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Innovating with in-service mathematics teachers' professional development: The intersection among mixed-reality simulations, approximation-of-practice, and technology-acceptance

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ABSTRACT

In-service teachers must be provided with high-quality professional development (PD) opportunities that not only effectively improves and develops their skills, but also engage, and motivate them to continue growing. In this project, we studied in-service teachers' perceptions, opinions, and mindset toward the use of mixed-reality simulations (MRS) as a potential tool for PD to advance and enhance their pedagogical knowledge for mathematics. We followed a convergent parallel mixed-method approach with 49 in-service teachers who were exposed to a series of simulations sessions. We found evidence that the use and integration of technologies like MRS as a tool for PD is considered to be an approximation of practice well accepted by the teachers. In addition, the majority of participants perceived the tool as an effective-unique strategy to develop skills related to questioning, eliciting and assessing students.

Keywords: in-service teachers, professional development, technology-integration

INTRODUCTION

In USA, teacher attrition numbers are worrisome, according to the National Education Association (2022). Many teachers are leaving the profession during their first years of work (Bentil, 2023; Kamenetz, 2022). After COVID-19, teacher shortage worsened, in part due to the work conditions and lack of empathy from their employers (Schmitt & DeCourcy, 2022). For example, Loewus (2021) asked 700 teachers from 300 different school districts how likely it is that they would leave the profession in the next two years. Not to her surprise, 54% of teachers who participated in the study responded that they would quit their jobs, and only 27% said they would stay only because of their "love [for] their students" (para. 8).

Several claims support the above, however, one main reason that teachers cite as a factor that might impact their decision about continuing as teachers is receiving effective training and professional development (PD). Teachers recognize the importance of continuing developing their content and pedagogical skills (Mizell, 2010; Parker & Patton, 2016), which are essential for a high-quality instruction. However, a study focused on understanding the reasons for teachers' shortage and teachers leaving the profession (García & Weiss, 2019), found that teachers decisions to leave education are due to the following: a. limited access to effective PD experiences that truly add value to their content and pedagogy knowledge, b. limited access to resources, and c. few opportunities to get involved with learning communities that effectively supports their career and growth.

It is clear that providing opportunities to get involved in high-quality PDs that effectively improves and develops teachers' skills, is essential for their continuing growth, motivation, and engagement. However, in many cases when teachers are asked by their districts–or schools administrators–to engage and take part in PD experiences, they are not involved in deciding the type of PD that is offered, nor its duration, place, provider, or even if PD's topic is what they really need (García & Weiss, 2019). All the above become barriers in terms of motivation and commitment from teachers, which hampers the goals and objectives of having well-prepared trained teachers who can provide the highest quality and learning experience for students.

A potential opportunity for schools–to not only have a better response from teachers regarding engagement, motivation, and participation in PD programs–is to use and combine state-of-the-art technologies like mixed-reality simulations (MRS) that foster the development of pedagogical and content skills. For the purpose of this study, we will be referring to MRS as a type of virtual simulation environment used as a PD in a master program for teachers. We expand our understanding of MRS in the literature review section below. MRS allows PDs to take place considering different formats and settings. For example, PDs do not necessarily need to take place in a particular setting. Instead, teachers can engage in them while at school, or at more convenient time.

Research into MRS has found that a single exposure of about 8-10 minutes intended to practice and develop classroom high-leverage skills (Ball, 2009) are comparable to having a real life-experience of about 40 minutes (Aguilar & Flores, 2022; Driver et al., 2018; Murphy et al., 2021). MRS is not intended to replace the real experience, but rather to offer an innovative approach that would engage, enhance, and motivate teachers to learn and develop their skills in a unique and different approachable way.

MRS is a state-of-the-art technology that has been gaining attention among teacher preparation programs (Cohen & Wong, 2021; Ersozlu et al., 2021). Researchers have been conducting studies related to its potential in different areas of education such special education (Driver & Zimmer, 2022), classroom management (Hudson et al., 2019), school leadership (Piro & O'Callaghan, 2019), or high-leverage practices (Aguilar & Flores, 2022). In particular, MRS is integrated in teacher preparation programs because it allows for multiple repetitions and instant feedback and coaching, that would not be possible in a real-life classroom environment. However, few research have been conducted studying the benefits of integrating MRS as a potential PD tool with in-service teachers. This represent a gap in the literature that we are intended to address in the study we are presenting here.

In this project, we studied in-service teachers' perceptions, opinions, and mindset toward the use of MRS as a potential tool to develop and enhance their pedagogical teaching skills, in a mathematics pedagogical graduate course. In the context of this study, we referred to in-service teachers to a certified professional educator working in a school setting. We considered a convergent parallel mixed-method approach (Mills & Gay, 2019) to answer the following questions:

a. What are in-service teachers' perceptions about being exposed to MRS as a PD tool to enhance their teaching skills in terms of classroom management and as a way to develop their teaching skills to implement and orchestrate classroom discussions?
b. Is peer-feedback perceived as an effective strategy to improve and develop teachers' teaching skills in the context of MRS?
c. Is there any change in the in-service teachers' perception before and after their exposure to MRS in regard to the use of MRS as a PD tool?

THEORETICAL PERSPECTIVES

Professional Development for Teachers

Teachers' development is an essential component of their professional growth and strategy to close the achievement gap among students (William, 2010). PD for teachers has been defined as the set of activities intended to help expand, understand, and develop the professional skills of teachers in both content and pedagogy (Sixel, 2013), for the benefit of the students (Darling-Hammond et al., 2009).

Districts and schools around the nation plan for PD for their teachers as a way to guarantee that their teachers continually strengthen, improve, and develop their teaching practice "throughout their career" (Mizell, 2010, p. 1). PDs are a vital component of the educational system to not only develop teachers' quality of instruction but to improve student achievement (Mizell, 2010).

The way teachers receive PDs can vary significantly from the traditional few-days hand-on workshops (Belman, 2015) to year-long curriculum-development or conference lecture-type exposure (Avalos, 2011). However, it is not uncommon that PDs offered to teachers are provided without a strong connection to their instruction or even to their cultural, social, and political context (Szelei et al., 2020). These result in a low-positive commitment to engage and attend PD opportunities, which in most cases takes place during teachers' out-of-work time (Johnson, 2016), forcing them to sacrifice personal or family time.

In contrast, a well thought PD plan for teachers can help them be successful in their teaching responsibilities by expanding their content and pedagogical knowledge (Mundry, 2005). In addition, it will support and foster their confidence in the work that they do and will promote collegiality as teachers will meet and collaborate during PDs (Mizell, 2010; Patrick et al., 2010; Robinson, 2019).

There are no doubts about the importance and relevance of PD in teachers' careers. In particular, for novice teachers who most of the time find themselves in the overloaded and stressful task of learning the profession while doing their work. In-service teachers who receive professional training during the first years of their career, have a higher student achievement in comparison with those who lack a strong well-planed support (Strong et al., 2004).

In the study presented here, we strive to depict the use of a state-of-the-art technology as an alternative tool to provide PD to in-service teachers. This is not intended to replace other strategies; our intention is to illustrate and describe how the use of innovative technologies could potentially enhance teachers' development.

Mixed-Reality Simulations for Teachers to Develop Productive Mathematical Talk Moves

MRS is a state-of-the-art technology developed by Mursion (2016). The technology is intented to simulate real-life environments that serve as a catalyst for the development of educational skills in a variety of safe contextual settings. For example, classrooms, where teacher-student interaction occurs, parent-conference, and principal-teacher conversations. What makes Mursion (2016) an effective simulation technology is that it provides an environment, where the learner is exposed to situations that simulate a real environment, but with the benefit of a controlled environment that allows for repetitions, pauses, and as-it-occurs feedback that would not be able to take place in a real-life situation (Driver et al., 2018). MRS combines artificial intelligence with a human component for a realistic experience to the learner. The learner interacts with a set of avatars that are shown on the computer screen of the learner. The avatars are controlled by an educational specialist who follows a semi-structured script, with the intention of enhancing the experience of the learner (Aguilar & Flores, 2022).

The development of pedagogical content knowledge skills for teaching is both relevant and important (Lannin et al., 2013). In particular, in a school setting, where teachers have the responsibility of setting the foundations of knowledge that students will later need, use, and apply while moving forward in their educational journey. In regard to mathematic, it is crucial that teachers foster mathematical proficiency in their students (Kastberg & Frye, 2013; Schoenfeld, 2007; Suh, 2007). One way to achieve this is by orchestrating mathematical discussions in the classroom (Samuelsson, 2010) while assessing, questioning, and eliciting students' thoughts. The use of productive mathematical talk moves (PMTM) (Chapin et al., 2009; Ginsburg, 1997; Jacob & Empson, 2016; Moyer & Milewicz, 2002) support the above because of the integration of teaching's pedagogical strategies that aims to foster engagement, participation, idea externalization, and collaboration. However, learning how to integrate PMTM requires teaching-classroom-time, which can be challenging in a well-known packed curriculum that inadvertently does not allow for extra activities (Dillon, 2006; OECD, 2020). The use of MRS, as it was integrated in this study, would support the development of high-leverage practices (Ball & Forzani, 2011) like the ones mentioned above. The implementation of MRS here served as a PD tool–not just to depict in-service teachers a state-of-the-art technology–with the potential of enhancing their skills with a fraction of their time, but with the same potential of any other PD opportunity.

Approximation of Practice with Teachers Through Mixed-Reality Simulations

In this study we considered the theoretical lens of approximation of practice (AoP) (Schutz et al., 2018; Grossman et al., 2009). AoP is an instructional strategy in which the learners–in this case in-service teachers–are given "opportunities to engage in aspects of practice [in a safe environment, where support and feedback is provided] for optimal learning … and [where] specific elements of practice are targeted" (Schutz et al., 2018, p. 57). According to Schutz et al. (2018), there are several different ways a learner can be exposed to an AoP, such as rehearsals, role-plays, micro-teachings, or MRS. For the purpose of this study, we implemented MRS by exposing in-service mathematics teachers to a series of MRS to provide them with a safe environment, where they could develop their mathematical skills in assessing, questioning, and eliciting their students in a context of problem-solving. Following an AoP allows for self-reflection, feedback, and discussion, as MRS does. It is relevant to highlight that AoP varies in authenticity, based on the setting and condition of the practice. For example, if the AoP takes place in a real classroom, it is considered very authentic. However, the way it is conceived within this study supports in-service teachers in developing their skills, in a safe and authentic environment that helps them be more prepared for their teaching responsibilities; if does not replace the real experience, but is a complement to it (Driver et al., 2018). In addition, MRS allows for repetitions, instant feedback, or video-reflection discussions, that would not be possible in a full authentic environment. All this allows for a large number of opportunities to enhance the learner's (i.e., the in-service teachers) abilities.

MRS is considered to be an AoP because it effectively simulates a classroom environment. With MRS teachers can practice and develop different skills. For instance, classroom-management, assessing, eliciting, and questioning students in a problem-solving context while orchestrating a classroom discussion, or how to integrate and use PMTM as a way to enhance a student's mathematical proficiency.

Mixed-Reality Simulations Technology Acceptance by Teachers

Teachers' acceptance of MRS depends on how well organized, structured, and planned the exposure is in relation to their perception of usefulness as a tool that could actually enhance their teaching practices. In fact, Davis et al. (1989) considered that from a behavior-attitude-perception point of view, an individual–in this case, in-service teachers–accepts a technology for a specific purpose (e.g., as a PD tool) when it is perceived as something useful worth of their time and easy to work and interact with. In this regard, we considered the technology acceptance model (TAM) as a lens to better understand teachers' approval of MRS in relation to its ease of use and usefulness as factors that trigger an attitude (Rasimah et al., 2011; Davis et al., 1989). MRS as a PD tool can potentially expand, improve, and renew the way PD is delivered for teachers. However, implementing MRS without understanding its acceptance, could be costly. Therefore, it is essential to understand how this type of technology would be accepted and what the perceptions would be for the sake of avoiding worthless investment on technologies (Theng et al., 2007).

TAM is rooted on the concept of situated learning, which relies on the fact that learning occurs in the same context, where it is applied (Rasimah et al., 2011). This is related to the theoretical concept of AoP explained above for which in-service teachers are exposed to an MRS with the intention of developing and enhancing their teaching skills. Then, MRS, TAMs, and AoP are related as they intersect in a single point of concurrency, which in this case are in-service teachers' professional growth.

METHODOLOGY

In this project 49 (n=49) in-service teachers participated in the study from which 12% were males and 88% females. In addition, 95% of the in-service teachers reported to be Hispanics and 5% White, teaching mostly in rural school districts. The in-service teachers were taking a mathematics pedagogical master course during the summer of 2022. The course is part of an online accelerate master program at an institution located deep south-central USA. As part of the course, participants were exposed to a series of MRS with the intention of both understanding their perception of the use and implementation of this type of technology as a PD tool, and enhancing and developing their teaching skills in assessing, questioning, and eliciting students in a classroom problem-solving context while integrating PMTM (Chapin et al., 2009; Ginsburg, 1997; Jacob & Empson, 2016; Moyer & Milewicz, 2002). To ensure that the in-service teachers integrated PMTM during their MRS exposure, they were assigned readings, videos-reflections, and assignments related to the use and implementation of PMTMs. This preparation took place two weeks before the exposure to MRS.

Table 1. Description of participants

	Age			Years of teaching experience			Ethnicity		Teaching grade		
Gender	20-30	31-40	> 40	1-6	7-15	>15	Hispanic	White	1- 5	6-8	9 -12
Male	7	0	5	6	4	2	12	0	3	4	5
Female	21	10	6	22	10	5	36	2	18	12	7

Table 2. Teacher perceptions through MRS professional development

Dimension/construct	Pre-survey	Post-survey
Technology/MRS experience	3.80 (0.56)	4.14 (0.58)
Skills for class/classroom discourse	3.94 (0.63)	4.24 (0.64)
Teacher preparation	3.93 (0.60)	4.24 (0.68)
Use MRS in courses	3.98 (0.65)	4.40 (0.66)
Receiving/providing feedback	4.18 (0.66)	4.48 (0.67)

Note. *Numbers in parentheses are standard deviations

Two sessions of MRS exposure of about eight-15 minutes each composed the intervention. In each MRS session, teachers practiced how to orchestrate a mathematical discussion using mathematical problem-solving tasks while integrating high-leverage classroom practices (Ball & Forzani, 2011) like PMTM. The problem-solving tasks considered for MRS followed the cognitive guide instruction framework (Carpenter et al., 2014). Once teachers completed their MRS session, they were required to write a short self-reflection essay and provide peer-feedback within their assigned small two-three members group in which the recording of their session, where shared.

We followed a convergent parallel mixed-method approach (Mills & Gay, 2019) by administering a questionnaire containing closed and open-ended items before and after exposing the teachers to MRS. To answer the research questions, the questionnaire was administrated before and after the in-service teachers were exposed to MRS. The instrument used was adapted from Aguilar and Telese (2020), Bousfield, (2017), Hudson at el. (2018), and Rasimah et al. (2011) to meet the needs of the study in terms of the participants and context. The instrument comprises 26 questions in a 5-Likert-scale type ranging from strongly agree to strongly disagree to measure teacher's perceptions and attitudes toward MRS in five main constructs: technology and MRS experience, skills for class, teacher preparation, MRS integration in master program, and receiving or providing feedback. Also, four additional open-ended questions were included to capture the in-service teachers' opinions about what they liked or disliked most, the challenges encountered with MRS, and perceptions of the benefits of being exposed to MRS (**Appendix A**).

To analyze the quantitative data, we conducted descriptive and inferential statistics (Frost, 2020). For the descriptive analysis (see **Table 1**) we depict teachers' data based on their age, gender, ethnicity, years of experience, and teaching grade level. For the inferential statistic, we decided to compare pre- and post-survey results using the Wilcoxon matched-pairs signed-ranks test (Conover, 1999) because the survey data are ordinal. The Wilcoxon matched-pairs signed-rank test is a nonparametric method for comparing before-after or matched subjects. We compared the teachers' perceptions of MRS before and after being exposed to MRS. This data was later correlated to the qualitative component of the study, which is detailed in the result section below.

The qualitative data were analyzed following a double-round open-codding process (Miles et al., 2018; Saldana, 2014) in which we independently coded all the opened-ended question to find the common topics that emerged from the teachers' responses. The coding process was performed by one of the researchers and one external expert with more than five years of teaching experience. Once the independent coding process was completed, we discussed our findings and resolved our differences to agree on five to nine major topics for each open-ended questions with an inter-rater agreement of about 93%. The in-service teachers' responses were re-coded based on the major topics that emerged during the first round of coding process.

FINDINGS AND DISCUSSION

In this section we show the findings of our study, it is implications and potential impact to the field of mathematics education and PD for teachers. To better inform the reader and answer the research questions, the section has been divided into the components that comprise the study: quantitative and qualitative.

Quantitative Analysis

As mentioned above, the instrument was implemented with forty-nine in-service teachers (11 males & 37 female) before and after they were exposed to two sessions of MRS. The in-service teachers' perceptions data collected from the survey were analyzed using a Wilcoxon matched-pairs signed-ranks test. To reduce measurement error and represent multiple aspects of a concept in a single factor, we averaged values from the survey and compared the effect of MRS.

Among the five constructs intended to measure the in-service teachers' perceptions and attitude toward MRS, we found that they showed increased perceptions overall from the pre- to the post-survey. **Table 2** shows the mean scores and their standard deviations in detail. A Wilcoxon signed-rank test determined that there was a statistically significant increase in perception after the in-service teacher were exposed to MRS. In-service teachers that participated in the study showed. particular increase in several items of the implemented instrument. For example, the use of MRS technology ($z=3.111$, $p=0.002$), MRS as a tool to develop skills for class ($z=2.418$, $p=.016$), MRS as a tool to enhance skills in class preparation ($z=2.775$, $p=.006$), willingness to use MRS in the master program courses ($z=3.240$, $p=.001$), and MRS as a tool that provoke reflection in one's own teaching ($z=2.654$, $p=.008$).

We also divided teacher teaching experience into two groups with top and bottom of 25% representing 25 (≤25 percentile, two years) and 75 percentiles (≥75 percentile, 13 years), respectively, and compared their experience from MRS PD. We found that although there was not difference in their perception before being exposed to MRS, the more experienced in-service teachers perceived MRS as more realistic than the less experienced teachers. The differences were all statistically significant. For example, the experienced teachers perceived that the students in MRS looked like real elementary students (experienced teachers: M=4.57, SD=0.51 vs. less experienced teachers: M=3.76, SD=1.30, t[33]=-2.21, p<.05, d=1.06). The experienced teachers also reported that rehearsing with MRS made them feel in a real classroom (M=4.36, SD=0.63), compared to the less experienced teachers (M=3.62, SD=1.24, t[33]=-2.04, p<.05, d=1.05). Considering that the experienced teachers have more content and pedagogical knowledge and managed more various teaching and learning situations, the results are counterintuitive. These findings are revealing, since the in-service teachers with more years of experience were the ones who perceived MRS to be a tool that could effectively simulate a classroom setting. In contrast, the less experience in-service teachers were more critical of MRS technology.

Few studies have been conducted intended to analyze in-service teachers' perception of MRS. In contrast, most studies in education have focused on pre-service teachers experiences (Aguilar & Telese, 2019; Cohen, & Wong, 2021) or skills development (Aguilar & Flores, 2022; Driver et al., 2018; Driver & Zimmer, 2022; Hudson et al., 2018) as depicted in the literature section. However, the fact that the more experienced teachers considered MRS as a realistic technological tool that effectively simulates a classroom experience, can serve as a mind-changed and first step in promoting the use of innovative technologies as a PD tool.

In regards of the teachers' perceptions about receiving and providing peer-feedback, we found evidence that their perceptions changed after being exposed to MRS. Teachers depicted that feedback from peers helped them to reflect on their strengths and weaknesses in both assessing a students' understanding and teaching skills. These were both statistically significant (p<.05). Similarly, teachers perceive that receiving feedback from peers helped them reflect on their strengths and weaknesses in conducting a clinical interview or orchestrating a group discussion, which was marginally significant (p=.051).

Teachers prefer to being observed by a peer than an administrator (Munson, 1998). With MRS, teachers can receive peer-feedback from a more experience teacher at a convivence time by watching MRS recording sessions as many times as needed. In addition, the observer teacher can highlight relevant aspects that need improvement or were done successfully. Similar to how it is done with pre-service teachers that are exposed to MRS in which feedback is received by an experience teacher who observe MRS session (Cohen et al., 2020). This is a unique feature that could not be possible in a real-live classroom.

In a general sense, our quantitative analysis partially helped us to answer our three research questions about the in-service teachers' perceptions about the use MRS as a tool for PD. In particular, about the in-service teacher's perception if MRS can effectively enhance their teaching skills (i.e., the use of PMTM to orchestrate classroom discussions), they showed a positive perception after been exposed to MRS. Similarly, in terms of feedback, the in-service teachers depicted a positive change after been exposed to MRS, as explained above. Because the in-service teachers depicted a positive perception and attitude toward MRS, the two aspects addressed above, can be considered by any school districts as components of their PD plan for their in-service teachers, and as a way to improve the quality of their instruction, and as result the learning process of the students.

In the qualitative section below, we analyzed the open-ended questions to deeper our understanding of the in-service teachers' perception toward MRS and to provide a more comprehensive response to our research questions.

Qualitative Analysis

Following our methods, we asked the in-service teachers their opinions, perceptions, and experiences about MRS before and after being exposed to the classroom simulations. Overall, we received 392 responses from which 196 were from the pre-questions and the same number for the post. The responses were coded and categorized following a double-round coding process, as stated in our research designs section. We decided to depict all the in-service teacher's responses, but to focus on the ones that they mentioned the most. In **Table 3**, we depict the characteristics of MRS that teachers enjoyed most.

Before teachers were exposed to MRS, they were excited to learn or improve their teaching and classroom's skills. This aligned with the 20% of teachers that in the post-questionary mentioned having learned a new teaching or classroom skill, which

Table 3. Frequency of open-ended question 1

Perceptions of most enjoyable characteristics of MRS	
Responses	
Pre	**Percentages**
Development of classroom/teaching skills	49%
Innovative experience	20%
Real-life similar experience	10%
Enjoyable learning experience	8%
Reflection of self-practice	6%
Others	6%
Post	
Realistic teacher-student interaction	45%
Development of teaching skills	20%
Adequate classroom/instruction realistic setting	13%
Reflection about own teaching skills	7%
Practicing what learned in class	5%
Enjoyable	4%
The use of new technologies for training	4%
Pre-preparation work	4%

Table 4. Frequency of open-ended question 2

Perceptions of less enjoyable characteristics of MRS	
Responses	
Pre	**Percentages**
Unexpected situations	38%
Not realistic	27%
Student's understandings & behaviors	9%
Technical difficulties	9%
Not enjoyable	4%
Lack of feedback	4%
Being observed	2%
Others	6%
Post	
Unrealistic	21%
Unexpected situations	6%
MRS avatar's limitations & MRS technology limitations	6%
Being recorded	6%
MRS time exposure (too short)	14%
Grade level effectiveness	6%
None	30%
Others	10%

effectively correlates with our findings in the quantitative section. In addition, teachers consider the use of MRS as an innovate experience, which is confirmed with their perception that the simulation is realistic in the sense they had to interact with the avatars during the simulations. However, it is relevant to mention that this perception corresponds mostly to the most experience in-service teachers, as explained above in the quantitate section. Similarly, other perceptions and opinions align for the pre and post questionnaire. For example, in-service teachers were expecting to have an enjoyable learning experience as mentioned in the pre-survey. In the post survey, in-service teachers not only considered that the exposure to MRS was enjoyable, but also was a way to practice classroom's skills, and an opportunity to reflect in their own instruction, and a great exposure to innovative technologies.

Despite the above, only 20% of the in-service teachers that participated in the study considered that after been expose to MRS, their teaching skills were enhanced. However, they do confirm that the experience was realistic, something that was barely mentioned in the pre survey. Based on our findings in the qualitative section, we considered that more evidence is needed to effectively confirm that the in-service teachers perceive MRS as an effective PD tool, which correspond to our first research questions. There are several positive aspects mentioned by the in-service teachers, but the fact that their perceptions related to classroom teaching skills decreased from the pre to the post survey, might be a sign that it does not potentially align with what they were expecting. The above can serve as a first step in contributing to the field, since few research has been conducted relating MRS with in-service teachers. However, a study involving a larger sample is needed to find more evidence that support of the above.

On the contrary to what we found about what teachers enjoyed most in their MRS exposure, we also asked them that was the less enjoyable experience. In **Table 4**, we depict what the in-service teacher's perceptions were before and after the simulations.

In regard to the experiences that teachers considered to be less enjoyable, we found that a number of in-service teachers (i.e., approx. 27%) considered in the pre survey that to be exposed to MRS would not be that realistic, which is contrary to what teachers mentioned in their previous question. But, once teachers were exposed to MRS, that perception dropped to 21%. Unexpected situations seemed to be something that the in-service teachers were more worried about, perhaps because they are used to keeping control of their own classroom, where they teach, specially if it's related to a topic that is covered in class, a question asked by a student, or a situation that emerged without warning (Cassar et al., 2023; Watson, 2017). However, during the post survey, in-service teachers depicted being less worried about unexpected situations, which could be considered as a way that they were able to successfully engage in the simulations. It is likely that the in-service teachers noticed that in a MRS session, they can behave as they would in a real classroom setting, but with the advantage of multiple possible repetitions. The fact that MRS allows for multiple repetitions (Driver & Zimmer, 2022), is one of the greatest advantages that this technology provides, since in a real-life setting is almost impossible to exactly duplicate a situation.

Withing this question, it can be highlight that 30% of the in-service teachers mentioned that nothing disliked them about MRS exposure. Despite that this is a positive sign of approval by the in-service teachers, it is still not conclusive to answer our first research questions. Once again, we consider that the responses provided by the in-service teachers serve as a first step in closing the literature gap, but that a larger study is needed, as mentioned before.

In-service teachers' perceptions about how challenging it would be to experience with MRS changed after they were exposed to the simulations. For example, we found that 41% of the in-service teachers were anxious about the need of interacting with emerging technologies and the easiness of that interaction. In fact, teachers are often afraid of trying, using, or integrating innovative technologies, mostly because of their doubts about its effectiveness, or because it stresses them and cause anxiety (Azarfam & Jabbari, 2012; Fernández-Batanero et a., 2022). These tendencies have shifted after COVID-19, however it is still a reality among in-service teachers (Winter et al.,2021). In this particular case, in-service teacher's perception about MRS changed once they engaged and were exposed to the simulations. For instance, teachers were able to perceive the natural limitations of MRS as technology, but they were no afraid or nervous about learning and practicing teaching skills with it. This is an interesting discovery,

Table 5. Frequency of open-ended question 3

Perception of challenge of being exposed to MRS	
Responses	
Pre	**Percentages**
Technology adaptation & understanding of MRS	41%
New unexpected experience	18%
Real interaction	16%
Understanding student's behavior	10%
Limitations of MRS technologies	4%
Different traditional PD-type experience	2%
Lack of feedback	2%
Others	6%
Post	
Limitations of MRS technology	30%
Unexpected situations	28%
More MRS practice skills or time	12%
Preparation pre-work	9%
Unrealistic	7%
Technical difficulties	5%
Being recorded	2%
Others	7%

Table 6. Frequency of open-ended question 4

Perception of MRS advantages, benefits, & value	
Responses	
Pre	**Percentages**
New skills Development & enhancing Practice	51%
Comparable Real-life Experience	14%
Enjoyable	12%
Teaching and skills Reflection	8%
Feedback about teaching practice	6%
Learning of potential student's behaviors	6%
Others	2%
Post	
Leverage different teaching skills (classroom & pedagogy)	65%
Reflection on teaching practice	15%
Practice of how to better prepare lessons (pre-work)	7%
Simulates real-interactions	5%
Educational settings	2%
Peer-feedback	2%
Develop skill on student's understandings	2%
Others	2%

since it depicts a deep connection of the in-service teachers with MRS to the point of noticing some of the weakest points. Similarly, teachers expressed that MRS presented unexpected classroom situations that allowed them to practice how they would actually react in a real setting with real students. Once again, the advantages of MRS emerged and is highlighted by the in-service teachers. Similar to what could potentially occur in a real classroom setting, the in-service teachers found challenging to navigate the unexpected situations that emerged during MRS exposure, as stated in their post survey responses. **Table 5** shows the frequency of open-ended question 3.

In regard to the in-service teachers' perception about the advantages, benefits, and value of MRS as can be seen in **Table 6**, it was clear for us that they had great expectations. For example, before being exposed to MRS in-service teachers were expecting to develop new skills through the interaction with the technology. This expectation was successfully achieved, as teachers noted in their responses after the simulations, where about 65% of them mentioned that the technology positively helped them develop some type of classroom skills (e.g., orchestrating a discussion, effectively questioning students, or classroom managing). Another input from teachers is related to the opportunity to reflect in their own instructions, which almost double from the pre-MRS experience to the post. Even though only15% of them agreed with the above.

In-service teachers acknowledge the need and benefit of self-reflecting about their instructions (Orakci, 2021), which is an important component of an educator (Goodell, 2000). However, it is likely the in-service teacher participating in this study preferred to reflect based on a real-life instruction rather on a simulated one. In any case, more research is needed that provide evidence to support the above.

Another aspect to consider is related to peer-feedback. Although there was a significant difference as stated in the quantitative section above, meaning there was an increase in the in-service teachers' perception to receiving peer-feedback, only 2% of teachers mentioned this during the open-ended questions. Similarly to what we mentioned above about self-reflection after been exposed to MRS, it is possible that teacher perceive the process of providing feedback and self-reflecting a task that needed to happen a real-life setting. Literature addresses the important of the above (Wilkins et al., 2009; Garcia et al., 2017; Van Popta et al.,

2017), but no literature is available about the process of reflecting and peer-feedback when exposed to MRS with in-service teachers. These need further research.

In terms of our second research question we agreed that, at least for the in-service teachers participating in this study, peer-feedback was not an effective strategy to improve their teaching skills, in the context of MRS. However, we also agreed that the evidence we found would need to be confirmed with a larger-scale study involving a greater sample of teachers that allows for a generalization of the results.

Finally, based on our finding from both the quantitative and qualitative components, we considered that we found evidence to confirm that the in-service teachers support the use of MRS as a professional tool to enhance their teaching skills. This answers our third research question. It's clear that the in-service teacher's perceptions about the use and integration of MRS as a PD changed from before and after their exposure to this technology. However, it is important to mention that this study serves as a first step in closing the gap in the literature relate to the use of MRS with in-service teachers, but as mentioned before a larger study is needed that provide more evidence relate to the effectiveness of using MRS as professional tool with in-service teachers, as a strategy to provide feedback, and as a tool that effectively develop the in-service teacher classroom skills.

CONCLUSIONS

The use and implementation of simulation technologies in different fields–including education–has been growing in recent years (Herur-Raman et al., 2021). However, within the field of education, MRS has been mostly implemented within teacher education programs as a way to better prepare pre-service teachers for their future teaching responsibilities (Driver et al., 2018). MRS has barely been used with in-service teachers. There is a gap in the literature that addressed the integration of MRS as a potential PD tool to enhance in-service teacher's pedagogical skills. In this study, we tried to address the above.

The in service-teachers that participated in this study had different years of experience for which we strove to provide an approximation to the practice (Grossman at al., 2009) that were as real as possible, in order for them to develop their teaching skills, regardless of the years of experience. It results relevant to mention that MRS was not integrated in this study with the intention of replacing the real experience, rather, to provide a safe environment for in-service teachers, where they could practice, enhance, and leverage their teaching skills for the benefit of their students.

In-service teachers were exposed to MRS within a research design that included both a quantitative and qualitative component. Our methods combined a series of two MRS exposures and a review of the literature related to high-leverage practices (Ball et al., 2011). In addition, self-reflection and peer feedback activities were included as part of MRS exposure. All the above, supported our endeavor in answering our three research questions. Our findings depict evidence that the majority of the teachers that participate in this study enjoyed and accepted the use of MRS as a tool to develop and practice teaching skills, in particular, in the context of this study, where in-service teachers received preparation to enhance their skills in assessing, eliciting, and questioning students in the context of problem solving and classrooms discussions. In addition, in-service teachers perceived MRS as a tool that positively provided a space for them to reflect about their own instruction.

Teachers acknowledge that the use and integration of state-of-the-art technologies as part of their PD through their career is worth their time and effort since they could repeatedly engage in a simulation until the desire skill is mastered. In addition, teachers can receive instant feedback from other teachers or experts who can point out areas of opportunities for growing. Even though the above was not one of the main characteristic teachers mentioned in the open-ended questions.

Although more research is needed in terms of the use of MRS in different academic fields–recalling that it was integrated considering only the field of mathematics education–this study can be used by districts as a first step in integrating new technologies within their PD program that help develop teachers' quality of instruction in both the pedagogy and content knowledge (Hill et al., 2008).

We will continue conducting research integrating MRS with a larger population of teachers, and in other fields like social studies and science, and as a way to develop classroom management skills for teachers. In addition, we plan to start conducting research including students in topics like bullying, disagreements, and anger management.

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REFERENCES

Aguilar, J. J., & Flores, Y. (2022). Analyzing the effectiveness of using mixed-reality simulations to develop elementary pre-service teachers' high-leverage practices in a mathematics methods course. *EURASIA Journal of Mathematics, Science and Technology Education, 18*(5), em2107. https://doi.org/10.29333/ejmste/12006

Aguilar, J. J., & Telese, J. A. (2020). Perceptions and opinions of the usability of simulations in a mathematics methods course for elementary pre-service teachers. *Journal of Education and Practice, 11*(12). https://doi.org/10.7176/JEP/11-12-02

Avalos, B. (2011). Teacher professional development in teaching and teacher education over ten years. *Teaching and Teacher Education, 27*(1), 10-20. https://doi.org/10.1016/j.tate.2010.08.007

Azarfam, A. A. Y., & Jabbari, Y. (2012). Dealing with teachers' technophobia in classroom. *Advances in Asian Social Science, 2*(2), 452-455.

Ball, D. L., & Forzani, F. M. (2011). Building a common core for learning to teach: And connecting professional learning to practice. *American Educator, 35*(2), 17-31.

Beltman, S. (2015). Teacher professional resilience: Thriving not just surviving. In *Learning to teach in the secondary school* (pp. 20-38). Cambridge University Press.

Bentil, J. (2023). Factors that influenced attrition of public school teachers in the USA and Ghana. *OHIO Open Library*. https://ohioopen.library.ohio.edu/studentexpo/2023/2023presentations/339/

Bousfield, T. (2017). *An examination of novice and expert teachers' pedagogy in a mixed-reality simulated inclusive secondary classroom including a student avatar with autism spectrum disorders* [PhD thesis, University of Central Florida].

Carpenter, T., Fennema, E., Franke, M. L., Levi, L., & Empson, S. B. (2014). *Children's mathematics: Cognitively guided instruction*. Heinemann.

Cassar, C., Oosterheert, I., & Meijer, P. C. (2023). Why teachers address unplanned controversial issues in the classroom. *Theory & Research in Social Education, 51*(2), 233-263. https://doi.org/10.1080/00933104.2022.2163948

Chapin, S. H., O'Connor, C., O'Connor, M. C., & Anderson, N. C. (2009). *Classroom discussions: Using math talk to help students learn, grades K-6*. Math Solutions.

Cohen, J. & Wong, V. (2021). Using classroom simulators to transform teacher preparation. *Brookings*. https://www.brookings.edu/blog/brown-center-chalkboard/2021/11/17/using-classroom-simulators-to-transform-teacher-preparation/

Cohen, J., Wong, V., Krishnamachari, A., & Berlin, R. (2020). Teacher coaching in a simulated environment. *Educational Evaluation and Policy Analysis, 42*(2), 208-231. https://doi.org/10.3102/0162373720906217

Darling-Hammond, L., Wei, R. C., Andree, A., Richardson, N., & Orphanos, S. (2009). *Professional learning in the learning profession*. National Staff Development Council.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982-1003. https://doi.org/10.1287/mnsc.35.8.982

Dillon, S. (2006). Schools cut back subjects to push reading and math. *The New York Times*. https://www.nytimes.com/2006/03/26/education/schools-cut-back-subjects-to-push-reading-and-math.html

Driver, M. K., & Zimmer, K. (2022). A guide to integrating mixed-reality simulation in initial and advanced special education programs. *Journal of Special Education Preparation, 2*(1), 48-57. https://doi.org/10.33043/JOSEP.2.1.48-57

Driver, M., Zimmer, K., & Murphy, K. (2018). Using mixed reality simulations to prepare preservice special educators for collaboration in inclusive settings. *Journal of Technology and Teacher Education, 26*(1), 57-77.

Ersozlu, Z., Ledger, S., Ersozlu, A., Mayne, F., & Wildy, H. (2021). Mixed-reality learning environments in teacher education: An analysis of teachLivE™ research. *SAGE Open*, *11*(3). https://doi.org/10.1177/21582440211032155

Fernández-Batanero, J. M., Román-Graván, P., Reyes-Rebollo, M. M., & Montenegro-Rueda, M. (2021). Impact of educational technology on teacher stress and anxiety: A literature review. *International Journal of Environmental Research and Public Health, 18*(2), 548. https://doi.org/10.3390/ijerph18020548

Frost, J. (2020). *Introduction to statistics: An intuitive guide for analyzing data and unlocking discoveries*. Jim Publishing.

García, E., & Weiss, E. (2019). The role of early career supports, continuous professional development, and learning communities in the teacher shortage. *Economic Policy Institute*. https://www.epi.org/publication/teacher-shortage-professional-development-and-learning-communities/

Garcia, I., James, R. W., Bischof, P., & Baroffio, A. (2017). Self-observation and peer feedback as a faculty development approach for problem-based learning tutors: A program evaluation. *Teaching and Learning in Medicine, 29*(3), 313-325. https://doi.org/10.1080/10401334.2017.1279056

Ginsburg, H. (1997). *Entering the child's mind: The clinical interview in psychological research and practice*. Cambridge University Press. https://doi.org/10.1017/CBO9780511527777

Goodell, J. (2000). Learning to teach mathematics for understanding: The role of reflection. *Mathematics Teacher Education and Development, 2*(1), 48-60.

Grossman, P., Compton, C., Igra, D., Ronfeldt, M., Shahan, E., & Williamson, P. W. (2009). Teaching practice: A cross-professional perspective. *Teachers College Record, 111*(9), 2055-2100. https://doi.org/10.1177/016146810911100905

Herur-Raman, A., Almeida, N. D., Greenleaf, W., Williams, D., Karshenas, A., & Sherman, J. H. (2021). Next-generation simulation–Integrating extended reality technology into medical education. *Frontiers in Virtual Reality, 2*, 115. https://doi.org/10.3389/frvir.2021.693399

Hill, H. C., Ball, D. L., & Schilling, S. G. (2008). Unpacking pedagogical content knowledge: Conceptualizing and measuring teachers' topic-specific knowledge of students. *Journal for Research in Mathematics Education, 39*(4), 372-400. https://doi.org/10.5951/jresematheduc.39.4.0372

Hudson, M. E., Voytecki, K. S., & Zhang, G. (2018). Mixed-reality teaching experiences improve preservice special education students' perceptions of their ability to manage a classroom. *Journal for Virtual Worlds Research, 11(*2), 1-16. https://doi.org/10.4101/jvwr.v11i2.7308

Hudson, M. E., Voytecki, K. S., Owens, T. L., & Zhang, G. (2019). Preservice teacher experiences implementing classroom management practices through mixed-reality simulations. *Rural Special Education Quarterly, 38*(2), 79-94. https://doi.org/10.1177/8756870519841421

Jacobs, V. R., & Empson, S. B. (2016). Responding to children's mathematical thinking in the moment: An emerging framework of teaching moves. *ZDM, 48*(1), 185-197. https://doi.org/10.1007/s11858-015-0717-0

Johnson, S. M. (2006). The workplace matters: Teacher quality, retention, and effectiveness. *National Education Association Research Department*. https://files.eric.ed.gov/fulltext/ED495822.pdf

Kamenetz, A. (2022). More than half of teachers are looking for the exits, a poll says. *National Public Radio*. https://www.npr.org/2022/02/01/1076943883/teachers-quitting-burnout

Kastberg, S. E., & Frye, R. S. (2013). Norms and mathematical proficiency. *Teaching Children Mathematics, 20*(1), 28-35. https://doi.org/10.5951/teacchilmath.20.1.0028

Lannin, J. K., Webb, M., Chval, K., Arbaugh, F., Hicks, S., Taylor, C., & Bruton, R. (2013). The development of beginning mathematics teacher pedagogical content knowledge. *Journal of Mathematics Teacher Education, 16*(6), 403-426. https://doi.org/10.1007/s10857-013-9244-5

Loewus, L. (2021). Why teachers leave–or don't: A look at the numbers. *Education Week, 5*, 2021.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2018). *Qualitative data analysis: A methods sourcebook*. SAGE.

Mizell, H. (2010). *Why professional development matters*. Learning Forward.

Moyer, P. S., & Milewicz, E. (2002). Learning to question: Categories of questioning used by preservice teachers during diagnostic mathematics interviews. *Journal of Mathematics Teacher Education, 5*(4), 293-315. https://doi.org/10.1023/A:1021251912775

Mundry, S. (2005). Changing perspectives in professional development. *Science Educator, 14*(1), 9-15.

Munson, B. R. (1998). Peers observing peers: The better way to observe teachers. *Contemporary Education, 69*(2), 108.

Murphy, K. M., Cook, A. L., & Fallon, L. M. (2021). Mixed reality simulations for social-emotional learning. *Phi Delta Kappan, 102*(6), 30-37. https://doi.org/10.1177/0031721721998152

Mursion. (2016). *About us*. http://www.mursion.com

National Education Association of the United States. (2022). *National Education Association, United States*. https://www.nea.org/advocating-for-change/new-from-nea/survey-alarming-number-educators-may-soon-leave-profession

OECD. (2020). *Curriculum overload: A way forward*. OECD Publishing. https://doi.org/10.1787/3081ceca-en

Orakci, S. (2021). Teachers' reflection and level of reflective thinking on the different dimensions of their teaching practice. *International Journal of Modern Education Studies, 5*(1), 118-149. https://doi.org/10.51383/ijonmes.2021.88

Parker, M., & Patton, K. (2016). What research tells us about effective continuing professional development for physical education teachers. In *Routledge handbook of physical education pedagogies* (pp. 465-478). Routledge. https://doi.org/10.4324/9781315743561-48

Patrick, F., Elliot, D., Hulme, M., & McPhee, A. (2010). The importance of collegiality and reciprocal learning in the professional development of beginning teachers. *Journal of Education for Teaching, 36*(3), 277-289. https://doi.org/10.1080/02607476.2010.497373

Piro, J. S., & O'Callaghan, C. (2019). Traveling through the liminal: Mixed reality simulations in educational leadership preparation. *International Journal of Leadership in Education, 24*(4), 458-490. https://doi.org/10.1080/13603124.2019.1629488

Rasimah, C. M. Y., Ahmad, A., & Zaman, H. B. (2011). Evaluation of user acceptance of mixed reality technology. *Australasian Journal of Educational Technology, 27*(8), 1369-1387. https://doi.org/10.14742/ajet.899

Robinson, J. (2019). Why professional development matters. *National Education Association*. https://www.nea.org/professional-excellence/student-engagement/tools-tips/why-professional-development-matters

Saldaña, J. (2014). Coding and analysis strategies. In *The Oxford handbook of qualitative research*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199811755.013.001

Samuelsson, J. (2010). The impact of teaching approaches on students' mathematical proficiency in Sweden. *International Electronic Journal of Mathematics Education, 5*(2), 61-78. https://doi.org/10.29333/iejme/250

Schmitt, J., & DeCourcy, K. (2022). *The pandemic has exacerbated a long-standing national shortage of teachers*. https://www.epi.org/publication/shortage-of-teachers/

Schoenfeld, A. H. (Ed.). (2007). *Assessing mathematical proficiency*. Cambridge University Press. https://doi.org/10.1017/CBO9780511755378

Schutz, K. M., Grossman, P., & Shaughnessy, M. (2018). Approximations of practice in teacher education. In P. Grossman (Ed.), *Teaching core practices in teacher education* (pp. 57-83). Harvard Education Press.

Sixel, D. M. (2013). *Teacher perceptions of professional development required by the Wisconsin quality educator initiative, PI 34* [Doctoral dissertation, University of Wisconsin Milwaukee].

Strong, M., Fletcher, S., & Villar, A. (2004). *An investigation of the effects of teacher experience and teacher preparedness on the performance of Latino students in California*. New Teacher Center.

Suh, J. M. (2007). Tying it all together: Classroom practices that promote mathematical proficiency for all students. *Teaching Children Mathematics, 14*(3), 163-169. https://doi.org/10.5951/TCM.14.3.0163

Szelei, N., Tinoca, L., & Pinho, A. S. (2020). Professional development for cultural diversity: The challenges of teacher learning in context. *Professional Development in Education, 46*(5), 780-796. https://doi.org/10.1080/19415257.2019.1642233

Theng, Y. L., Lim Mei-Ling, C., Liu, W., & Cheok, A. D. (2007). Mixed reality systems for learning: A pilot study understanding user perceptions and acceptance. In *Proceedings of the International Conference on Virtual Reality* (pp. 728-737). Springer. https://doi.org/10.1007/978-3-540-73335-5_79

Van Popta, E., Kral, M., Camp, G., Martens, R. L., & Simons, P. R. J. (2017). Exploring the value of peer feedback in online learning for the provider. *Educational Research Review, 20*, 24-34. https://doi.org/10.1016/j.edurev.2016.10.003

Watson, E. (2017). Unexpected questions: Reflecting on the teacher's experience of responding in class. *High School Journal, 101*(1), 49-61. https://doi.org/10.1353/hsj.2017.0015

Wilkins, E. A., Shin, E. K., & Ainsworth, J. (2009). The effects of peer feedback practices with elementary education teacher candidates. *Teacher Education Quarterly, 36*(2), 79-93.

Williams, C. S. (2012). Combating teacher burnout. *The Education Digest, 77*(7), 39.

Williams, M. L. (2010). *Teacher collaboration as professional development in a large, suburban high school*. The University of Nebraska-Lincoln.

Winter, E., Costello, A., O'Brien, M., & Hickey, G. (2021). Teachers' use of technology and the impact of COVID-19. *Irish Educational Studies, 40*(2), 235-246. https://doi.org/10.1080/03323315.2021.1916559

APPENDIX A: QUESTIONNAIRE

1. I like to experiment with new technologies.
2. I will enjoy rehearsing teaching strategies with mixed-reality simulations.
3. I will be unhappy when mixed-reality simulations sessions are over.
4. Once my experience with mixed-reality simulations are over, I would like to repeat the same experience.
5. Using mixed-reality simulations will enhance my learning experience
6. Once my experience with mixed-reality simulations are over, I will feel better prepared to teach.
7. Using mixed-reality simulation is an effective way to practice new classroom skills.
8. Mixed-reality simulation sessions will look like a real classroom experience.
9. Mixed-reality simulation's students will look like real elementary students.
10. I am confident that after practicing my teaching methods using mixed-reality simulations, I will be effectively able to teach mathematics (or science) concepts.
11. After mixed-reality simulation session, I will be prepared to conduct a clinical interview to assess and elicit student's thoughts and understanding using mathematics productive talk moves (teaching techniques to assess students).
12. After mixed-reality simulation session, I will be more confidence that I can engage students in a discourse about problem-solving activities.
13. I am confident that I will be able to effectively manage the session during my mixed-reality simulation sessions.
14. After mixed-reality simulation session, I will be prepared to orchestrate a group discussion in a classroom to assess understanding using mathematics productive talk moves.
15. After mixed-reality simulation sessions, I will be able to successfully conduct a clinical interview with an elementary student.
16. After mixed-reality simulation sessions, I will be more confidence in my ability to manage undesired behaviors in group discussion.
17. After my mixed-reality simulation sessions, I will be prepared to teach lessons involving problem solving.
18. I am confident that I will be able to conduct my mixed-reality simulation's sessions effectively.
19. Rehearsing with mixed-reality simulation will feel like being in a real classroom.
20. Mixed-reality simulation rehearsals will help me to create a plan for a clinical interview or group discussion within my classroom.
21. My experience with mixed-reality simulations will prepared me to teach.
22. I would like to use mixed-reality simulation in other courses to develop my teaching skills.
23. Having Reflections after mixed-reality simulation sessions will helpe me to be better prepared for the next session.
24. Receiving feedback from my peers after each mixed-reality simulation session will help me to reflect on my strengths and weakness in assessing a students' understanding.
25. It is likely that receiving feedback from my peers after each mixed-reality simulation session will help me to reflect on my strengths and weakness in conducting a clinical interview or orchestrating a group discussion.
26. It is likely that providing feedback to my peers after each mixed-reality simulation session will helped me to reflect on my own teaching skills.

Open-Ended Questions

1. What do you anticipate will be what you will like the most about practicing and rehearsing with mixed-reality simulations?
2. What do you anticipate will be what you will dislike the most about mixed-reality simulation?
3. Do you believe using mixed-reality simulation will be beneficial for your teaching practice? If yes, why? if not, why?
4. What do you consider will be the most challenging aspect of interacting in with mixed-reality simulations?