Sweeney, J., Milewski, A., & Amidon, J. (2018). On-ramps to professional practice: Selecting and implementing digital technologies for virtual field experiences. *Contemporary Issues in Technology and Teacher Education, 18*(4), 670-691.

On-Ramps to Professional Practice: Selecting and Implementing Digital Technologies for Virtual Field Experiences

Joe Sweeney
University of Mississippi

Amanda Milewski
University of Michigan

Joel Amidon
University of Mississippi

Teacher educators understand that the preparation of teachers needs to be rooted in the practice of teaching. This understanding, paired with the advancement in digital technologies capable of delivering practice-based teaching experiences, requires that those charged with preparing teachers consider how to best to position these technologies within their programs. This article positions virtual field experience platforms as on-ramps to professional practice and provides guidance for examining the features and capabilities of such platforms to inform their selection and use within teacher preparation programs.

For some time now, many in the field have acknowledged the need for teacher education to root preservice teachers' experiences in the everyday work of teaching (Ball & Cohen, 1999). Such approaches have been gaining speed, as evidenced by the widespread revamping of teacher education programs to include more practice-based experiences for novices (Bowman & Gottesman, 2017; Kang & Windschitl, 2018).

Parallel with these changes has been an increasing pressure for initial teacher preparation programs (ITPPs) to meet the needs of a diverse set of learners through the infusion of digital technologies (Allen & Seaman, 2013). In the face of these realities, there is a need to clarify how digital technologies should be evaluated from the perspective of supporting practice-based approaches in teacher education to increase the frequency, diversity, and quality of practice available to novice teachers. The work described in this article builds crucially on the work of Lampert (2010) — acknowledging that across this article, we have used three distinct notions of the word *practice*: (a) practice as a verb with the synonym rehearse — as it is used here; (b) the practice of teaching as synonymous with the more global sense of professional practice, as in the practice of medicine; and (c) teaching as a collection of practices identified as the kinds of regular or habitual things teachers do. For clarity sake, we have used the singular version (i.e., *practice*) when we intended to reference the verb, the extended phrase *professional practice* to allude to the second, and the plural version (i.e., *practices*) when we intended to reference the third.

This paper describes our examination of ways in which digital technologies can be selected and implemented to serve as an *on-ramp* to professional practice. We have used *on-ramp* to refer to those experiences that provides novices with a means to practice teaching-related skills in settings of reduced complexity prior to culminating clinical experiences, such as student teaching.

Several digital technologies (e.g., Lesson*Sketch*, TLE TeachLive, Second Life, and GoAnimate) are currently used to assist in the on-ramping of preservice teachers into professional practice. Some of these digital technologies have been explicitly designed for practice, while others have been co-opted for such work (e.g., GoAnimate; see Amador, Weston, Estapa, Kosko, & De Araujo, 2016).

As the number of available digital technologies grows and increasingly pervades teacher education programs, a means for evaluating the features of such artifacts needs to be developed (Halverson & Halverson, 2011). In a recent contribution, Herbst et al. (2016) outlined some of the possible directions for both the development of and research on technology-mediated practice-based teacher education pedagogies. In this article, we have built on the ideas presented there, together with our own experiences as teacher educators using two digital technologies (i.e., TLE TeachLive, and Lesson*Sketch*) to implement practice-based experiences with preservice teachers by offering a framework for informing the selection and use of such digital technologies.

Before describing the framework, the benefits and problems associated with field experience are discussed, and we define field experience as any concrete, direct experiences preservice teachers have in real classrooms. We then describe various on-ramps to professional practice that can be found in the literature — some that are situated in classrooms with actual students, and those within simulated spaces. Next, we describe the Design Framework (Halverson & Halverson, 2011) and use it in a discussion of the various features of virtual field experiences, which we present as a means for digital technologies to support practice-based approaches in teacher education. Finally, we offer a virtual field experience inventory, in the form of guiding questions, that users and designers of virtual field experience platforms should consider.

Benefits of Field Experience

A field experience, "much like medical residencies … provide future teachers with opportunities to play active participatory roles in their professional development" (Maheady, Smith, & Jabot, 2014, p. 3). High-quality field experiences function to bridge

theory and practice (Grossman, Hammerness, & McDonald, 2009) and are crucial to properly preparing future teachers (Coffey, 2010). According to Darling-Hammond (2014), the most powerful teacher training programs are able to create strong connections between the theory taught in coursework and field experiences. Darling-Hammond also argued that powerful teacher training programs pay special attention to ensuring that the characteristics of the field experience closely match the participant's desired future teaching setting.

Because of the importance of experience, many scholars have argued that it is not enough to wait until the culminating field experience (i.e., student teaching in most teacher preparation programs) for preservice teachers to have a first chance with practical, hands-on experiences acting as a teacher (Grossman, Compton et al., 2009; Maheady et al., 2014). Yet field experiences happening in the semesters or years prior to a student teaching experience have traditionally been used to provide novices with opportunities to observe others engaged in professional practice, while later field experiences (such as student teaching) provide a way for beginning teachers to practice, reflect, and adjust in a real-life, classroom-based experience.

These earlier experiences in the field understandably center on observation of a classroom teacher because novices are typically not ready to take on the full complexities of teaching. While preservice teachers' experiences observing in the field are an important step in their development and growth, preservice teachers need the chance to move beyond observation and have regular opportunities to practice the craft of teaching (Ball & Forzani, 2009; Shulman, 1998).

Problems of Field Experience and Technology-Mediated Solutions

Field experiences also come with several issues and barriers that should be considered. For one, locating placements in which novices can engage with students in ways that are consistent with the goals outlined in a teacher education program is not always straightforward (Allsopp, DeMarie, Alvarez-McHatton, & Doone, 2006). Even if a teacher education program is able to secure desirable placements, for logistical reasons preservice teachers may go to different placements or to the same placement at different times, which creates two distinct issues.

First, whether an experience comes early or late in the program, novice teachers typically may not be ready to engage in professional practice with students. Also, they often require close supervision because of this inexperience. However, with teacher education candidates placed across multiple locations, it is difficult for teacher educators to observe and supervise their work, while clinical instructors/cooperating teachers are usually not trained, nor have the time, for such work (Darling-Hammond, 2014). Second, with novices placed across a variety of classrooms, variability of preservice students' experiences is inevitable — making those experiences difficult for a teacher educator to draw on (Allsopp et al., 2006; Cruickshank & Armaline, 1986).

Further, when the preservice teachers' experiences are not shared experiences, they are left to do much of the reflective work on their own, which can make it difficult to support novices in making new sorts of meanings needed for engaging in the profession of teaching (Korthagen & Kessels, 1999). This final issue is particularly crucial, as it has led some to question the ability for classrooms to serve educative purposes capable of unseating "the problems of inequity and injustice in U.S. public education" (Zeichner, 2012, p. 380) deeply rooted in schools (see Ellis, 2010, and Zeichner, 2012, for arguments). In some cases, the educational norms being practiced in schools and observed by future teachers may act to

undermine the work that is going on at the university to help novice teachers make sense of educational systems in new ways.

Many have suggested that prior to being placed in the complex environments of classrooms, novice teachers can benefit from engagement in settings of reduced complexity (e.g., Grossman et al., 2009; Grossman & McDonald, 2008). Such settings can provide preservice teachers with better opportunities to get ready for the engagement in the complexities of practice. One way that teacher educators have been addressing this issue is through the use of videorecording and videoconferencing technologies, enabling preservice teachers to gain more practical experience prior to being placed in real classrooms observing or teaching real students.

Videorecords, for example, have been used to create multimedia, case-based records of instruction, enabling preservice teachers to observe and study the intricacies of instruction (Atkins, 1998; Baker, 2005; Knight, Pedersen, & Peters, 2004; Lampert & Ball, 1998). One premise of such work has been to reduce the complexity of teaching by enabling it to be slowed down or replayed for more careful inspection by novices.

Additionally, one-way and even two-way videoconferencing technologies have been used by teacher educators to create opportunities for preservice teachers to interact with real teachers and students in real classrooms from a distance (Karchmer-Klein, 2007; Lehman & Richardson, 2003; Malewski, Phillion, & Lehman, 2005; McDevitt, 1996; Santagata, Zannoni, & Stigler, 2007). One affordance of videoconferencing is the development of a virtual setting for novices to interact with real teachers and students under the watchful eye of an expert. Videoconferencing allows novices and experts to do that work from afar, however. That is, preservice teachers in one locale can gain experience in a different (and perhaps remote) locale without necessarily engaging in all the complexity that might come with actually relocating into a new locale.

Where videorecords reduce complexity by allowing for the manipulation of time (slowing down or rewatching an aspect of classroom practice), videoconferencing is suggested to reduce complexity by allowing for the manipulation of geographic distance (enabling the preservice teacher and the teacher educator to step into particular kinds of classrooms or instructional practice that might not be readily accessible as well as step away from such environments to create some distance for novices to react and reflect).

Laying the Foundation for Virtual Field Experiences as an On-Ramp to Professional Practice

While we acknowledge the value of engagement in actual classrooms that can be created through video records or video conferencing, we see them as distinct from the on-ramps into practice discussed in this paper. Without discounting the benefits of the use of video records, the primary focus there is on observing and studying practice rather than practicing teaching-related skills in settings of reduced complexity. On the other hand, while preservice teachers' engagement with actual students through video conferencing certainly allows for some oversight of novice teachers while learning to practice, it is still a form of engagement with real teachers and students — even if it is at a distance and mediated by technology.

When we refer to *on-ramps* to professional practice, we point to methods such as microteaching and rehearsals (see Lampert et al., 2013; McGarvey & Swallow, 1986) that have been developed, in part, to offer simulated environments for novices to move past observation and study to approximate practice in spaces that are less complex than actual

classrooms. These methods are what we refer to in this paper as on-ramps to professional practice.

In recent years, emerging digital technologies have made possible the consideration of virtual settings for engaging in simulated field experiences. In particular, digital technologies such as Lesson*Sketch*, TLE TeachLive, Second Life, and GoAnimate have been used by teacher educators to enable novices to engage in simulations of practice. The more typical, nondigital peer-teaching methods, such as micro-teaching, have come under some critique in the field for the extent to which they (a) are read by novices as artificial; (b) rely on novices' comfort and ability to represent young children's thoughts and actions for peers trying to practice the role of teacher; and (c) faithfully represent school contexts (e.g., Andreasen et al., 2008; Bell, 2007; Collins & Ting, 2010; Cripwell & Geddes, 1982; Garbett & Ovens, 2012; He & Yan, 2011; Kavanoz & Yüksel, 2010; Kourieos, 2016).

The simulated settings generated within such digital technologies have the added advantage of increasing the fidelity (e.g., representing students using avatars rather than teacher educators or other preservice teachers) and flexibility of the simulations (e.g., representing a variety of classroom characteristics such as the arrangement of furniture, availability of resources, or frequency of interruptions). The need for on-ramps to professional practice supposes that what can be experienced in the field is not enough to foster the kinds of teachers needed in today's classrooms — those who have built up enough confidence and competence for working with a wide variety of students in a wide variety of contexts.

In this paper, we provide a framework for making sense of the categories of features found in digital technologies used to facilitate virtual field experiences. We are aware that such digital technologies have a variety of uses that fall outside of the scope of this paper. Instead, we have focused on using this framework to consider how these digital technologies can be used to create virtual field experiences for the purpose of on-ramping into professional practice.

Building Better On-Ramps to Professional Practice

As part of the efforts to revamp teacher education to better prepare novices for professional practice, many educational scholars have been trying to gain a clearer picture about what a *practice-based approach* might entail. In a seminal paper, Grossman, Compton et al. (2009) definde practice, or what we are calling *professional practice,* as "the orchestration of understanding, skill, relationship, and identity to accomplish particular activities with others in specific environments" (p. 2059). Using this definition, Grossman, Compton et al. engaged in a cross-professional examination of the training of teachers, clergy, and counselors and noted at least three common practice-based pedagogies: *representation* (i.e., making various elements of practice visible to novices), *decomposition* (i.e., breaking down professional practice into its critical components), and *approximation* (i.e., giving novices the opportunity to carry out practice in settings of reduced complexity).

Using these conceptions of practice-based professional education, numerous scholars have designed various kinds of experiences for supporting novices to gain professional competencies. The following two sections describe scholarly work that offers different kinds of practice-based approaches for better preparing preservice teachers. This brief review of the literature begins with an acknowledgment that the discussion is concise, capturing the broader patterns that have emerged from the field. Many practice-based approaches can fit into two broad categories (described below as On-Ramp 1 and On-Ramp

2), and little has been written until recently (see Herbst et al., 2016) about how technology can mediate practice-based experiences, or on-ramps to professional practice.

On-Ramp 1

Some practice-based approaches used by ITPPs take advantage of classroom settings to create opportunities for preservice teacher learning. Like earlier work in the field (Holmes Group, 1986), some recent ITPPs have managed to immerse preservice teacher experiences in the classroom by relocating portions of their programs into school settings. In one such program, preservice teachers have opportunities to see elements of a lesson modeled by the teacher educator and school-based practitioner, as well as practice portions of that lesson before teaching with students (McDonald et al., 2014). Similarly, McDonald, Kazemi, and Kavanagh (2013) offered a "learning cycle" for novice teachers that provides a means for "collectively learning to engage in an authentic and ambitious instructional activity" (p. 382).

These learning cycles move novices through both pedagogies of investigation, such as studying practice as represented on video, and pedagogies of enactment, such as rehearsing for teaching and carrying out routines "with real students in real classrooms" (McDonald et al., 2013, p. 383). Other ITPPs have explored the use of early field experiences, sometimes called "early entry." In many of these programs, preservice teacher candidates move beyond observation to engage in field experiences with small groups of students (without taking full control of the classroom) prior to engaging in more formal university course work typical of ITPPs (e.g., Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2006).

Such approaches are laudable for addressing the problematic aspects of traditional field experiences by developing an on-ramp to professional practice. They can be logistically challenging, however, (McDonald et al., 2014). For example, researchers have acknowledged that these endeavors rely crucially on establishing high-quality partnerships between ITPPs and schools (Goodlad, 1990; Ross, Brownell, & Sindelar, 1999).

In this way, these approaches share some of the same liabilities as field experiences, like the difficulty in finding classrooms with teachers willing to allow preservice teachers to practice. Furthermore, like the previous iterations of such programs, these efforts are often resource-heavy and, for those reasons, are difficult to maintain (see literature on professional development schools, e.g., Goodlad, 1990).

On-Ramp 2

Another body of literature has emerged that reports on the viability of simulations for supporting preservice teachers' engagement in approximations of practice. Distinct from the kind of practice one can gain from actual classrooms, approximations of practice can provide novices with a safe environment (both safe for the novices and safe for the students under their care), in which to experiment with instructional practices while having opportunities to make mistakes and learn from those experiences. For some time now, teacher educators have been engaging preservice teachers in activities like microteaching, in which preservice teachers are given opportunities to simulate teaching a lesson in the context of a methods course (McGarvey & Swallow, 1986). Many of these kinds of experiences happen in face-to-face settings with preservice teachers enacting an abbreviated version of a lesson while their peers simulate various kinds of students for that lesson.

One liability of these methods is that preservice teachers may not feel comfortable providing reasonable estimates of students' conceptions and behaviors because of the ways that it might affect the performance of their classmate playing the role of the teacher (Bell, 2007). When playing the role of students, Bell noted, the preservice teachers "were uniformly helpful and compliant, readily following the microteacher's instructions and earnestly offering responses" (p. 33). Moreover, when playing the role of students, preservice teachers were hesitant to offer incorrect or unexpected answers, and on the few occasions when they did, they "not only corrected the mistake, but apologized" (p. 33).

A second liability is, even if willing to play the part, preservice teachers may be prone to over- or underexaggerate certain behavioral tendencies (Kourieos, 2016) or be unaware of students' common conceptions and misconceptions (Andreasen et al., 2008). To handle these liabilities, some in the field have introduced experts into such situations by having the teacher educator also play the role of a student (e.g., Lampert et al., 2013) or providing an actor to follow a script written by a teacher educator to simulate a student (e.g., Shaughnessy & Boerst, 2018).

With the growing ubiquity of digital technologies, educational scholars have also begun to explore how such technologies, might support similar practice-based experiences (e.g., Amador et al., 2016; Amidon, Chazan, Grosser-Clarkson, & Fleming**,** 2017**;** Brown, Davis, Lewis, & Kulm, 2011; Herbst & Milewski, 2017**;** Hayes, Straub, Dieker, Hughes, & Hynes, 2013; Milewski, Herbst, Bardelli, & Hetrick, 2018; Webel & Conner, 2017). In a recent chapter, Herbst et al. (2016) examined the ways in which pedagogies of professional practice (Grossman, Compton et al., 2009) can be mediated through the use of digital representations and computing technology. Herbst et al. (2016) suggested that "the extent to which technology can mediate approximations of practice depends a great deal on the peripherals that are used to collect data from the novice who is practicing" (p. 14). By peripherals, the authors referred to artifacts such as computer mouse, keyboard, microphone, or camera that allow novices to extend themselves into the model of reality to engage in simulated practice.

Building on that claim, we suggest that the extent to which those peripherals enable a user to interact within a digital representation of practice can also make a difference in terms of the ability for technology to mediate pedagogies of approximation. That is, where one simulation environment could enable users to author elements of the teacher dialogue and gesture, another environment could enable users to author elements of the teacher and/or student dialogue and gesture as well as aspects of the classroom environment (e.g., how desks are positioned). Such variation would make a difference for the kind of practice that could be approximated by a novice. In this article, we offer a way to consider the selection and use of digital technologies capable of mediating preservice teachers' engagement in virtual field experiences. First, we describe a framework for defining and examining features and affordances of such technologies.

Design Framework

Halverson and Halverson (2011) described education as "design for learning" (p. 325), where learning is intentionally shaped through artifacts (e.g., policies, curricula, strategies, and behavior plans) designed to promote certain outcomes. The Design Framework is named as a lens with which to examine such artifacts (Halverson & Halverson, 2011). The intentions of the designer (both explicit and implicit) can be seen through the features of the artifact.

Features imply a certain kind of use of the artifact for the intended user. The affordances of the artifact are how the user of the artifact perceives its features and puts them to use. Finally, the outcomes of the artifact are the influence of the artifact on learning. In other words, the following question is being answered: Did the artifact, designed to influence learning, result in shaping learning as intended?

For example, the Design Framework can be used to analyze a policy on what writing utensil to use in a mathematics classroom. Lampert (2001), in her book *Teaching With Problems and the Problems With Teaching*, intended for her students to make mistakes, reflect on those mistakes, and then improve their work in mathematics based on what they learned. To enact this intention, she designed a policy that all her students would work in pen, and if they made a mistake they were not allowed to start over or scribble it out. They would simply put a single line through the work so it could still be seen, but it would not be recognized as a formal part of the solution.

The ways the students took up the policy would be the affordances of the policy. Did they use it as planned or did the thought of having a "messy" paper with crossed-out mistakes cause students to overthink what they were writing or to recreate their work so it "looked neater"? Finally, whether or not students were more likely to learn from their mistakes better than if they erased all the mistakes would be the outcomes of Lampert's policy.

The Design Framework is employed in the following section as a way of making sense of the features and affordances of virtual field experience platforms for the purpose of providing an on-ramp to professional practice.

Virtual Field Experiences

A virtual field experience is a mechanism that mediates the practice of teaching and teacher behaviors through interactions with virtual students. In this way, we build on Hixon and So's (2009) work, which defined one kind of field experience in which preservice teachers engage with a model of reality rather than engaging with actual classrooms and students through in-person or remote field experiences. A virtual field experience has the following characteristics:

1. It allows one to practice behaviors and skills related to teaching.
2. It allows the preservice teacher to interact with simulated students who can display a variety of characteristics.
3. It involves the use of digital technologies to aid and facilitate the experience.

The definition of a virtual field experience contains characteristics that align with microteaching and rehearsals, specifically the first two characteristics in this definition. Microteaching of lessons can be broadly defined as teaching a lesson without students present and is touted as a way for novices to practice teacher behaviors in front of peers and instructors (Kourieos, 2016). Microteaching has found a place in most preservice training programs, and the flexibility afforded within this broad definition allows teacher preparation programs to use it for a number of purposes (McGarvey & Swallow, 1986).

Since its first use at Stanford University in 1963 by Dr. Dwight W. Allen and Dr. Kevin Ryan, microteaching has addressed the immense complexity of the classroom by offering a safe and controlled introduction to teaching (McGarvey & Swallow, 1986). As its use in teacher preparation programs grew in popularity, so did the body of research on microteaching. Rehearsals expand on microteaching and add the element of instructors (in

addition to peers) who behave as students while the preservice teacher delivers the lesson (Lampert et al., 2013).

The second characteristic of virtual field experiences of is the ability to interact with simulated students. Microteaching, rehearsals, and virtual field experiences allow preservice teachers to practice in a way that does not negatively influence a real classroom in ways associated with cognition, learning, and safety. It also allows for teacher-trainers to identify any major issues that would negatively impact the preservice teacher's future students. Research on the use of simulation in healthcare training often touts the benefits of safety, where those training for careers in health-care can practice on simulated patients without the consequences that come with harming a real person (Murphy, Hartigan, Walshe, Flynn, & O'Brien, 2011).

Similarly, virtual field experiences can create a safe place of practice where mistakes made in the practice of teaching will not be detrimental to the safety or well-being (cognitive, physical, or emotional) of real students (Hayes et al., 2013). In sum, virtual field experiences, microteaching, and rehearsals, share the core feature of being a sandbox, where teaching by the preservice teacher is done with a simulated set of students.

The final characteristic in the definition of a virtual field experience can be leveraged within either microteaching or rehearsals, but is a mandatory element of a virtual field experience. The use of digital technologies, to mediate a virtual field experience, what we will term a 'virtual field experience platform" allows for increased flexibility beyond the constraints of microteaching/rehearsals in certain features.

For example, virtual field experiences, microteaching, and rehearsals all share the core feature of having a flexible representation of time, where teaching does not have to be a continuous, real time, single-timeline experience, where more options can be exercised within a virtual field experience than in microteaching or rehearsals. The indicated flexibility can be seen in features of the digital technologies that are used to mediate virtual field experiences. The features of these virtual field experience platforms then fall into two categories: features used to design elements of practice within the experience and features used to deliver the experience in particular ways.

Virtual Field Experience Features

Two virtual field experience platforms are used to illustrate the features described in the following section: (a) TLE TeachLive (Dieker, Rodriguez, Lignugaris/Kraft, Hynes, & Hughes, 2014); and (b) Lesson*Sketch* (Chieu & Herbst, 2012) to. We are aware of other digital technologies with the capability of mediating a virtual field experience (e.g., GoAnimate and Second Life), but have limited this discussion to two platforms. We are not the designers of either of these platforms and are not attempting to represent the thinking of the designers in discussing the features of the platforms. Rather, the resulting list of features have emerged from the literature (e.g., Herbst, Chazan, Chen, Chieu, & Weiss, 2011) and coincide with our experiences with the platforms. In no way do we suggest that the list of features is comprehensive. Focusing on these two familiar platforms allows us to illustrate the intersection of theory and practice as they relate to the use of virtual field experiences.

Flexibility in Designing Elements of Practice Within the Experience. Several features of virtual field experience platforms allow for flexibility in designing elements of practice within the virtual field experience. These features allow the teacher educator to shape what happens within the virtual field experience and realize the intended learning

outcomes. The features (flexible classroom complexity, authorable scenarios, and authorable students) can be found within microteaching and rehearsals, with additional flexibility existing when these features are present within a virtual field experience platform.

In previous work, Herbst et al. (2011) spoke to the need for representations of teaching to reflect the unique demands of teaching. Namely the demands of multivocality, the need for a teacher to "attend to the many individual voices of a class who may have diverging responses to the same stimulus" (p. 100), and multimodality, the need for a teacher "to interpret individual messages that may be communicated in several modalities" (p. 100). The features named within this category attend to the multiple demands of teaching defined by Herbst and colleagues (2011).

Flexible Classroom Complexity. To design a virtual field experience for on-ramping to professional practice is to create an environment for developing fluency with the practices of teaching. It is common for the practices, as carried out, in the simulated setting, to be distinct from the practices, as exhibited, in the profession (Shulman, 1998). When beginning teachers are allowed a chance to rehearse through microteaching or a virtual field experience, the complexity of the experience becomes adjustable.

Through the feature of flexible classroom complexity, the primary focus could be placed on teacher behavioral skills, with a secondary focus on content knowledge (Allen & Krasno, 1968), or vice versa. These teacher behavioral skills can include planning, verbal delivery of instructions, practice using different delivery techniques (visual, audio, etc.), and practice using instructional technology, among others. This ability to vary the complexity can allow for the focus to rest on what the preservice teacher will do to plan and present the lesson, in order to prevent the preservice teacher from being overwhelmed by all the factors concerning students and teaching.

Allen and Krasno (1968) argued that once the desired practices were mastered decision-making skills could be developed using microteaching, because participants had to decide the best methods for reaching instructional goals. This kind of practice, which could be replicated within a virtual field experience (see Table 1), was shown to improve self-efficacy for preservice teachers (Arsal, 2014). While some have suggested that microteaching could have the limitations of encouraging the reproduction of normal teacher behaviors (Bell, 2007; Kourieos, 2016), the flexible classroom complexity feature of virtual field experiences allows for teacher educators to incrementally increase the complexities (e.g., increasing the number and arrangement of students in the room) in order to help novices learn to handle increased complexities over time.

Authorable Scenarios. For their preservice teachers' benefit, instructors commonly decompose the professional practice of teaching into smaller practices (Grossman, Compton et al., 2009). While microteaching often attempts to remove the teacher from the "real situation" (McGarvey & Swallow, 1986), the virtual field experience affords the opportunity to present prescribed, or authorable, scenarios. With this feature in mind, a virtual field experience can afford the replication of scenarios that may not be consistently present in a real-life field experience.

Table 1
Comparison of Virtual Field Experience Platform Features

Feature	TLE TeachLive	Lesson*Sketch* Depict Tool
Core Features		
Sandbox Environment	Classroom is a hybrid lab space where students are previously determined by the designers of the platform.	Classroom is a storyboard environment where students are created by a teacher educator, or the preservice teacher.
Flexible Representation of Time	Experience occurs in real-time where one minute in the experience represents one minute of teaching. Experience can be paused or repeated but limited to skill of, and prior communication with, the interactor.	Experience is not in real time. Representations are moment-to-moment in the form of panels within a comic book.
Flexibility in designing elements of practice within the experience		
Flexible Classroom Complexity	Default experience uses a defined number of students. Lab can be used without interactor/live students to simulate practice.	Experience can include a classroom of students or reduced to a single student or group interaction.
Authorable Scenarios	Scenario composed by the teacher educator or novice teacher practicing particular aspects of practice in concert with the interactor playing the part of students in a particular scenarios. In particular, the scenarios consists of a small number of students sitting in desks all oriented to the front of the room. Scenarios are limited to the available student avatars and communication with, and skill of, the interactor to play out the scenario	Unlimited scenarios composed by users (in this case both novice teachers and teacher educators) from a limited library of graphics available within the **Depict** tool (Herbst & Chieu, 2011), or an unlimited number of graphics that could be imported by the user.
Authorable Students	Students consist of limited number of TLE TeachLive designed avatars, voiced by a live interactor.	Students consist of unlimited number of avatars whose actions are represented by users (in this case both novice teachers and teacher educators)
Flexibility in delivering the experience in particular ways		
Adjustability of Risk	Audience for experience can be limited to an interactor or expanded to include an interactor, facilitator, and viewers from within the lab	Audience for experience can be limited to teacher educator or expanded to include all other participants in the experience.
Collective/Shared Nature of Engagement	Experiences can be connected through common lessons or scenarios, and a common set of students.	Experiences can be connected through common classrooms and classroom/student interactions.
Repeated Practice	Only limitation is the capacity of the environment/number of labs	Only limitation is availability of technology and access provided by teacher educator through platform
Flexibility of Time/Space	Experiences must be completed in a TLE TeachLive Lab. Number of experiences is limited to the number of labs and capacity to run the labs.	Experiences can be completed at any time and on any device that meets the minimum specifications.
Document/Replay Experience	Experience exists in the moment unless steps are taken to record what occurs.	Experience is reviewable without any additional steps.

With a virtual field experience, any scenario can be replicated for all participants. This benefit is also commonly noted in simulation use in the healthcare field, especially when certain scenarios do not play out frequently in day-to-day professional practice (Murphy et al., 2011). In relation to field experience for preservice teachers, a field experience may not always be possible or practical (e.g., training alternate-route teachers when schools are not in session, or having a field experience where the number of students in the classroom is fewer than typical). Hixon and So (2009) noted that a common limitation of traditional field experience is "access to rural and diverse settings" (p. 300). When these instances occur, a virtual field experience can fill the void by providing an authored scenario, in which the preservice teacher can practice.

Authorable Students. Many virtual field experiences focus on classroom management (Meritt, Gibson, Christensen, & Knezek, 2015). However, a field experience will provide different levels of management difficulties based on the types of students present in a particular setting.

While microteaching can be understood to have the feature of authorable students, the representation of those students is limited to the abilities of other preservice teachers to understand and execute typical student conceptions and misconception and behaviors. Lampert et al.'s (2013) design of rehearsal made improvements on this limitation by placing the mathematics teacher educator in the role of the student, and yet they are just one simulated student amongst the sea of many others.

Virtual field experiences, like those created in TLE TeachLive, allow preservice teachers to practice with a diverse set of students who display consistent and controllable behaviors (controllable in that the behaviors they display can be authored and manipulated by the interactor of the simulation). The students created for a virtual field experience can include students with a variety of behavioral dispositions (e.g., eager to participate, energetic, disengaged, etc.) or disabilities (e.g., emotional impairments, learning impairments, cognitive impairments, autism, etc. — see Dieker et al., 2014; Vince Garland, Holden, & Garland, 2016), as well as other variations that would impact their behavior.

Similarly, designers of virtual experiences may elect to represent students more generically to mask elements of their individuality or to represent particular features of their individuality in more or less proximal ways. For example, the Lesson*Sketch* platform enables users to choose whether or not to distinguish elements of students' identity such as gender, race, or ethnicity by providing users with capabilities to change the color of students' vests or the color of students' skin tones — including more fanciful and more realistic options — or to use the voice tool to give the students particular accents (Herbst et al., 2017).

This feature ultimately allows for practice in situations where a real student, fitting those same characteristics, may not be available. The benefit of having authorable students runs parallel to what is seen in simulation use in the healthcare field. When used to train healthcare professionals, human patient simulators expose novice healthcare professionals to simulated patients who can display common behaviors (Anderson, Holmes, LeFlore, Nelson, & Jenkins, 2010). In the same way, the capability of authorable students affords teacher educators the opportunity to engage novices with common patterns of student behavior or cognition.

Flexible classroom complexity, authorable scenarios, and authorable students are features of virtual field experience platforms that afford teacher educators flexibility in designing virtual field experiences that provide preservice teachers with the practice needed to on-

ramp to professional practice. What follows are features of virtual field experience platforms that allow for flexibility in delivering the experience in particular ways.

Flexibility in Delivering the Experience in Particular Ways. The features of the platforms afford the teacher educator the ability to shape how the virtual field experience is delivered in order to realize the intended learning outcomes. The identified features (adjustability of risk, collective/shared nature of engagement in practice, repeated practice, flexibility of time/space, document/replay experience) can be found within microteaching and rehearsals, with additional options existing when these features are present within a virtual field experience platform.

Adjustability of Risk. Previously, the sandbox feature of a virtual field experience was presented as a core feature of what defines a virtual field experience. This feature affords preservice teachers place to experiment through practice to realize productive teaching practices in ways that are safe for real students. Another angle to the issue of safety, or the feature of adjustability of risk, is that of the risks experienced by the preservice teacher in trying something new.

While the removal of risk for K-12 students is a benefit of virtual field experiences, the *risks* taken by the preservice teacher in trying something new is a feature of experimentation worth maintaining. To say more, with rehearsals, microteaching, and virtual field experiences, preservice teachers are asked to take a risk by practicing skills that are not fully developed in front of peers and expert instructors. While dealing with anxiety during teaching is important, the level of anxiety should be considered. In this regard, flexibility in who is able to view a virtual field experience can be adjusted based on the desired preservice teacher experience.

For example, experiences in Lesson*Sketch* can be experienced individually, with only the teacher educator providing feedback on the experience, or experienced collectively, where a preservice teacher's peers can also view responses in the experience through forums. In this way, the Lesson*Sketch* platform allows for the teacher educator to determine the amount of risk a preservice teacher must undergo at particular places across a program.

Collective/Shared Nature of Engagement in Practice. Another affordance of microteaching is that practice can become a common experience/text for the class. The research has shown that preservice teachers who engage in peer review end up benefiting through the practice of assessing, reflecting, and building interpersonal skills (Wu & Kao, 2008). This feature of collective/shared nature of engagement in practice can be seen through the default set of avatars within TLE TeachLive, where discussion between preservice teachers (even across institutions) can ensue about interactions they individually had with a specific avatar from a virtual platform. The feature can also be seen within Lesson*Sketch* through shared considerations for how to enact a problem-based task within a specific classroom environment with built in assumptions (Amidon et al., 2017).

Repeated Practice. The creators and early adopters of microteaching were aware of the benefit of repeated practice (McGarvey & Swallow, 1986). The original microteaching model included the following six-part cycle: plan, teach, observe (critique), replan, reteach, and re-observe (Arsal, 2014). This feature can be found in virtual field experiences, where scenarios can be replicated and practiced multiple times for the same participant, affording preservice teachers opportunities to make adjustments and improvements to their approach.

For example, an instructional sequence can be implemented in TLE TeachLive multiple times by multiple preservice teachers with an instructional coach to reduce errors in execution when implemented by the preservice teachers within a field experience (Dieker et al., 2014). Or a depiction of practice can be edited multiple times within Lesson*Sketch* to consider how best to use student responses to enhance conceptual understanding of a topic. Similarly the Lesson*Sketch* platform supports the development of fuller simulations of practice, in which a task of teaching unfolds as a novice is faced with a sequence of decision points whose consequences are experienced by the novice teacher as the story branches in new ways providing novices with different kind of feedback (see Chieu, Boileau, Huisinga, Herbst, & Milewski**;** Webel & Conner, 2017).

Flexibility of Time and Space. Simulations of teaching have necessary requirements in order to make them happen, resulting in the feature of flexibility of time and space. This feature affords users of the experience varying abilities to interact with the experience. Microteaching and rehearsals call for a methods classrooms with knowledgeable teacher educators and a critical mass of people to serve as students.

Virtual field experience platforms have similar needs, with the difference being in the form of technological requirements. For example, Lesson*Sketch* requires each preservice teacher to interact with the environment within a Flash-enabled web browser, which provides a limitation to access (preservice teachers having access to the required technology), but the same environment can be accessed at any time of day. In contrast, the TLE TeachLive environment does not require the preservice teacher to have access to specific technology but does require a dedicated space to interact with the platform, a facilitator, and a trained interactor to provide the default experience.

Document/Replay Experience. Simulations of teaching, like microteaching and virtual field experiences, allow participants to reflect on their experience (Arsal, 2014; Hixon & So, 2009). The feature of document/replay experience affords preservice teachers the opportunity to extend and enhance the learning by reviewing durable representations of practice. This extension of learning has occurred through the video recording of microteaching experiences (McGarvey & Swallow, 1986).

While research on video recording virtual field experience sessions is minimal, the benefits of this practice can be hypothesized to be similar to the benefits found with video recording microteaching sessions. Alternatively, some virtual field experience platforms, such as Lesson*Sketch*'s Depict are such that preservice teachers' actions are automatically documented in a durable form of representation (namely a storyboard), making the possibility of review automatically available.

Whether through the creation of a video record or storyboard, preservice teachers can benefit from the debriefing of their performance through the review and reflection on a durable record of practice. These kinds of records stand in contrast to filming actual lessons where children are present. While possible, the creation of such records adds layers of liability and logistics related to obtaining consent to film students.

Research has shown that recording microteaching, combined with guided reflection and peer dialog, allows preservice teachers to find connections between theory and practice (Kourieos, 2016). In addition, the use of video allows preservice teachers and instructors the opportunity to revisit a rehearsal, microteaching, or virtual field experience (Hixon & So, 2009; Wu & Kao, 2008).

The adjustability of risk, collective/shared nature of engagement in practice, repeated practice, flexibility in terms of time/space, document/replay experience are features of virtual field experience platforms that afford teacher educators the ability to shape how the virtual field experience is delivered in order to realize the intended learning outcomes.

Virtual Field Experience Platform Inventory

The features of virtual field experience platforms presented here are not intended as a comprehensive list. The purpose of identifying and describing these features is to allow those in charge of selecting and using such platforms the opportunity to consider the affordances and constraints in the features that are designed elements of the platform. In addition, consideration needs to be given to the intentions for using the platform and the resulting outcomes. The Virtual Field Experience Platform Inventory (see Table 2) has been included to provide platform users guiding questions to ask of themselves in order to make clear their intentions before choosing or using a virtual field experience platform.

The focus of this paper is to help users of platforms to create and implement virtual field experiences as on-ramps to professional practice, but the content and framework provided in this paper may also prove useful to designers of such platforms. The features and the questions here (Table 2) can provide a means for considering how to design platforms to create another setting, that is, virtual field experiences, within which to engage in the various quadrants of a learning cycle (McDonald et al., 2013).

Conclusion

A continued increase is likely in the use of technology platforms in conjunction with teacher preparation. In addition, through improvements in technology, there will be an increase of potential student representations and scenario possibilities. ITPPs will be able to continue leveraging digital technologies for the purpose of providing effective and practical teacher training. ITPPs should be mindful of the purpose and scope of using technology (specifically, virtual field experience platforms) and the multitude of ways they can be adjusted to meet specific intentions/outcomes.

In this paper, we outlined the need for using on-ramps to professional practice and, ultimately, virtual field experiences to fill in the gaps of practice leading up to field experiences. These on-ramps have some important benefits, including creating consistent, shared learning experiences between novice teachers and providing common scenarios that might not be available due to the unpredictable dynamic nature of real-life field experiences.

The major contribution of this paper is a virtual field experience platform inventory, which identifies guiding questions for teacher educators to use when selecting and using a virtual field experience platform to on-ramp to professional practice. These questions will be useful not only to ITPPs, instructors, and stakeholders, but also to the designers of digital technologies for practice-based teacher education.

Table 2
Virtual Field Experience Platform Inventory

Feature	Guiding Question
Core Features	
Sandbox Environment	Is the experience situated in a "sandbox" environment, disconnected from interactions with real students?
Flexible Representation of Time	Can time be manipulated in the experience where scenarios can be stopped, slowed down, sped up, or repeated?
Flexibility in designing elements of practice within the experience	
Flexible Classroom Complexity	What practices are desired? What classroom variables are needed to sufficiently engage in the desired practices?
Authorable Scenarios	What contexts/situations are needed to adequately execute the desired practices? What elements of the scenario can the novice learn to alter? Are those elements alterable in the context/situation the novice is approximating practice?
Authorable Students	What representations of students are needed to adequately execute the desired practices? In what ways does the environment allow for preservice teachers to construct aspects of simulated students? What opportunities for learning might exist for novices in the construction of various kinds of students and their contributions?What might a teacher educator learn about preservice teachers having a chance to construct students and their contributions?
Flexibility in delivering the experience in particular ways	
Adjustability of Risk	What are the ramifications of mistakes given the desired practices? What are the risks involved (and for whom) in the novices approximations of practice?
Collective/ Shared Nature of Engagement	What can others learn by a novice's engagement in the approximation of practice? To what degree can preservice teachers talk across their experiences?
Repeated Practice	How can preservice teacher's repeat an experience? What number of repetitions are needed for the desired practice to be learned?
Flexibility in Terms of Time/Space	What time is available for engaging with the experience? What access to particular people, spaces, technology is needed to engage in the experience?
Document/ Replay Experience	What kind of reflection is desired? What kind of durable representations can be created of the preservice teacher's experience?

References

Allen, D. W., & Krasno, R. M. (1968). New perspectives in teacher education. *The National Elementary Principal*, *47*(6), 36-42.

Allen, I. E., & Seaman, J. (2013). *Changing course: Ten years of tracking online education in the United States*. Newburyport, MA: Sloan Consortium.

Allsopp, D. H., DeMarie, D., Alvarez-McHatton, P., & Doone, E. (2006). Bridging the gap between theory and practice: Connecting courses with field experiences. *Teacher Education Quarterly, 33*(1), 19-35.

Amador, J., Weston, T., Estapa, A., Kosko, K., & De Araujo, Z. (2016). Animations as a transformational approximation of practice for preservice teachers to communicate professional noticing. *Journal of Technology and Teacher Education, 24*(2), 127-151.

Amidon, J., Chazan, D., Grosser-Clarkson, D., & Fleming, E. (2017). Meet me in Azul's room: Designing a virtual field placement for learning to teach mathematics. *Mathematics Teacher Educator*, *6*(1), 52-66.

Anderson, M., Holmes, T. L., LeFlore, J. L., Nelson, K. A., & Jenkins, T. (2010). Standardized patients in educating student nurses: One school's experience. *Clinical Simulation in Nursing*, *6*(2), e61-e66.

Andreasen, J. B., Haciomeroglu, E. S., Akyuz, D., Coskun, S., Cristwell, P., & Whitby, P. S. (2008). Teacher training in multiple environments: Microteach versus virtual. *Florida Association of Teacher Educators Journal, 1*(8), 1-20.

Arsal, Z. (2014). Microteaching and preservice teachers' sense of self-efficacy in teaching. *European Journal of Teacher Education*, *37*(4), 453-464.

Atkins, S. L. (1998). Windows of opportunity: Preservice teachers' perceptions of technology-based alternatives to field experiences. *Journal of Computers in Mathematics and Science Teaching, 17*(1), 95-105.

Baker, E. A. (2005). Can preservice teacher education really help me grow as a literacy teacher? Examining preservice teachers' perceptions of multimedia case-based instruction. *Journal of Technology and Teacher Education, 13*(3), 415–431.

Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In L. Darling-Hammond & G. Sykes (Eds.), *Teaching as the learning profession* (pp. 3–31). San Francisco, CA: Jossey-Bass.

Ball, D. L, & Forzani, F. M. (2009). The work of teaching and the challenge for teacher education. *Journal of Teacher Education, 60*(5), 497-511.

Bell, N. D. (2007). Microteaching: What is it that is going on here? *Linguistics and Education, 18*(1), 24-40.

Bowman, M., & Gottesman, I. (2017). Making the socio-historical visible: A place-conscious approach to social foundations in practice-centered teacher preparation. *Teaching and Teacher Education, 68*, 232-240. doi:10.1016/j.tate.2017.09.001

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2006). How changes in entry requirements alter the teacher workforce and affect student achievement. *Education Finance and Policy, 1*(2), 176–216.

Brown, I. A., Davis, T. J., Lewis, C. W., & Kulm, G. (2011). Preservice teachers' knowledge for teaching algebra for equity in the middle grades: A preliminary report. *Journal of Negro Education, 80*, 266-283.

Chieu, V. M., Boileau, N., Huisinga, M., Herbst, P., & Milewski, A. (2017). *Can a teaching simulation predict novice and expert teachers' decision making?* Paper presented at the annual meeting of the American Educational Research Association, San Antonio, TX.

Chieu, V. M., & Herbst, P. (2012, March). LessonSketch: A rich-media scenario-based learning environment for teacher development. In P. Resta (Ed.), *Proceedings of the Society for Information Technology & Teacher Education International Conference* (pp. 968-973). Norfolk, VA: Association for the Advancement of Computing in Education.

Coffey, H. (2010). "They taught me": The benefits of early community-based field experiences in teacher education. *Teaching and Teacher Education*, *26*(2), 335-342.

Collins, S., & Ting, H. (2010). Actors and act-ers: Enhancing inclusion and diversity in teaching and teacher education through the validation of quiet teaching. *Teaching and Teacher Education, 26*(4), 900-905.

Cripwell, K., & Geddes, M. (1982). The development of organizational skills through micro-teaching. *ELT Journal, 36*(4), 232–236.

Cruickshank, D. R., & Armaline, W. D. (1986). Field experiences in teacher education: Considerations and recommendations. *Journal of Teacher Education, 37*(3), 34-40.

Darling-Hammond, L. (2014). Strengthening clinical preparation: The holy grail of teacher education. *Peabody Journal of Education, 89*(4), 547-561.

Dieker, L. A., Rodriguez, J. A., Lignugaris/Kraft, B., Hynes, M. C., & Hughes, C. E. (2014). The potential of simulated environments in teacher education: Current and future possibilities. *Teacher Education and Special Education, 37*(1), 21-33.

Ellis, V. (2010). Impoverishing experience: The problem of teacher education in England. *Journal of Education for Teaching 36*(1), 105–120.

Garbett, D., & Ovens, A. (2012). Being a teacher educator, exploring issues of authenticity and safety through self-study. *Australian Journal of Teacher Education, 37*(3), 44–56.

Goodlad, J. (1990). *Teachers for our nation's schools*. San Francisco, CA: Jossey-Bass.

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

Grossman, P., Hammerness, K., & McDonald, M. (2009). Redefining teaching, re-imagining teacher education. *Teachers and Teaching: Theory and Practice, 15*(2), 273-289.

Grossman, P. L., & McDonald, M. (2008). Back to the future: Directions for research in teaching and teacher education. *American Educational Research Journal, 45*(1), 184–205.

Halverson, R., & Halverson, E. (2011). Education as design for learning: A model for integrating education inquiry across research traditions. In C. F. Conrad & R. C. Serlin (Eds.), *Sage handbook for research in education: Pursuing ideas as the keystone of exemplary inquiry* (pp. 323-339). Thousand Oaks, CA: Sage Publications.

Hayes, A. T., Straub, C. L., Dieker, L. A., Hughes, C. E., & Hynes, M. C. (2013). Ludic learning: Exploration of TLE TeachLivE™ and effective teacher training. *International Journal of Gaming and Computer-Mediated Simulations*, *5*(2), 20-33.

He, C. J., & Yan, C. M. (2011). Exploring authenticity of microteaching in preservice teacher education programmes. *Teaching Education, 22*(3), 291–302.

Herbst, P., Chazan, D., Chen, C., Chieu, V. M., & Weiss, M. (2011). Using comics-based representations of teaching, and technology, to bring practice to teacher education courses. *ZDM—The International Journal of Mathematics Education, 43*(1), 91–103.

Herbst, P., Boileau, N., Clark, L., Milewski, A., Chieu, V., Gürsel, U., Chazan, D. (2017, October). *Directing focus and enabling inquiry with representations of practice: Written cases, storyboards, and teacher education*. Paper presented at the annual meeting of the PME-NA. Indianapolis, IN.

Herbst, P., Chazan, D., Chieu, V. M., Milewski, A., Kosko, K. W., & Aaron, W. R. (2016). Technology-mediated mathematics teacher development: Research on digital pedagogies of practice. In M. Niess, S. Driskell, & K. Hollebrands (Eds.), *Handbook of research on transforming mathematics teacher education in the digital age* (pp. 78-106). Hershey, PA: IGI Global.

Herbst, P., & Chieu, V. M. (2011). *Depict: A tool to represent classroom scenarios* (Technical report). Retrieved from the Deep Blue database at the University of Michigan: http://hdl.handle.net/2027.42/87949

Herbst, P., & Milewski, A. (2017). What StoryCircles can do for mathematics teaching and teacher education? In R. Zazkis & P. Herbst (Eds.), *Mathematical dialogue: Scripting approaches in mathematics education research and practice*. New York, NY: Springer Publications.

Hixon, E., & So, H. J. (2009). Technology's role in field experiences for preservice teacher training. *Journal of Educational Technology & Society*, *12*(4), 294.

Holmes Group. (1986). *Tomorrow's teachers*, East Lansing, MI: Holmes Group Inc.

Kang, H., & Windschitl, M. (2018). How does practice-based teacher preparation influence novices' first-year instruction? *Teachers College Record, 120*(8).

Kavanoz, H. S., & G. Yüksel. (2010. An investigation of peer-teaching technique in student teacher development. *The International Journal of Research in Teacher Education, 1,* 1–19.

Karchmer-Klein, R. (2007). Reexamining the practicum placement: How to leverage technology to prepare preservice teachers for the demands of the 21st century. *Journal of Computing in Teacher Education, 23*(4), 121-128.

Knight, S. L., Pedersen, S., & Peters, W. (2004). Connecting the university with a professional development school: Preservice teachers' attitudes toward the use of compressed video. *Journal of Technology and Teacher Education, 12*(1), 139–154.

Korthagen, F. A., & Kessels, J. P. A.M. (1999). Linking theory and practice: Changing the pedagogy of teacher education. *Educational Researcher, 28*(4), 4-17.

Kourieos, S. (2016). Video-mediated microteaching–A stimulus for reflection and teacher growth. *Australian Journal of Teacher Education, 41*(1), 4.

Lampert, M. (2001). *Teaching problems and the problems of teaching*. New Haven, CT: Yale University Press.

Lampert, M. (2010). Learning teaching in, from, and for practice: What do we mean? *Journal of Teacher Education, 61*(1-2), 21-34.

Lampert, M., & Ball, D. L. (1998). *Teaching, multimedia, and mathematics: Investigations of real practice*. New York, NY: Teachers College Press.

Lampert, M., Franke, M. L., Kazemi, E., Ghousseini, H., Turrou, A. C., Beasley, H., & Crowe, K. (2013). Keeping it complex: Using rehearsals to support novice teacher learning of ambitious teaching. *Journal of Teacher Education, 64*(3), 226-243.

Lehman, J., & Richardson, J. (2003). Virtual field experiences: Helping preservice teachers learn about diverse classrooms through video conferencing connections with K-12 classrooms. In D. Lassner & C. McNaught (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications* 2003 (pp. 1727-1728). Chesapeake, VA: AACE,.

Maheady, L., Smith, C., & Jabot, M. (2014). Field experiences and instructional pedagogies in teacher education: What we know, don't know, and must learn soon. In P.T. Sindelar, E. D.McCray, M. T. Brownell, & B. Lignugaris/Kraft, (Eds.), *Handbook of research on special education teacher preparation* (pp. 161–177). New York, NY: Routledge.

Malewski, E., Phillion, J., & Lehman, J. D. (2005). A Freirian framework for technology-based virtual field experiences. *Contemporary Issues in Technology and Teacher Education, 4 (4)*, 410–428. Retrieved from https://www.citejournal.org/volume-4/issue-4-04/general/a-freirian-framework-for-technology-based-virtual-field-experiences

McDevitt, M. A. (1996). A virtual view: Classroom observations at a distance. *Journal of Teacher Education, 47* (3), 191–195.

McDonald, M., Kazemi, E., & Kavanagh, S. S. (2013). Core practices and pedagogies of teacher education: A call for a common language and collective activity. *Journal of Teacher Education, 64*(5), 378-386.

McDonald, M., Kazemi, E., Kelley-Petersen, M., Mikolasy, K., Thompson, J., Valencia, S. W., & Windschitl, M. (2014). Practice makes practice: Learning to teach in teacher education. *Peabody Journal of Education, 89*(4), 500-515.

McGarvey, B., & Swallow, D. (1986). *Microteaching in teacher education and training*. London, UK: Taylor & Francis.

Meritt, J., Gibson, D., Christensen, R., & Knezek, G. (2015). Teacher training using interactive technologies: Performance and assessment in second life and simschool. In P. Isaías, J. M. Spector, D. Ifenthaler, & D. Sampson (Eds.), *E-learning systems, environments and approaches* (pp. 181-198). New York, NY: Springer.

Milewski, A., Herbst, P., Bardelli, E., & Hetrick, C. (2018). The role of virtual spaces for professional growth: Teachers' engagement in virtual professional experimentation. *Journal of Technology and Teacher Education, 26*(1), 103-126

Murphy, S., Hartigan, I., Walshe, N., Flynn, A. V., & O'Brien, S. (2011). Merging problem-based learning and simulation as an innovative pedagogy in nurse education. *Clinical Simulation in Nursing*, *7*(4), e141-e148.

Paese, P. C. (1996). Context overview and framework. In J. J. McIntre & D. M. Byrd (Eds.), *Preparing tomorrow's teachers: The field experience* (pp 1-8). Thousand Oaks, CA: Corwin.

Ross, D. D., Brownell, M. T., & Sindelar, P. T. (1999). Research from professional development schools: Can we live up to the potential? *Peabody Journal of Education, 74*(3-4), 209-223.

Santagata, R., Zannoni, C., & Stigler, J. W. (2007). The role of lesson analysis in preservice teacher education: An empirical investigation of teacher learning from a virtual video-based field experience. *Journal of Mathematics Teacher Education, 10*(2), 123–140.

Shaughnessy, M., & Boerst, T. (2018). Uncovering the skills that preservice teachers bring to teacher education: The practice of eliciting a student's thinking. *Journal of Teacher Education, 69*(1), 40–55.

Shulman, L. S. (1998). Theory, practice, and the education of professionals. *The Elementary School Journal*, *98*(5), 511-526.

Vince Garland, K.M. Holden, K., & Garland, D.P. (2016). Individualized clinical coaching in the TLE TeachLive lab: Enhancing fidelity of implementation of system of least prompts among novice teachers of students with autism. *Teacher Education and Special Education, 39*(1), 47-59.

Webel, C., & Conner, K. A. (2017). Using simulated teaching experiences to perturb preservice teachers' mathematics questioning practices. *Mathematics Teacher Educator, 6*(1), 9-26.

Wu, C. C., & Kao, H. C. (2008). Streaming videos in peer assessment to support training preservice teachers. *Educational Technology & Society, 11*(1), 45–55.

Zeichner, K. M. (2012). The turn once again toward practice-based teacher education. *Journal of Teacher Education, 63*(5), 376-382. doi: 10.1177/0022487112445789 http://jte.sagepub.com