Using the Covid-19 Pandemic to Create a Vision for XR-Based Teacher Education Field Experiences

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If there was a bright side to the COVID-19 pandemic, particularly related to education, it was the massive and rapid introduction of educational technologies to scaffold teaching and learning. Most notably, within teacher education, this included extended reality (XR) technologies to supplement or replace face-to-face field experiences. With the pandemic turning endemic, and with preK-12 schools returning to traditional modalities, there is a danger that the successes of virtual field experiences may be lost. This article presents a vision for 2025 to implement low-cost and effective XR technologies to supplement teacher education field experiences, regardless of if and when another global or local crisis occurs (e.g., pandemic, war, weather). In doing so, empirical and theoretical research is presented that argues for teacher educators to seek out and employ more immersive representations of practice that take advantage of the perceptual capacity of XR.


INTRODUCTION

COVID-19 changed how, where, and when we educate (Ferdig et al., 2020a). Arguably research has provided evidence that not all pandemic education—particularly that labeled emergency remote instruction—was successful (Barbour et al., 2020; Hodges et al., 2020). However, there were positive aspects of the pandemic’s impact on education (Hartshorne et al., 2020)—particularly for teacher education (Ferdig & Pytash, 2021). For instance, there was a massive increase in the use of educational technologies to support teaching and learning for preservice and inservice teacher education (Vlasova et al., 2020; Williamson, 2021). This included the use of extended reality (XR) technologies such as mixed reality, virtual reality, and augmented reality innovations for training current and future teachers (Cherner & Fegley, 2022; Gandolfi et al., 2021a; Kosko et al., 2021a).

Consider, for instance, field experiences for preservice teachers (PSTs). Cruickshank and Armaline (1986) summarized that “there remains general and strong consensus… that learning to teach must be, if not entirely then at least partially, accomplished through practicing teaching” (p. 35). Such practice, also known as field experience, becomes more difficult when preK-12 classes are not meeting face-to-face or when the school limits visitors for pandemic precautions. Yet, Cruickshank and Armaline (1986) added that “preservice teachers can practice teaching both in the field and on campus using a variety of instructional alternatives” (p. 35; italics added). This is exemplified by countless examples of XR-based virtual field experiences created during or pre-pandemic (e.g., Howell et al., 2020; Vu & Fisher, 2021; Webster et al., 2021; Wells, 2021) using a variety of low- to high-cost technologies. However, there is concern that milestones reached with virtual field experiences may be curtailed by a desire to return to things just as they existed pre-pandemic (Martin & Mulvihill, 2021). While a return to in-person field experiences is definitely welcome, the purpose of this paper is to describe a vision for incorporating XR-based field experiences into teacher education as both a supplement and precursor to work with preK-12 students.

XR and Field Experiences

Prior to the pandemic, numerous examples of XR-based field experiences emerged. One prevalent example is Mursion (formerly TeachLive) — a subscription-based service where PSTs can engage in simulations with
digital avatars of students who are operated by humans in the background (Dieker et al., 2019; Luke et al., 2021). 360 videos are another readily available medium, with free access on platforms such as YouTube or project websites (e.g., https://xr.kent.edu). Prior to the pandemic, some teacher educators began engaging PSTs with recording 360 videos of their own teaching (Balzaretti et al., 2019; Buchbinder et al., 2021; Weston & Amador, 2021). Such representations may be viewed on flat screened devices (e.g., laptop, phone) or VR headsets (e.g., Oculus/Meta, HTC).

**Figure 1.** Classroom Map of a 360 Video and its Perceptual Capacity.

Research on such immersive representations of practice like 360 videos is promising (Kosko et al., 2021a). In particular, 360 videos record omnidirectionally such that the viewer can turn the camera perspective in any direction (see Figure 1). By allowing PSTs the autonomy of where to look in a recorded scenario, they report a higher sense of presence—or a sense of being there—than their peers watching the same scenario with a standard video (Ferdig & Kosko, 2020; Walshe & Driver, 2019). Further, PSTs viewing sessions can be recorded such that viewing patterns of where they focused their attention can be examined and assessed (Tan et al., 2020).
The Problem and Opportunity for Field Experiences

Few would suggest completely replacing face-to-face field experiences for virtual. However, there is a growing concern that going back to normal (Martin & Mulvihill, 2021) may include the loss of positive gains from the pandemic such as digital technology implementation or virtual field experiences (Ferdig & Pytash, 2021; Fernandes & Gattolin, 2021). There are at least three major concerns regarding the removal, or extreme reduction, of virtual field experiences.

First, there is no guarantee that the pandemic is gone for good, nor is there any way to predict the occurrence of a new problem that reduces future field placement opportunities (e.g., another pandemic, war, weather, economy). Second, the COVID-19 pandemic did not create online preK-12 learning—it was in place as early as 1995 (Kennedy & Ferdig, 2018). Thus, teacher education has a responsibility to prepare current and future teachers for all instructional modalities (Tan & Chua, 2022; see also Bacevich, 2021 and Hodges et al., this volume). This is particularly true given the decision by some elementary and secondary schools to keep some aspects of online and blended learning post-pandemic (Gandolfi et al., 2021b; Singh et al. 2021). While field experiences in K-12 online and blended learning (OBL) is not the focus of this article, virtual field experiences can provide PSTs with technology-infused pedagogy that may represent some of the innovations currently used in OBL.

Third, and perhaps most importantly, there are several advantages of virtual field experiences like their ease of implementation. For example, in many teacher education programs, field experiences are limited and may occur later in the program (i.e., in their third or fourth year). Virtual field experiences can happen at any time, including early in teacher education programs when students are trying to assess if they really want to become a teacher (Riccio, 1961). Additionally, virtual field experiences allow future teachers to engage in aspects of teaching without the risk of “any potential harm in interacting with virtual students” (Chieu & Herbst, 2011, p. 106).

Researchers have also shown that teacher educators who offer virtual field experiences, particularly with 360 video, can more specifically attend to preservice teacher noticing patterns and actions (Buchbinder et al., 2021; Kosko et al., 2021b; Weston & Amador, 2021). Moreover, such experiences give PSTs opportunities to visit and revisit important aspects of viewed classrooms (Roche et al., 2021). This is due, in part, to the perceptual capacity of XR technologies. Perceptual capacity is a medium’s ability to convey what is perceivable in a represented scenario including the senses of sight,
sound (ambisonic audio), smell, touch (haptics), spatial sense, movement, and the interactions of all such senses (Ferdig & Kosko, 2020; Kosko et al., 2021b). In other words, perceptual capacity describes the ability of a technology to reproduce a given scenario (e.g., an educational environment) in its whole complexity and richness. The more an innovation can succeed in this process, the better the fidelity and authenticity it will provide with important implications in terms of both engagement and learning.

For example, in a 360 video (see Figure 1), a teacher can adjust their perspective in any direction to see the entire classroom. This is notably different than technologies with standard cameras that follow a teacher or student. For PSTs, this difference (in terms of perceptual capacity) between standard and 360 videos may lead to entirely different interpretations of what has happened in the lesson (Kosko et al., 2021b). For experienced and knowledgeable teachers, the particular events at specific timelines may not align but the patterns of noticing are similar enough to lead to similar interpretations of what has occurred (Dessus et al., 2016; Lee & Tan, 2020).

In sum, while standard video has been used for quite some time to supplement field experience (Gaudin & Chaliès, 2015), XR technologies offer greater perceptual capacity in virtual field experiences that can positively impact PST learning prior to entering real classrooms. The danger is that, post-pandemic, teacher education programs may return to limited virtual field experiences or, at best, return to the sole use of standard video as a representation of practice. The vision for 2025, therefore, is that teacher education programs writ large and teacher educators specifically seek out and employ virtual field experiences based on more immersive representations of practice.

VISION

The overarching vision for 2025 is to have teacher education programs use and teacher educators seek out more immersive representations of practice for virtual field experiences, such as those offered by XR technologies. There are at least five goals to make this overarching vision a reality.

1. There needs to be earlier implementation of XR-based field experiences in TE programs. Some programs begin field experiences as early as the first year of college (Seiforth & Samuel, 1979). Most wait until later in the program, due to logistics like acceptance into programs, availability of field experiences, credit hours, timing of courses offered, or simply
historical patterns. While timing is important, quality of field placement is also important. This is a continuing and evolving problem in teacher education, “particularly as mentor or cooperating teachers exercise substantial influence in learning to teach” (Sykes et al., 2010, p. 468). While no pedagogical strategy or related technological innovation is perfect, XR-based field experiences alleviate three face-to-face placement issues. First, because XR technologies include recorded practice, teacher educators can ensure inclusion of opportunities for students to see pedagogical and student diversity (Ferdig & Roehler, 2003). Second, PSTs do not need to travel or arrange schedules with existing classroom teachers. Moreover, such field experiences can be introduced earlier in the program without having earlier career PSTs compete for field placements with soon-to-be graduating, future teachers. Third, although some XR technologies require expensive equipment or coding, there are many newer technologies (i.e., 360 cameras) that require little cost and training. Given such efforts, teacher educators not only record practice, but they also give PSTs access to 360 cameras to record and analyze their own practice (Balzaretti et al., 2019; Buchbinder et al., 2021; Weston & Amador, 2021).

2. Teacher education programs and colleges of education must be willing to invest in XR technologies. Innovative technologies are often costly, at least initially. Only a few years ago, an affordable and reliable 360 video camera capable of recording an entire class lesson was not available. Now, there are several low-cost options that have enabled significant 360 video and teacher education research (Kosko et al., 2021b; Weston & Amador, 2021). But finances are not the only threat when considering cost. Teacher educators must have access to the technology, but they must also have time and training to be able to implement virtual field experiences (Austin & Kosko, 2022; Sweeney et al., 2018). Future research should also examine the relationship between financial cost, other costs, and teacher educator adoption.

3. More advanced research is needed on the perceptual capacity of various XR technologies for teacher education. Each new XR technology brings affordances and constraints that will impact PST learning. For instance, Kosko et al. (2021b) observed that PSTs viewing a 360 video for students mathematical thinking had less variance in where they focused when using a virtual reality (VR) headset than peers who viewed the same 360 video on a laptop screen. Gandolfi et al. (2021a; 2021c) expanded on such findings, observing that PSTs majoring in early childhood had a higher sense of presence when watching an
elementary mathematics video than peers who were not. This follows
Tan et al.’s (2020) observation that the content within and objectives for
viewing a 360 video interact with how PSTs engage in them. Finally,
when comparing PSTs’ 360 video viewing with ambisonic (realistic
or spatial audio) versus standard (monophonic) audio, findings from
Ferdig et al. (2020b) suggest that many PSTs viewing 360 videos with
ambisonic audio were able to hear students’ actions without needing to
turn the camera perspective towards them. In sum, the affordances and
constraints of various XR technologies (e.g., 360 videos experienced
on a desktop computer or via a VR headset) need further research to
determine their impact on teacher learning in virtual field experiences.

4. Additional instruments are needed for measuring the outcome of XR
technologies in teacher education. Researchers have found ways to
measure teacher engagement in XR initiatives. For instance, Gandolfi
et al. (2021a; 2021c) developed and then validated the eXtended Reality
Presence Scale (XRPS). The XRPS can be used with PSTs to measure
presence when engaging in XR environments like virtual reality.
Researchers have also begun using eye tracking (Beach & McConnel,
2019) and biometrics (e.g., Borthwick et al., 2015) to understand
teacher behavior with this technology. While both are in their infancy
regarding application to XR and teacher education environments, they
show promise for helping teacher educators understand and scaffold
PST learning. Additional hardware (e.g., biometrics, haptics) and
instruments are needed to make sense of XR-based teacher education
environments.

5. More advanced technologies are required in the implementation of
XR for teacher education. XR technologies, at least outside of teacher
education, continue to grow and gain commercial acceptance. Teacher
educators and educational researchers need to continue to monitor,
develop, and/or adapt new technologies to support XR implementation.
For instance, machine learning is a form of artificial intelligence (AI)
that allows a system to automatically learn and improve upon its
algorithms without explicit instruction. Machine learning in education
is already widespread but focuses predominately on intelligent tutoring
systems for predicting K-12 students’ success in school (Korkmaz &
Correia, 2019). However, some scholars have begun to use machine
learning to examine teachers’ transcripts of instruction (Araya et
al., 2012). Machine learning could be used to annotate immersive
representations of practice (Miller et al., 2020; Tan et al., 2020), as well
as to assist teacher educators in making meaning of what PSTs attend.
IMPLEMENTATION

To achieve the overarching vision for 2025 articulated above, we believe there are pragmatic tasks for teacher educators and licensure programs to engage within the next three years. There are at least five specific recommendations that could lead to measurable results.

1. Adopting and/or maintaining early implementation of XR-based field experiences. The most pressing and fundamental priority for implementation of XR is the implementation of XR. There are freely accessible collections of 360 video for those who lack equipment to record their own 360 video. However, there are also tutorials and guidelines for using 360 video for those new to this endeavor. Those interested in either can find examples of both 360 videos available to use and tutorials and recommendations for creating your own content (https://xr.kent.edu). The next step is for teacher educators to engage PSTs as early as possible with 360 videos of different classroom contexts and situations. This may include different grade levels and content, but also different schools (public, private, rural, urban, etc.) and even countries (e.g., developing countries). Given that most success with 360 video has focused on engaging PSTs with focusing on students’ actions (Kosko et al., 2021a; Weston & Amador, 2021), giving a pragmatic task of observing for a purpose is also recommended. It is through the practical use of XR like 360 video that additional growth and understanding of this technology will evolve.

2. Investing in XR for research and practice. Time and resources are necessary for teacher educators to adopt novel technologies (Christ et al., 2017). Beyond professional development for learning to use such technology, and additional time and resources for incorporating it, teacher educators may need support for recording and editing their own 360 video content. Austin and Kosko (2022) found that teacher educators working with PSTs in higher grade bands used media less often (standard or 360 video) and this was likely due to less available content. Thus, colleges and schools of education need to provide support for teacher educators to engage in various forms of this work.

3. Studying the role of perceptual capacity in representing practice. When newer technologies emerge, there is often an effort at comparing them to older technologies without considering theoretical constructs to explain why such differences may exist. This led researchers (i.e., Ferdig & Kosko, 2020; Kosko et al., 2021a; 2021b) to define perceptual
capacity as a means of understanding such differences. However, this useful construct needs to be explored further. There are multiple senses that could be approximated through XR, but the question remains as to whether approximating certain perceptual experiences is worth the cost. For example, audio (Ferdig et al., 2020b) and spatial-visual (Gandolfi et al., 2021a; Kosko et al., 2021a) matter, but we do not have research on taste or smell. Another facet to consider is that some embodied experiences are not solely sensory, but social. Further exploration of the role of digital agents (Huang et al., 2021) or avatars (Luke et al., 2021) in the context of VR is needed, even looking at holograms and shared experiences.

4. Tie the use of XR-based representations to practice-based outcomes. Many departments of education that manage teacher licensure require early-career teachers to submit standard video of their instruction and some colleges and universities have incorporated this into their program requirements. We believe incorporating XR into PSTs' coursework is a necessary and pragmatic step to achieving Goal #4 above (i.e., to create additional instruments to measure outcomes for teacher education). This may take the form of PSTs' recording and studying 360 video of their own instruction (Buchbinder et al., 2021; Weston & Amador, 2021) or examining cases of others' classrooms for evaluative purposes (Kosko et al., 2021a; 2021b).

5. Collaboration between computer scientists, educational technologists, content-area teacher educators, and generalists. The fifth goal in the prior section called for more advanced technologies for implementing XR into teacher education. For this to occur, teacher educators of varying backgrounds (educational technology, generalists, content-specific) cannot wait for the technology to come, and computer scientists and similar professionals should not anticipate a “if you build it, they will come” moment. Conversations and partnerships must be initiated both by individual faculty and by administrators and program coordinators. Partnerships may need to occur beyond a single institution of higher learning. Regardless of the particular structure of such collaborations, we view such interdisciplinary partnerships as fundamental if XR is to be applied meaningfully and purposefully to teacher education and beyond.
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