For Level 1, the Kurtosis could not be calculated because $n < 4$.

A statistically significant difference was not found for Level 1 of the independent variable on scores for the Zung SAS for Time 1 (*Mdn* = 36) to Time 2 (*Mdn* = 29), p = 1.0. As shown in Table 5, two of the participants self-reported a decline in anxiety, while only one self-reported an increase. A statistically significant difference was also not found for Level 1 of the independent variable on scores for the PFI for Time 2 (*Mdn* = 29) to Time 3 (*Mdn* = 29), p = 1.0. One of the participants self-reported a decline in anxiety, while two self-reported an increase. There was also no statistically significant difference found for Level 1 of the independent variable on scores for the Zung SAS for Time 1 (*Mdn* = 36) to Time 3 (*Mdn* = 29), p = 1.0. Two of the participants self-reported a decline in anxiety, while one self-reported an increase. No statistically significant difference was found for Level 2 of the independent variable on scores for the Zung SAS for Time 1 (*Mdn* = 48) to Time 2 (*Mdn* = 48), p = 0.687, with four individuals self-reporting a decrease in anxiety and two participants self-reporting increases, while one participant reporting no overall change. There was also no statistically significant difference found for Level 2 of the independent variable for scores on the Zung SAS for Time 2 (*Mdn* = 48) to Time 3 (*Mdn* = 49), p = 1.0, with three participants self-reporting decreases in anxiety and four self-reporting increases in anxiety. A statistically significant difference was also not found for Level 2 of the independent variable for scores on the Zung SAS for Time 1 (*Mdn* = 48) to Time 3 (*Mdn* = 49), p = 1.0, with two participants self-reporting an increase in anxiety, another three self-reporting a decrease, and two reporting no overall change.

Research Question Three

How are the perceived coping and anxiety levels of pre-service teachers impacted by time within a mixed-reality simulator (MRS)? Research question three was qualitative in nature and was used to explore the impact of mixed-reality simulations on the pre-service teachers' perceptions of their anxiety and adaptiveness in coping. For readability purposes, please refer to Table 6 below, which identifies the abbreviations for the qualitative instruments as they are used in the text.

Table 6: Abbreviations for qualitative instruments.

Instrument	Abbreviation
Student Demographic Questionnaire	SDQ
Mixed-Reality Simulation Anxiety and Coping Observation Protocol	MRSACOP
Exit Survey	ES

Three findings emerged from the analysis of the data. Finding one: participants experienced anxiety surrounding the mixed-reality simulations from many different sources, included the themes of performance anxiety and situational anxiety. Table 7 demonstrates the finding statement one, with themes and sample participant utterances that support the themes.

Table 7: Finding one and themes.

Finding Statement One: Participants experienced anxiety surrounding the mixed-reality simulations from many different sources	
1. Mixed-reality simulations presented the participants with anxiety surrounding their performance	Damon (Level 1) discussed having anxiety surrounding "feelings of messing up" (ES) within the mixed-reality simulatorThe participants within this study identified anxiety stemming from being observed by their peers and professors (Hailey, Level 2, ES), particularly when they were the first participant to experience the simulation (Maurice, Level 2, ES).
2. Participants experienced situational	Participants identified anxiety surrounding their performance, even though the simulation had no

anxiety surrounding the mixed-reality simulations	impact on their grade. Participants also reported some of the anxiety stemming from the unknown nature of how the avatar/avatars would respond, "not knowing what to expect from the parent's behavior" (Gabrielle, Level 2, ES) and how to handle the simulation (Hailey, Level 2, ES; Maurice, Level 2, ES; Janice, Level 2, ES; Kayla, Level 2, ES; Paul, Level 2, ES).

Finding two: participants' anxiety surrounding the mixed-reality simulations manifested itself in a variety of ways, included the themes of physical manifestations of anxiety and emotional manifestations of anxiety. Table 8 demonstrates the finding, themes, and supporting data.

Table 8: Finding two and themes.

Finding Statement Two: Participants' anxiety surrounding the mixed-reality simulations manifested itself in a variety of ways Theme	
1. The participants experienced emotional manifestations of anxiety surrounding the mixed-reality simulations	Participants discussed the anxious feeling of "messing up" (Damon, Level 1, ES) and feeling "nervous about interacting with the simulation" (Hailey, Level 2, ES). Other emotional responses to the anxiety that participants reflected upon were fear (Hailey, Level 2, SDQ; Paul, Level 2, SDQ), nervousness (Cole, Level 1, SDQ; Hailey, Level 2, ES), overthinking (Janice, Level 2, SDQ; Gabrielle, Level 2, SDQ), getting "shaken up" (Damon, Level 1, SDQ), "freezing up" (Kayla, Level 2, SDQ).
2. The participants experienced physical manifestations of anxiety surrounding the mixed-reality simulations	Participants in both levels were observed to exhibit physical manifestations of anxiety while interacting within the mixed-reality simulation scenarios. Some participants were restlessly fidgeting with their hands (Damon, Level 1; Eleanor, Level 1; Hailey, Level 2; Maurice, Level 2), or mildly rocking back and forth and being unable to sit still (Damon, Level 1; Hailey, Level 2), or exhibiting a change in their breathing (Hailey, Level 2).

Finding three: participants implemented different coping skills to attempt to manage the anxiety they were experiencing surrounding the mixed-reality simulations, included the themes physical coping mechanisms and cognitive coping mechanisms. Table 9 demonstrates the finding, themes, and supporting data.

Table 9: Finding three and themes.

Finding Statement Three: Participants implemented different coping skills to attempt to manage the anxiety they were experiencing surrounding the mixed-reality simulations	
1. The participants implemented physical coping mechanisms to attempt to manage anxiety surrounding the mixed-reality simulations	The act of "taking deep breaths" (Gabrielle, Level 2, SDQ; Eleanor, Level 1, ES; Janice, Level 2, ES; Kayla, Level 2, ES; Maurice, Level 2, ES; Paul, Level 2; ES) seemed to aid in alleviating the participants' anxiety. - Participants would "use the rubric … to plan out what [they] wanted to say" (Hailey, Level 2, ES) and even just knowing that they were prepared ahead of time was enough to quell some of the anxiety (Kayla, Level 2, ES). - Cole (Level 1) reported on the Exit Survey that one of the coping techniques was ensuring that he ate breakfast. - Quinn (Level 2) and Janice (Level 2) took notes on their peers' performances in the simulation to keep track of what worked well for them and what did not (ES). - Kayla (Level 2) found it helpful to be "using [her] fidget toy" (ES) while waiting for her turn in the simulator.
2. The participants implemented mental coping mechanisms to attempt to manage anxiety surrounding the mixed-reality simulations	Positivity and positive thinking helped them cope with the stressors (Paul, Level 2, ES; Kayla, Level 2, ES) - "Go with the flow" (Damon, Level 1, ES). - Kayla (Level 2, ES) noted the importance of "taking a deep breath

| | and reminding [herself] that [she] was prepared" to manage her anxiety. |
| | - - Hailey (Level 2) made sure to not "replay the situation in [her] head a bunch" (ES), which allowed her to ensure that the anxiety did not linger and she was able to "move on with [her] day." |

Research Question Four

How do the qualitative and quantitative results converge or diverge? Research question four was mixed methods in nature and was analyzed in alignment with the mixed-method framework defined by Creswell and Plano Clark [62] for convergent parallel mixed-method designs. After analyzing the quantitative and qualitative data individually, findings were then compared to identify common themes across the two data sets. Two common themes emerged from this analysis: (a) pre-service teachers can benefit from experiencing anxiety within a mixed-reality simulation setting, (b) mixed-reality simulations provide pre-service teachers with the opportunity to develop their coping skills.

Pre-Service Teachers Can Benefit from Experiencing Anxiety within a Mixed-Reality Simulation

The participants within this study consistently reported that the mixed-reality simulations caused anxiety. Prior to the first simulation, participants noted their intent was on developing the skills that they will utilize within their career. Participants were aiming to "become better at adapting to students" (Cole, Level 1, SDQ) in a classroom setting for the Level 1 participants. The Level 2 participants, being in a different scenario, were looking forward to experiencing the one-to-one parent meeting (Gabrielle, SDQ; Hailey, SDQ; Kayla, SDQ; Maurice, SDQ). The unknown nature of the scenarios, being that the pre-service teachers have not experienced real classroom settings or actual one-on-one parent conversations, added stress and worried to the overall experience. However, knowing that this was all for practice (Quinn, Level 2, ES) and would not impact their grade (Gabrielle, Level 2, ES) allowed the participants to focus on the

anxiety surrounding the situation. Participants also noted that "each session reduced their anxiety little by little" (Paul, Level 2, ES). This was additionally seen to be true in the quantitative data in the results from the Zung Anxiety Self-Assessment Scale (Zung SAS). Forty percent of the participants had their Zung SAS score reduce with every subsequent session within the simulator. One participant in Level 2, Quinn, self-reported on the exit survey that the sessions within the mixed-reality simulator did not have any impact on her anxiety. However, she was one of two participants, along with Cole (Level 1) who consistently scored higher on the Zung SAS. Cole also reported "low levels of stress" surrounding the simulations and did not feel that there was any anxiety surrounding the mixed-realty simulations (ES). Both Cole's and Quinn's scores on the third administration of the Zung SAS scored in the category of "Marked for Severe Anxiety" with scores of 61 and 70, respectively.

Mixed-Reality Simulations Provide Pre-Service Teachers with the Opportunity to Develop Their Coping Skills

The participants within the study did not have a significant median change to their adaptive coping scores for any of the matched pairs of responses to the Personal Functioning Inventory; however, many participants reported that the simulations helped them to develop their coping skills. One of the participants (Eleanor, Level 1) reported on the Student Demographic Questionnaire that the simulation experiences had no impact on her coping skills, yet there was a consistent increase in her scores on the PFI from Session 1 to Session 2 to Session 3. Other participants found that the stress of the simulations provided them with a platform to "adapt and try some new coping skills" (Hailey, Level 2, ES) and that continued use of the simulations has improved their coping abilities (Kayla, Level 2, ES). The quantitative data supported Hailey's and Kayla's perceptions because they were two of the four participants who saw increases for their PFI scores for each successive administration. Overall, the quantitative and qualitative data demonstrated that mixed-reality simulations both produced anxiety for the participants and provided them with an opportunity to practice coping skills to resolve this anxiety.

Discussion and Implications

A recommendation for future practice is for administrators of teacher preparation programs utilizing a mixed-reality simulator to purposefully include opportunities for pre-service teachers to reflect on specific coping strategies that are utilized within the simulator and opportunities to develop new coping strategies and enhance their coping skills. Within the mixed-reality simulation environment, pre-service teachers can be given opportunities to review their own performance within the simulation and their peers' performances within the simulation with a specific intention to identify the different coping strategies used and the effectiveness of different strategies responding to different situations. Future researchers can attempt to understand the impact on pre-service teachers' adaptiveness in coping over time and can provide teacher preparation programs the opportunity to improve their programs and curriculum.

Research question two explored the impact of exposure to the mixed-reality simulations on pre-service teachers' anxiety, as measured by the Zung Anxiety Self-Assessment Scale [67]. Though no statistical significance was found, individual change was found. The findings of this study may contribute to the findings of Maulimora [21], who found that pre-service teachers experienced anxiety when they practiced their teaching and felt nervous in front of other students.

A recommendation for future practice is for the administrators of teacher preparation programs that utilize mixed-reality simulations to consider anxiety awareness training for pre-service teachers and to intentionally embed anxiety-inducing situations into the simulations for the pre-service teachers. The administrators of these programs can consider enhancing the simulations by providing pre-service teachers with an opportunity to discuss the anxiety surrounding the simulation and different methods of coping with that anxiety. For future research, researchers can explore the potential change in pre-service teacher anxiety levels over time through a teacher preparation program, as opposed to just a single course, although controlling for confounding variables would be important in this

type of study. Further, researchers can explore the impact of specific instructional strategies aimed to develop coping strategies on pre-service teachers within a mixed-reality simulation environment. Understanding the impact on pre-service teachers' adaptiveness in coping over time can provide teacher preparation programs the opportunity to improve their programs and curriculum. Researchers could also consider a similar study to this study with a larger sample size to determine if statistical significance would be found with a larger number of participants.

The third research question was qualitative in nature. There were three finding statements that emerged from the qualitative analysis. The first finding statement was that participants experienced anxiety surrounding the mixed-reality simulations from many different sources. The participants within this study identified anxiety stemming from being observed by their peers and professors, particularly when they were the first participant to experience the simulation. Participants identified anxiety surrounding their performance even though the simulation had no impact on their grade.

A recommendation for future practice for administrators of teacher preparation programs that utilize mixed-reality simulations is to consider embedding anxiety awareness directly into the teacher education curriculum to bring awareness to the pre-service teachers' primary sources of stress and anxiety. Future researchers may wish to further explore the primary sources of anxiety that pre-service teachers feel within a mixed-reality simulator. Developing understanding of the sources of pre-service teacher anxiety within the simulations can aid program administrators in designing the simulation scenarios to target these particular stressors, and provide the pre-service teachers an opportunity to develop their skills for managing anxiety.

The second finding statement was that participants' anxiety surrounding the mixed-reality simulations manifested itself in a variety of ways. The participants in this study were observed and reported both emotional and physical manifestations of anxiety.

The pre-service teacher participants experienced nervousness and fear surrounding different aspects of the simulations. As a recommendation for future research, researchers can consider having the pre-service teachers reflect on their own and their peers' emotional and physical manifestations of anxiety and to discuss different coping techniques that could be utilized to manage those anxieties.

The third finding statement from the qualitative data was that participants implemented different coping skills to attempt to manage the anxiety they were experiencing surrounding the mixed-reality simulations. The simulation experience provided an opportunity to work to persevere through these situations and to learn how to manage this emotional anxiety. Administrators of programs that utilize mixed-reality simulations can consider encouraging discussion between pre-service teachers and their peers about different coping strategies that they utilized within the simulations. The administrators of teacher preparation programs can also consider introducing pre-service teachers to different coping strategies and facilitate the practice and refinement of different coping strategies when using the mixed-reality simulator. Future researchers may wish to explore the different coping techniques and strategies utilized by pre-service teachers utilizing a mixed-reality simulation and to attempt to evaluate their effectiveness. These suggestions may hold true for pre-service teacher preparation programs in the United States, where this research was conducted, but also in other countries and cultures.

Research question four was the mixed-method research question. Two connecting themes emerged from the comparison of the quantitative and qualitative data. The first connection was that pre-service teachers can benefit from experiencing anxiety within a mixed-reality simulation setting. These findings contribute to the findings of Gul and Pecore [31], who identified that, through a controlled simulation environment, pre-service teachers are provided with the opportunity to practice their teaching skills and practice their ability to control stress. Participants in the current study emphasized the feeling that the anxiety felt surrounding the simulations was important to

experience and would aid them in their futures. Further research can explore the progress of pre-service teachers managing anxiety through mixed-reality simulations over several years to identify any benefits brought on by multiple years of exposure.

The second connection between the quantitative and qualitative data was that experiences within a mixed-reality simulation provide pre-service teachers the opportunity to develop their coping skills and to learn different coping strategies. This study may contribute to studies such as Brooksbank [30], Gul and Pecore [31], and Kilbourn [34], in that when coping with stressful, anxiety-inducing situations within the mixed-reality simulator, pre-service teachers had to utilize different coping techniques, which included deep breathing and controlling emotions. Future researchers can attempt to understand the impact of the specific development of coping strategies for pre-service teachers within a mixed-reality simulation environment.

Limitations

One of the major limitations of this study was a small sample size. The study lost some initial participants to attrition when participants failed to complete all of the instruments or each administration of the instruments in the necessary timeframe. The virtual nature of the MRS sessions also had a large impact on the observational component of the study. Participants were only visible from the shoulders up. Elements of the Mixed-Reality Simulation Anxiety and Coping Observation Protocol such as "Arms/Legs are shaking or trembling" and "Inability to sit still" were much harder or impossible to identify at times with this limitation.

Conclusions

This study was designed to investigate the impact of time within a mixed-reality simulation on pre-service teachers' anxiety and adaptiveness in coping and on the perceptions of the pre-service teachers on anxiety and adaptiveness in coping through a mixed-methods convergent parallel mixed-method design [62]. Research questions one and two did not find overall significance;

however, individual changes were made over time. Research question three found that participants experienced anxiety surrounding the mixed-reality simulations from many different sources, including that mixed-reality simulations presented the participants with anxiety surrounding their performance and participants experienced situational anxiety surrounding the mixed-reality simulations. Finding statement two, participants' anxiety surrounding the mixed-reality simulations, manifested itself in a variety of ways, including the participants experienced emotional manifestations of anxiety surrounding the mixed-reality simulations and the participants experienced physical manifestations of anxiety surrounding the mixed-reality simulations. Finding statement three was that participants implemented different coping skills to attempt to manage the anxiety they were experiencing surrounding the mixed-reality simulations, including that the participants implemented physical coping mechanisms to attempt to manage anxiety surrounding the mixed-reality simulations and the participants implemented mental coping mechanisms to attempt to manage anxiety surrounding the mixed-reality simulations. Research question four found two connections between the quantitative and qualitative research questions: (a) pre-service teachers can benefit from experiencing anxiety within a mixed-reality simulation setting and (b) mixed-reality simulations provide pre-service teachers with the opportunity to develop their coping skills.

The findings of this study lend support to the inclusion of anxiety management and the development of coping strategies and ability within pre-service teacher programs, especially programs utilizing the context of mixed-reality simulators within the curriculum. Research has indicated links between pre-service teacher anxiety, coping skills, and positive and negative emotions [2,16,23,25,28-34,47,48,66]. The inclusion of mixed-reality simulations in teacher education programs may have potential for exposing pre-service teachers to anxiety-inducing situations to impact their adaptiveness in coping [28,29,47,66].

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