



Article

Using Mixed Reality to Support Inclusive Teaching Strategies in General and Special Education Preparation Programs

Maria B. Peterson-Ahmad ^{1,*} , Randa Keeley ¹ and Andrea Frazier ^{2,*}

¹ Department of Teacher Education, College of Professional Education, P.O. Box 425769, Denton, TX 76204, USA; rkeeley@twu.edu

² Honors College, 4225 University Avenue, Columbus, GA 31907, USA

* Correspondence: mpeterson3@twu.edu (M.B.P.-A.); frazier_andrea@columbusstate.edu (A.F.)

Abstract: Preparing teacher candidates to provide learning strategies that support the differentiated needs of students should be at the forefront of all educator preparation programs (EPPs). Teacher candidates must become fluid in providing strategies that promote students' individualized academic and social-emotional growth as well as strategies that support effective collaboration to enhance student productivity across the school environment. This pilot study explored the use of mixed reality (e.g., Mursion) as a tool to support pre-service general and special education teacher preparation and improvement of self-efficacy related to student engagement and instructional strategies. This study collected data on teacher candidates' pre-/post-self-efficacy and participant self-reflections from an EPP in the United States. The results of this study yielded ideas as to how EPPs can better support teacher candidate preparation using a mixed-reality platform, as data revealed participant increase in self-efficacy and gains in the use of student engagement and instructional strategies that supported the use of evidence-based and high-leverage practices.

Keywords: educator preparation; general education; high-leverage practices; mixed-reality; Mursion; self-efficacy; special education



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1. Introduction

Data indicate that fewer individuals are choosing to go into the education profession, with significant decreases noted in educator preparation program (EPP) enrollment over the past decade (Carver-Thomas and Darling-Hammond 2017; Sutchter et al. 2016). It is predicted that by the year 2025, there may be as few as 200,000 available teachers for hire, resulting in a deficit of more than 100,000 teachers annually (NCES 2023; Sutchter et al. 2016). This is a serious cause for concern as school districts across the United States have already been experiencing a dire shortage of qualified educators to fill vacancies, particularly vacancies in special education classrooms (Berry et al. 2017). EPPs are challenged with cultivating learning experiences for teacher candidates that allow for longitudinal practice-based learning experiences so that teachers have effective strategies that can be employed in today's diverse classrooms. For example, preservice teacher candidates need numerous opportunities to learn about and actively practice explicit teaching methods and strategies, how to find and utilize research-based curricula, and how to collect and analyze data to make informed and individualized data-based decisions. If teacher candidates have the opportunity for these types of experiences during their EPP, they have a greater chance of successful longevity in the classroom (Ingersoll et al. 2012); therefore, EPPs must create opportunities for teacher candidates to develop such skill sets through practice opportunities coupled with constructive feedback (Benedict et al. 2016; Darling-Hammond et al. 2020) so that they can enter their first years of teaching with increased teaching confidence, knowledge of collaborative strategies, and increased teaching self-efficacy.

One way that EPPs can provide teacher candidates with early skill development prior to teaching in a classroom with 'real' students is through practice-based opportunities in a

mixed-reality platform. [Ingersoll et al. \(2014\)](#) found that teacher candidates who graduated and who completed at least a semester of practice teaching were significantly more likely to remain in teaching than those who completed less than a semester. Moreover, [Hoy and Woolfolk](#) found that novice teachers who had additional teaching experiences also had higher self-efficacy ([Hoy and Woolfolk 1993](#)). Mixed-reality simulations allow teacher candidates, who may have little formal teaching experience, opportunities in a preparation program to practice specific strategies with student avatars in a safe environment without incorrectly using a strategy with vulnerable students in an actual classroom ([Dieker et al. 2015](#)). Mastery experiences within a mixed-reality simulation also allow for feedback, which has been documented by research to increase self-efficacy ([Bandura 1997](#); [Tschannen-Moran et al. 1998](#); [Wolters and Daugherty 2007](#)). This pilot study utilized a mixed-method research design to determine how the mixed-reality platform Mursion, combined with feedback, impacted participants' self-efficacy. The objectives of this study included (1) Was there a difference between special education and general education teacher candidates in pre-/post-self-efficacy scores specific to student engagement? (2) Was there a difference between special education and general education teacher candidates in pre-/post-self-efficacy scores specific to instructional strategies? (3) What was discovered from participant self-reflection questions?

1.1. Supporting Self-Efficacy Growth in the Provision of High-Leverage Practices

Understanding the individualized needs of teacher candidates is something that should be considered by EPPs and can be fostered by providing early learning experiences to best support future employment across a variety of classroom settings and student scenarios. One method to better understand pre-service teachers' individualized needs is through self-efficacy. The theory of self-efficacy comes from Bandura's Social Cognitive Theory ([Bandura 1986](#)) and encompasses self-motivation and the belief that one holds of their ability to successfully complete a task ([Bandura 1977, 1997](#)). Within the context of teaching, teacher self-efficacy focuses on "the teacher's belief in their capability to organize and execute a course of action required to accomplish a specific teaching task in a particular context" ([Tschannen-Moran et al. 1998](#), p. 233). Teacher candidate preparation experiences are key to the development of teacher efficacy, that is, teachers' confidence in producing positive student learning ([Gao and Mager 2011](#)). Research has found that the impact of teacher self-efficacy on student outcomes and teachers who have a higher self-efficacy often have increased successes because they have increased fluidity in providing educational opportunities for students through scaffolded learning experiences, relationship building, and student engagement, which can lead to heightened student achievement ([Good and Brophy 2003](#); [Fackler and Malmberg 2016](#); [Hajovsky et al. 2020](#); [Lee et al. 2013](#); [Pianta et al. 2012](#); [Rubie-Davies et al. 2012](#)). Moreover, self-efficacy can also impact and influence teacher candidates' expectations about their future classroom ([Cole and Knowles 2002](#); [Hoy and Spero 2005](#); [Tschannen-Moran and Hoy 2001](#); [Viel-Ruma et al. 2010](#); [Wasburn-Moses 2009](#)).

Today's classrooms encompass a wide variety of students and learning abilities. The Individuals with Disabilities Education Act ([IDEA 2004](#)) federal law recommends that students with disabilities receive a free appropriate public education (FAPE) in the least restrictive environment (LRE) to the greatest extent possible. Among students receiving special education services, the most common category of disability is specific learning disabilities (32 percent), with most students spending most of the school day in a general education inclusive classroom ([NCES 2023](#)). Therefore, general education teachers and special education teachers are both responsible for the academic progress of students with and without disabilities and need to effectively collaborate to meet the individualized needs of their students. In this co-teaching partnership, each teacher "makes a unique contribution to instruction and together, ensures that a rigorous curriculum is delivered in a general education classroom with specially designed instruction embedded based on the student needs" ([Friend et al. 2015](#), p. 80). While the general education teacher typically has specialization in a particular content area, the special education teacher specializes in

instructional practices that enhance learning. While both teachers' skills may overlap, the collaborative partnership is powerful in meeting the diverse needs of students in today's classrooms (Friend et al. 2015). Data from general and special education teachers revealed that a majority (82%) viewed co-teaching as beneficial; however, many (62%) believed that they lacked the necessary skills needed for implementing aspects of co-teaching such as effectively co-planning, co-instructing, and co-assessing (Brendle et al. 2017; Chitiyo 2017). Providing opportunities for pre-service general and special education teacher candidates to work collaboratively to construct and deliver lessons focusing on effective instructional practices throughout an EPP is needed to gain teaching self-efficacy prior to working in a real classroom.

"Once pre-service teachers have increased knowledge of effective instruction teaching students and feel more confident in their teaching, their levels of self-efficacy levels will increase" (Peterson 2014, pp. 20–21). To foster increases in teacher candidate self-efficacy, it is critical that preparation programs provide early, individualized, and repeated active and collaborative (i.e., general and special education teacher candidates) learning practice opportunities that focus on teaching methodology such as how to implement high-leverage practices (HLPs) and how such skills can be refined for continuous improvement. An HLP is defined as practices that can be used to leverage student learning across different content areas, grade levels, and student abilities and disabilities (Ball and Forzani 2011; Grossman et al. 2009; McDonald et al. 2013). These instructional strategies are critical, because HLPs are shown to be effective in improving student outcomes (students with or without disabilities) (Cook et al. 2012) and can occur with high frequency across any type of teaching setting, foster student engagement and learning and can be used in any content area or approach to teaching and are fundamental to effective teaching when executed skillfully (McLeskey et al. 2017). To support teacher candidates in gaining proficiency in HLPs that can increase student achievement, they must first develop requisite skills (e.g., through course work) to successfully complete the task with confidence (e.g., practice-based learning opportunities) in effectively using these skills (Peterson 2014). Teacher preparation programs must provide teacher candidates with longitudinal opportunities in both coursework and practice-based opportunities.

1.2. Active Learning in Teacher Preparation

Many pre-service teachers are not adequately prepared to integrate HLPs into their teaching practices with a high level of self-efficacy (Leko et al. 2015). To support the widespread use of HLPs within daily instruction, intentional and repetitive practice integrating these skills is required. In many situations, pre-service teachers learn about HLPs as part of coursework but then have limited opportunities to implement them during field-based placements such as student teaching. Pre-service teachers need ample early practice opportunities with fidelity prior to field-based experiences (Kennedy et al. 2015; Scheeler et al. 2016). Therefore, repeated practice through active learning opportunities supports teacher candidates in learning how to integrate such strategies as they learn how to move beyond novice-level instruction and begin to think in a more flexible manner as part of their normal teaching practices. Active learning occurs through a synergistic process that allows EPPs to support the increase of teacher candidates' pedagogical fluidity in using HLPs by incorporating learning opportunities into the acquisition of strategic skills. Mixed reality can provide change in human (teaching) behavior and increase student engagement and classroom management and can be used to support active learning, which has the capacity to produce significant and lasting changes in learning pedagogical skills (e.g., instructional and classroom management strategies) through rehearsal and reflection (Dawson and Lignugaris/Kraft 2013; Elford et al. 2013; Garland et al. 2012; Hudson et al. 2019; Landon-Hays et al. 2020; Peterson 2014; Peterson-Ahmad 2018). When teacher candidates have repeated opportunities to actively practice high-impact teaching skills, there is significant potential for deepening teacher candidate knowledge of teaching and how to improve classroom pedagogy (Kamman et al. 2014; Maheady et al. 2007). Active

learning on how to use HLPs in a classroom can be fostered by feedback and practice in a mixed-reality environment.

Explaining and Modeling Content Through Explicit Instruction. Explicit instruction can be defined as the way in which teachers teach content, skills, or concepts to students in ways that facilitate learning through teacher modeling and scaffolding of material in a systematic and engaging manner (Archer and Hughes 2011; Ball and Forzani 2012; McLeskey et al. 2017). Explicit instruction can be embedded into all aspects of lesson design as they can improve outcomes for diverse learners of all ability levels (Riccomini et al. 2017). The foundational aspects of explicit instruction include content, lesson development, delivery skills, and practice and should follow a scaffolded structure that begins with increased teacher support and then fades to student independence as the lesson progresses (Foxworth et al. 2021), inclusive of the provision of frequent, varied opportunities for engagement and practice with immediate, specific feedback (Hughes et al. 2017).

Adjusting Instruction to Meet the Needs of Students. Teachers can adapt instructional practices to meet the individualized needs of students in their classrooms. This can be facilitated by making modifications to lessons that are responsive to the needs of each student. Moreover, instruction should be authentic to student experiences while recognizing strengths and needs and (by substituting, simplifying, and highlighting important instructional content, teachers increase the likelihood that students will meet learning goals (McLeskey et al. 2017). Teacher candidates must learn how to adjust instruction to maintain coherence to ensure that students are adequately responding to instruction, then adjust their teaching based on students' responses.

Guiding Learning Through Feedback. Feedback is an effective strategy to support teacher candidates as they are learning targeted teaching pedagogy. Feedback creates opportunities for teacher candidates to construct and transform their beliefs and practices, solidify, and deepen their understanding of skills used in the teaching profession, improve early instructional practices, observe results, and evaluate effects on student outcomes (Brownell et al. 2020; Collet 2012; Darling-Hammond and Bransford 2005). When teacher candidates effectively utilize and subsequently increase implementation of such practices independently and with fidelity, it can directly impact the students whom they serve, including children with disabilities (McCray et al. 2017). Moreover, when teacher candidates implement feedback, it can enhance their self-efficacy because progress can be gauged as a candidate rehearses a specific competency, making periodic adjustments to achieve the desired goal (Kraft and Blazar 2017). Exposure to early and multiple active learning opportunities with accompanying feedback has the potential to prepare pre-service educators to meet the many demands more thoughtfully in today's schools. Moreover, utilizing mixed reality as part of a teacher preparation program can serve as an efficacious tool for teacher candidates to practice instructional methods and allow for a systematic process of feedback to improve upon specific teaching practices, prior to trying them out in a real-world classroom setting (Peterson 2014).

Mursion. Mursion is a mixed-reality simulated environment that allows for the development of a variety of skills and assists in the fine-tuning of specific pedagogical strategies. Mursion can be utilized with adult or student avatars that are unique in that they represent an array of demographics and personalities. Mursion immerses participants in settings that are meant to replicate environments realistic to real-world settings (i.e., school classroom, office). Mursion allows participants the opportunity to interact with avatars in real time, meaning that the dialogue and actions of the participant and avatars are responsive based on body language and content being discussed. Mursion allows teacher candidates to engage in active learning trials that can be practiced multiple times for fluency or improvement in practice, without risking the loss of valuable resources (e.g., money, time, and people) (Dieker et al. 2008). Mursion can also enable the transfer of knowledge learned from college coursework by applying it in the context of the mixed-reality classroom, thereby solidifying and deepening understanding of skills and providing contextualized professional development. These experiences, in combination with feedback,

create opportunities to further construct beliefs and practices that are grounded in teaching experiences (Britton and Anderson 2010; Collet 2012).

2. Materials and Methods

This pilot study utilized a mixed-method research design, combining elements of quantitative (pre-/post-Teacher Self-Efficacy Scale) (Tschannen-Moran and Hoy 2001) and qualitative data (open-ended self-reflection responses) to determine how the mixed-reality platform Mursion, combined with feedback, impacted participants' self-efficacy. The research was guided by the following research questions:

1. Was there a difference between special education and general education teacher candidates in pre-/post-self-efficacy scores specific to student engagement?
2. Was there a difference between special education and general education teacher candidates in pre-/post-self-efficacy scores specific to instructional strategies?
3. What was discovered from participant self-reflection questions?

2.1. Participants

Participants in this pilot study included $N = 36$ graduate-level general and special education teacher candidates completing their first year of a two-year graduate-level master's degree program, leading to initial teacher certification in general or special education. Participants included students who were enrolled in graduate-level initial teaching certification programs (general education and special education) at a regional university located in the northwest region of the United States. The Master of Arts and Teaching (MAT) program prepares teacher candidates to receive a general education degree with teaching certification with a single subject endorsement (e.g., mathematics, science, social studies, English language arts). $N = 17$ MAT teacher candidates participated in this pilot study. The Master of Special Education program prepares teacher candidates to receive a special education degree with teaching certification in pre-K through 12th-grade special education classrooms. $N = 19$ special education teacher candidates participated in this pilot study. All participants were completing a required program plan course in their respective degrees related to instructional literacy strategies, focusing on principles and strategies to support students in an inclusive classroom environment. All aspects of this study were approved by the university Institutional Review Board (IRB), and consent for participating was received from all participants prior to data collection.

2.2. Procedures and Data Collection

Prior to the start of the semester in which participants were enrolled in their respective instructional literacy courses, the researchers (who were also faculty of record for both courses) met to coordinate syllabus and lecture content, class activities, and course assignments so that strategic efforts were made to synchronize instruction and model practices specific to HLPs. Similar content was infused in each class that included cross-walked HLP instruction and student-engagement-specific content from TeachingWorks, focusing on the fundamentals of teaching that can be used across subject areas, grade levels, and context (TeachingWorks 2023), and the Council for Exceptional Children High-Leverage Practices for Students with Disabilities, which are fundamental aspects of practice for special educators and include aspects of practice in collaboration, assessment, social/emotional/behavioral elements, and instruction (Council for Exceptional Children 2023). This collaborative endeavor was aimed at bridging the research-to-practice gap to create a shared understanding of effective teaching across general and special education EPP faculty and participants enrolled in these courses (McLeskey et al. 2018). After careful synthesis of each set of instruction-specific standards, the researchers decided to focus course HLP content on instruction and student-engagement-specific courses as they complemented each other and are widely used by both general and special education teachers in K–12 settings. Table 1 below outlines the selected TeachingWorks and Council

for Exceptional Children High-Leverage Practices for Students with Disabilities alignment, specific to instruction and student engagement.

Table 1. Aligned instruction and student engagement HLPs.

TeachingWorks High-Leverage Practices	Council for Exceptional Children High-Leverage Practices for Students with Disabilities
HLP 2: Explaining and modeling content.	HLP 16: Use explicit instruction.
HLP 6: Coordinating and adjusting instruction.	HLP 13: Adapt curriculum tasks and materials for specific learning goals.
HLP 15. Checking student understanding.	HLP 22: Provide positive and constructive feedback to guide students' learning and behavior.

At the beginning of the semester, participants in each literacy instruction class were paired with another class member. This partnership remained consistent across the duration of the semester for planning and collaborative teaching in all Mursion sessions. During each class meeting throughout the semesters, the researchers engaged in teaching regularly planned course content and engaged weekly in class discussions with the participants. These conversations initiated a 'process of interaction', which is the initial stage of qualitative grounded theory, as they were all situated in the 'views of the participants in the study' (Corbin and Strauss 2008). These discussions revealed information from each of the participants about their self-perceived preparedness to teach. In addition, each participant completed the validated pre-Teacher Self-Efficacy Scale (TSES) (Tschannen-Moran and Hoy 2001), which measured respondents' perceptions of self-efficacy on a 9-point Likert scale ranging from 1 = 'nothing' to 9 = 'a great deal' in the areas of instruction, student engagement, and classroom management and included common question stems known to be difficult for teachers in school settings and/or activities. Tschannen-Moran and Hoy (2001) developed the Ohio State Teacher Efficacy Scale (OSTES), which later became the TSES. The 2001 study tracks the refinement process that took place to take the OSTES from a 52-item scale down to a long-form scale with 24 items and a short scale with 12 items. Tschannen-Moran and Hoy (2001) tested the scale across N = 224 participants to establish item importance and factor analysis. The process was then repeated with the revised scale to establish the 24-item long scale and 12-item short scale. Once the long- and short-scale items were established, both were subjected to factor analysis using principal-axis factoring with varimax rotation. The results indicated that the OSTES could be considered reasonably valid (Tschannen-Moran and Hoy 2001). The researchers were interested in better understanding baseline individual participant self-efficacy related to instruction and student engagement measures, both commonly cited items in research and documented as predominant difficulties for novice teachers in school settings (Atteberry et al. 2017; Guthery and Bailes 2022; Ingersoll 2001). Table 2 outlines the specific TSES instruction and student engagement scale items.

To keep data collection and feedback consistent, a pre-prepared middle school literacy lesson from the local district curriculum was provided to all participants which would be used for their collaborative practice teaching during each Mursion session. Five Mursion sessions were scheduled across the duration of one semester, where the co-teaching partnership planned together and taught the same science vocabulary lesson, starting at the beginning of the lesson each session. Prior to the first Mursion co-teaching session though, participants had a 'meet and greet' session with the avatars to familiarize themselves with the environment, gain a better understanding of each student, initiate classroom community, and relieve feelings of anxiety in using a mixed-reality classroom for the first time (Anton et al. 2023). A small group of five, diverse avatars typifying middle-school-aged students with diverse learning abilities was used across all Mursion sessions (Figure 1).

Table 2. Teacher Self-Efficacy Scale (TSES) instruction and student engagement scale items.

Instruction
Q7. How well can you respond to difficult questions from your students?
Q10. How much can you gauge student comprehension of what you have taught?
Q11. To what extent can you craft good questions for your students?
Q17. How much can you do to adjust your lessons to the proper level for individual students?
Q18. How much can you use a variety of assessment strategies?
Q20. To what extent can you provide an alternative explanation or example when students are confused?
Q23. How well can you implement alternative strategies in your classroom?
Q24. How well can you provide appropriate challenges for very capable students?
Student Engagement
Q1. How much can you do to get through to the most difficult students?
Q2. How much can you do to help your students think critically?
Q4. How much can you do to motivate students who show low interest in schoolwork?
Q6. How much can you do to get students to believe they can do well in school?
Q9. How much can you do to help your students value learning?
Q12. How much can you do to foster student creativity?
Q14. How much can you do to improve the understanding of a student who is failing?
Q22. How much can you assist families in helping their children do well in school?



Figure 1. Mursion middle school classroom. Reprinted with permission from Mursion. Copyright 2023, San Francisco, Mursion, Inc.

During each Mursion session, one of the researchers observed the co-teaching partners. For example, if the MAT students were completing their sessions, the researcher from the opposite course (special education) was present, and vice versa. Each Mursion session was recorded so that the researchers could go back to watch each session again to verify data and obtain inter-rater reliability (inter-rater reliability between each researcher remained consistent at 80% or higher across the duration of the study) on the data collected from sessions on participants' use of instruction and student-engagement-related HLPs where researchers were not present in person. Each Mursion session was supported with explicit feedback from the researchers during each session and immediately after each session. This repeated practice strategy aligned with research recommendations for teaching with

technology and maintained that teacher educators received sufficient repetition during coaching-centered learning (Dieker et al. 2014).

Following each Mursion session, participants individually responded to a set of open-ended self-reflection questions which included: 1. *What do you think went well during your Mursion session today related to your instruction and how well you engaged your students?* 2. *What would you change for your next Mursion session?* 3. *What goals do you have for you and your teaching partner for your next session?* These self-reflection questions, in combination with feedback from the researchers, allowed participants to immediately deliberate on the completed Mursion session before beginning to collaboratively plan for the next Mursion session, to monitor individual perceptions about teaching, and to identify if the front-loaded instruction in their courses was impacting their teaching and use of instruction and student-engagement-related content in their Mursion session. Responses from these questions, in addition to the researcher's anecdotal notes, guided the researchers in providing continuous strategic feedback and individualized participant support.

Following the final Mursion session, all participants completed a post-TSES to gather data to determine changes in perceived self-efficacy between pre- and post-assessments.

2.3. Qualitative Data Analysis

The researchers were interested in how participants 'made sense' of their experiences within the mixed-reality environment from session to session; therefore, the self-reflection question stems served as the constant focus for qualitative data analysis. Following the grounded theory methodology, the researchers 'derived a general abstract of theory based on the views of the participants, generated categories of information for open coding, and further selected categories to position within the theoretical model that interconnected each category' (Corbin and Strauss 2008; Creswell and Poth 2018). A priori codes were established (e.g., instructional strategies, teaching partnership, student behavior, classroom management) as a baseline for the researchers during the initial phases of the coding process. These codes remained fluid so that inductive codes could be established during the second-stage coding process which looked at specific patterns, themes, and trends (Rossman and Rallis 2012). The researchers also gathered participants' individual self-reflection responses after every Mursion session. Each open-ended response was read, and the researchers wrote reflective notes to highlight insights to aid in the inductive coding process. The researchers reached saturation of their thematic categories when data gleaned similar concepts. The inductive process yielded three overarching participant themes including (1) awareness of teaching partner interactions, (2) recognizing individual student needs, and (3) use of explicit instruction. Qualitative research validity was established using multiple investigators as collectors, analyzers, and interpreters of the data collected. An inter-rater reliability (IRR) of 98% was established prior to coding participant data by reading and coding previously collected student self-reflections to "mitigate interpretative bias" and ensure a "continuous dialogue between researchers to maintain consistency of the coding" (Walther et al. 2013, p. 650). Additional member checking was used for verification, insight, and a deeper understanding of the collected data (Birt et al. 2016).

2.4. Quantitative Data Analysis

The Statistical Package for the Social Sciences (SPSS) 26 software was used to analyze the data related to the quantitative research questions. Four independent *t* tests addressed whether there were differences in instructional strategies and student engagement efficacy at preassessment and post-assessment for the two groups of students. The alpha level was adjusted to 0.0125 (0.05/4) for the four tests to correct for inflated Type I errors associated with multiple tests on the same data; equality of variance and normality can be assumed for all *t* tests. Paired sample *t* tests were used to address whether there was a positive increase in instructional strategies efficacy and student engagement efficacy at post-assessment for the two groups of students. The alpha level was adjusted to 0.0125 (0.05/4) for the four

tests to correct inflated Type I errors. Normality can be assumed for all paired-sample *t* tests.

3. Results

3.1. Research Questions 1 and 2

Research questions one and two determined to investigate differences between special education and general education teacher candidates in pre-/post-self-efficacy scores for student engagement and instructional strategies. In examining the means for the two groups for instructional strategies self-efficacy at the pre-test stage, the mean was higher for the special education participants; however, the means were not significantly different from each other ($t(34) = 0.616, p = 0.542, d = 0.206$). There was a statistically significant increase in instructional strategies efficacy for special education participants ($t(18) = \text{Student Engagement } 4.37, p < 0.001, d = 1.002$) and general education participants ($t(16) = 3.92, p = 0.001, d = 0.952$) at post-test. The increase in instructional strategies efficacy was not accompanied by a significant difference between the two groups at post-test ($t(34) = 1.302, p = 0.202, d = 0.435$) (see Table 3). In examining the means for the two groups specific to student engagement self-efficacy at pre-test, the mean was higher for the special education participants (see Table 3), with this difference being statistically significant ($t(34) = 3.25, p < 0.003, d = 1.09$), ensuring that there is a 95% confidence interval or true difference between the special education and general education participants between 0.312 and 1.35 points. There was a statistically significant increase in student engagement self-efficacy for the special education participants ($t(18) = 3.51, p = 0.003, d = 0.805$) and general education participants ($t(16) = 4.23, p < 0.001, d = 1.03$) at post-test. The increase in student engagement efficacy was not accompanied by a significant difference between the two groups at post-test ($t(34) = 1.37, p = 0.180, d = 0.457$). Table 3 shows pre- and post-TSES scores on the instructional strategies and student engagement from both groups of participants.

Table 3. Pre- and post-TSES scores for instructional strategies and student engagement.

	Instructional Strategies		Student Engagement	
	Pre-test M (SD)	Post-test M (SD)	Pre-test M (SD)	Post-test M (SD)
Master of Special Education Participants ($n = 19$)	6.22 (1.33)	7.30 (1.08)	6.42 (0.838) *	7.13 (0.923)
Master of Arts in Teaching (General Education) Participants ($n = 17$)	5.99 (0.844)	6.85 (0.945)	5.59 (0.679)	6.67 (1.10)

* Significantly different at $p < 0.05$.

3.2. Research Question 3

Research question three sought to find themes noted from participants' self-reflection responses. Through examination and thematic analysis of participants' self-reflection responses following the five Mursion sessions, data revealed three predominant themes which included: (a) awareness of partner interactions in teaching, (b) growth in authentic understandings of individual student needs, and (c) mindful deliberation and growth in the use of explicit instruction. All participants across the general and special education programs discussed their improvement in coordinating and adjusting instruction during a lesson (e.g., modeling, and scaffolding steps or processes needed to understand content and concepts) with their teaching partner. Participants also commented on their increased understanding of individual student needs and set specific goals related to increasing student (avatar) attention and engagement. Moreover, numerous self-reflections focused on Harrison (a student avatar with characteristics of a specific reading learning disability) regarding the need for modifications to their teaching so that it provided personalized and individualized instruction based on his unique characteristics and needs. Table 4 outlines the identified qualitative themes highlighted by corresponding participant responses.

Table 4. Qualitative themes with corresponding participant self-reflection statements.

Identified Themes	Corresponding Participant Self-Reflection Responses
Awareness of partner interactions in teaching.	"I was very proud of this lesson; We got straight to the point of the lesson which was vocabulary and had equal amounts of input and control as teachers; We were able to incorporate a visual activity which was a goal from last session."
Growth in authentic understandings of individual student needs.	"I think involving Harrison * more and checking more frequently for understanding would be good; We need to make our instruction more targetable for Harrison; Including something visual into our lesson; Including more synonym examples and integrating more differentiation specific to Harrison's needs."
Mindful deliberation and growth in the use of explicit instruction.	"Next time, we would encourage students to make more personal connections with the vocabulary words and see if students can come up with their own definitions and creative sentences using the vocabulary."

* Harrison is an avatar in Mursion that has characteristics of a student with a specific learning disability.

Quantitative data analysis from this pilot study suggests that the general and special education teacher candidates differed in student engagement self-efficacy at pre-assessment, with special education participants exhibiting higher ratings. Data suggest that each of the groups (i.e., general education and special education) had statistically significant increases in self-efficacy; however there was no significant difference between groups at post-assessment. Specifically, in connection to student engagement, there was a difference at pre-assessment with the special education participants as they scored themselves higher in this category than the general education participants. Further, as each group completed the Mursion sessions and scored themselves again on perceived self-efficacy at post-assessment, there was a statistically significant increase in student engagement self-efficacy for both groups. While differences still existed, both groups had increases between pre- and post-assessment in perceived self-efficacy in instructional strategies and student engagement. It is evident through the analysis of pre- and post-TSES assessment that Mursion had a positive impact on both groups for both instructional strategies self-efficacy and student engagement self-efficacy.

Qualitative data suggested that trends in responses between the first and last Mursion sessions became increasingly robust, in that participants moved from surface-level reflections to in-depth introspective reflections. Because of the opportunity to re-teach the same lesson and refine instruction from session to session, a greater understanding of how to provide explicit opportunities for student engagement and attention to the importance of differentiation in instructional strategies within an inclusive classroom was noted. All participants identified and discussed their perceived increase in the ability to utilize explicit instruction. More specifically, participants reported an increased ability to explain and model content (HLP 2 and HLP 16), differentiate instruction by personalizing based on students' strengths and needs (HLP 6 and HLP 13), and integrate strategies for teaching vocabulary (e.g., using examples and non-examples) and how to scaffold instruction to support comprehension (HLP 15 and HLP 22) (see Table 1). Participants' alignment to both the TeachingWorks and High-Leverage Practices for Students with Disabilities HLPs suggests that the triangulation of front-loaded course content, active learning in each Mursion session, and feedback allowed for an increase in understanding and implementation of the HLPs specific to student engagement and instructional strategies.

4. Discussion

Today's classrooms expect that all educators can effectively and efficiently support students of varying abilities, including students with disabilities (DaFonte and Barton-Arwood 2017). EPPs are responsible for providing robust learning opportunities that are focused on strategies that support effective teaching and learning; however, this cannot be done without the collaboration of general and special education faculty "to provide a coherent educational program to support student's academic achievement" (Ketterlin-Geller et al. 2015, p. 52). When planning instruction for students with disabilities, collaboration is key

and takes mindful effort, persistence, and continued professional development (Hamilton-Jones and Vail 2014). Teacher candidates benefit from repeated practice opportunities where mistakes can be made and explicit feedback can be given prior to practicing a particular skill again. A simulated learning environment provides candidates with opportunities to collaborate (Brendle et al. 2017; Chitiyo 2017) and repeatedly teach a lesson that can be adjusted based on immediate feedback (Brownell et al. 2020; Collet 2012; Darling-Hammond and Bransford 2005), something that cannot be done in a traditional classroom setting. Subsequently, the real-time nature of a mixed-reality simulated environment provides the needed structure that is the bridge between coursework and field experiences to provide opportunities for strengthened teacher self-efficacy (Cole and Knowles 2002; Hoy and Spero 2005; Tschannen-Moran and Hoy 2001; Wasburn-Moses 2009). This pilot study provides a model for EPPs to think about how to further develop pedagogical and collaborative skills between general and special educators in a safe environment prior to working with students in an actual classroom, through repeated opportunities in a mixed-reality environment to support the active practice of learning how to use high-impact teaching skills (Kamman et al. 2014; Maheady et al. 2007). Data positively suggest that the repeated practice opportunities in Mursion aided in the increase in special and general education teacher candidate growth in teaching self-efficacy specific to student engagement and their enhanced use of explicit instructional strategies by the last Mursion session.

4.1. Theme 1

The first theme that emerged in data analysis was that of ‘Awareness of Teaching Partner Interactions’. Both groups of participants (general education and special education teacher candidates) self-reflected on the importance of partner collaboration. Across the five Mursion sessions, participants noted that they had increased awareness of their partner’s interactions, which allowed for more discrete lesson planning and teaching which was directly from the collaborative planning and teaching for each Mursion session. For example, several participants discussed how more attention was given to teaching equity (i.e., equal teaching time) during each simulated session and increased partner discussion, with later sessions indicating a better sense of not only what to improve but how to make such improvements as a teaching pair. For example, one participant wrote, “Today’s session did not go as well as I hoped. We attempted a new approach to our lesson based on feedback received, but honestly, we should have done more collaborative prep and troubleshooting. I want to be sure to discuss how to make a more meaningful connection with our lesson for our next session with my partner.” This theme coincides with the HLPs #6 and #13 (see Table 1).

4.2. Theme 2

Another theme that became apparent in the data was, ‘Recognizing Individual Student Needs’. Across the semester of research, participant reflections following each Mursion session increased in awareness of adjusting instruction to the individualized needs of each student. Course content in addition to the corresponding Mursion sessions allowed teacher candidates to apply learned pedagogy and refine teaching based on feedback received after each session. Participants discussed the need to “have the students make more personal connections to the lesson” and “allow Harrison to work independently or with a partner”, or “use visuals to support instruction for Harrison”. Harrison is an avatar that exhibits the characteristics of a student with a learning disability. Students with learning disabilities require strategic accommodations and/or modifications as set forth in their individual education plan (IEP) as part of their specially designed special education services. The increased understanding and awareness of how differentiated supports could be provided to specific students for heightened educational outcomes through lesson plans and instructional supports was evident across the duration of the semester and Mursion sessions. This also overlaps with HLP #6, HLP #13, HLP #15, and HLP #22 (see Table 1).

4.3. Theme 3

Lastly, the theme of 'Use of Explicit Instruction' became evident in the pilot study data. Prior to each Mursion session, the teaching pair submitted a lesson plan that was revised from the prior session and that integrated the feedback received from the course faculty (i.e., the researchers of this study). Teacher candidates not only modified their lesson plans across the semester to include detailed teaching strategies and inclusion of HLPs, but they were increasingly mindful in refining based on what they continued to learn about the avatar students and about their collaborative teaching partnership and strengths. This connected the class content with the Mursion sessions, which demonstrated a growing understanding of the application of class concepts to support diverse student learning. For example, one participant self-reflected that "I want to make sure that my lesson includes various ways for students to learn whether it be through games, pictures, or graphic organizers." At the end of the semester and the final Mursion session, this participant reflected, "I'm glad we decided to increase our use of visual supports, particularly for Harrison, although they helped all the students. It allowed my partner and I to increase our interactions with each of the students and get them more interested in the lesson." Through the integration of course content, revision of lesson plans based on feedback, and repeated practice of their teaching skills, explicit instruction occurred on a more frequent and intentional basis. These data align with HLP #2, HLP #6, HLP #13, and HLP #16.

4.4. Teacher Candidate Self-Efficacy

In addition to teacher candidate increases in their pre-/post-TSES scores, it was also apparent across their Mursion sessions and post-session self-reflections. Repeated practice, along with intentional and individualized feedback, allowed each teacher candidate to become more confident in their lesson planning, collaboration, and use of HLPs. Self-reflections distinctively shifted between the first and last Mursion sessions in statements that moved from general statements (e.g., "I feel like I needed to move faster in my lesson.") to statements that were intentionally tied to student success initiatives (e.g., "I am glad I introduced the lesson with a classroom community building exercise, because later when we did turn and talks, students were more comfortable in sharing and working on lesson content. Before, they didn't talk or want to participate in the activity."). Participants also became more self-aware in the overall process of teaching. One participant discussed after the final Mursion session that "Teaching is never going to be a perfectly linear process and I will make mistakes every single time, but I know that it doesn't have to be perfect and that I can think about each day and talk with people or seek out resources that will help me for my next day of teaching. I have realized that teaching is a continuous learning process". This coincides with Peterson (2014) in that "once pre-service teachers have increased knowledge of effective instruction teaching students and feel more confident in their teaching, their levels of self-efficacy levels will increase" (pp. 20–21).

5. Limitations

The limitations of this study include (a) the small sample size, (b) participant sampling (i.e., differences in ability or gender), (c) the use of *t* tests for data analysis, and (d) the overall cost of Mursion. Participants in this study included an overall $N = 36$ and this therefore limits the ability for generalization of findings. Additionally, participants were a convenience sample of students from one institution of higher education enrolled in the researcher's respective general and special education courses. Using Cohen's *d* effect size guidelines removes the effect of sample size from calculations and provides evidence that the increases in self-efficacy related to student engagement and instructional strategies were robust for each group. Additionally, *t* tests typically have a high error rate and tend to perform better for larger sample sizes. Finally, there is a cost associated with the use of Mursion; therefore, this learning platform would not be readily available to all educator preparation programs.

6. Conclusions

It is essential that EPPs provide repeated opportunities for teacher candidates to actively practice high-impact teaching skills such as learning how to use HLPs in a classroom. EPPs can nurture this through faculty who collaboratively plan experiences that involve general and special education teacher candidates. This is important given the landscape of K–12 classrooms that support inclusion, as students with and without disabilities are provided instruction in the general education classroom environment. Not only can EPP faculty learn from one another on their specific expertise in each area, but it also allows for the creation of course content that is strategically aligned to what teachers are going to need to know when they enter their first classroom. Additionally, when course activities are created that foster collaboration between pre-service teachers, it allows for a sneak peek into the day-to-day workings of a real classroom. Opportunities for early collaboration in an EPP allow teacher candidates to model and be coached on effective academic and behavioral pedagogical strategies to best support the differentiated needs of learners in the classroom (Landon-Hays et al. 2020).

Additionally, repeated pedagogical practice opportunities support teacher candidates in learning how to integrate such strategies as they learn how to move beyond novice-level instruction and begin to think in a more flexible manner as part of their normal teaching practices. When teacher candidates have repeated opportunities to learn about and actively practice explicit teaching methods and strategies, they begin to make informed and individualized data-based decisions that positively impact the way in which they differentiate instruction, align curriculum, and provide adaptations to the learning environment to increase learning success for all students. Course content in addition to the use of Mursion across the duration of a semester did support and benefit teacher candidates in improving their teaching and increasing self-efficacy, which is indicative that it has the potential as a strategic preparation activity in addition to coursework and other traditional field-based opportunities.

As EPPs seek ways to continually improve aspects of teacher preparation so that teacher candidates are increasingly prepared for their first classroom post-graduation, consideration of innovative ways in which learning can occur must take place. Mixed reality, such as Mursion, has the potential to provide teacher candidates with the capacity to bridge classroom theory and concepts through active practice with pedagogical skills (i.e., HLPs) that will impact the diverse learners in today's classrooms. Moreover, it provides a platform in which candidates can make mistakes, reconfigure their teaching based on feedback provided, and then try again until practices become increasingly fluid.

7. Future Research

EPPs need to provide early, repeated, active learning opportunities for their teacher candidates so that pedagogy can be individually refined prior to entering a real classroom. Future research in this area should continue to investigate constructs of teacher candidates' self-efficacy so that content and active learning experiences can be increasingly differentiated. Additionally, a larger population of participants, expansion of participants to urban and suburban settings, and an added control group should be incorporated into future research designs to further measure the effects of mixed reality against other methods of instruction. It is also recommended that in future studies, larger sample sizes should be utilized to create increasingly robust research results.

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