What Teacher Educators Should Have Learned From 2020

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And I applied my heart to what I observed
and learned a lesson from what I saw.

Psalm 24:32 (NIV)

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FOREWORD

Throughout 2020, the COVID-19 pandemic made the invisible visible in education. Critical issues of equity and access were illuminated and exacerbated. The digital divide, for example, became apparent in ways that may not have happened without the abrupt, unforeseen, and unplanned shifts to "emergency remote teaching" (Hodges et al., 2020, para. 5). Students and teachers who had access to personal devices and the Internet *and* were prepared to use technology for high-quality learning were able to continue education at a distance. Everyone else struggled to keep up or dropped out of remote learning, revealing that while the digital divide has existed for decades, closing the divide had not been prioritized in schools, districts, and colleges.

What 2020 made apparent was that many teachers, students, and families were woefully ill-prepared to use technology for educational purposes (Trust & Whalen, 2020). Students and their families struggled to login to and troubleshoot their experiences with learning management systems, digital assessment tools, interactive apps, and other required technologies for learning. Educators with little or no prior experience teaching in blended, remote, or online settings discovered that their teacher-centered, brick-and-mortar practices were not enough to engage students at a distance. As educators tried to adapt their practice by using more digital tools, students and their families struggled with issues of privacy, accessibility, equity, and safety (Trust, 2020). Sonnemaker (2020) noted that the increased reliance on digital tools and apps "forced parents to choose between keeping their kids' schooling on track and protecting their civil liberties" (para. 3). Additionally, students and their families started to question the use of technologies in education that were exploitative and discriminatory, such as plagiarism detection tools which "strip mine and sell student work for profit" (Stommel, 2017, para. 2) and digital surveillance tools that disproportionately harm students of color, female students, transgender students, disabled students, and low-income students (Walker, 2020).

Late in the year, as the COVID-19 pandemic continued disrupting education and society, Project Tomorrow in partnership with Blackboard issued a series of "90 Days That Changed K-12 Teaching & Learning" reports (https://tomorrow.org/speakup/2020-90-Days-That-Changed-K-12-Teaching-Learning.html) which refer to the nearly system-wide shift to emergency remote teaching that occurred in April, May, and June 2020. Like the chapters in this book about what teacher educators should have learned from 2020, the 90 Days reports do not shortchange the damaging disruptions and inequities of the past year nor lightly predict a return to the old normal after the pandemic ends. Instead, the reports acknowledge that the traditional before-the-pandemic in-school experience was not engaging or intrinsically motivating for many students, and that re-engaging students with learning is the essential task now facing us all.

This book begins the hard work of synthesizing what the experiences of 2020 can show us about how to remake education for the future. As we look back and look ahead, it is clear that education is not going to return to anything like pre-pandemic schooling. Instead, a workable balance of in-person and digital learning must be found to motivate and educate all students - call it a 21st century combination of "high tech" and "high touch" - terms first proposed by futurist Alvin Toffler in 1970 at the dawn of the computer revolution.

While many people yearn for a "return to normal," the shift to emergency remote teaching, accompanied by a resurgence in the civil rights movement, made clear that "normal" really only worked for the privileged few. We must see 2020 as an opportunity for an educational revolution. We are thinking of 'revolution' from the Latin *revolutio*, meaning "a turn around." We, as teacher educators, must turn around how we envision teaching and learning in schools. Traditional teacher-centered schooling did not work for so many students and bringing those same approaches to online learning did not succeed either. On the other hand, students who struggled to learn in traditional settings, those who were bullied, stereotyped, or faced microaggressions due to their race, gender, beliefs, or other differences, and students who had health issues or other needs that made going to school challenging found that they could excel in online learning settings. There is great value in what we can learn, uncover, unpack, and change from education in 2020, and this book invites us to do just that.

Using ideas and insights from the researchers who wrote the following chapters, teacher educators can now begin the front-line work of reimagining and reconstructing education. Through teacher education classes and professional development opportunities, pre-service and in-service educators can gain the information and inspiration needed to push beyond the status quo to expansive change - to become active, not reactive in their practice, and to chart the course toward new instructional models that will promote education for all students.

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Introduction

There is a running joke on meme threads that future classrooms will have an entire history course solely devoted to the year 2020. The truth is that 2020 could probably fill an entire years worth of course content in many disciplines. Public health classes will look back and examine the pandemic, what was done right, and what could have been done differently. Science classes will examine the creation, spread, and evolution of the virus. Psychology and sociology classes will examine human behaviors (e.g., buying habits and decisions on mask wearing) and pandemic outcomes (e.g., the relational or mental health impact of social distancing). Teacher education, of course, has its own set of lessons to review, dissect, and learn from. At its core, that is what this book is all about. It was created to begin (or, perhaps, continue) a conversation about those lessons.

To further explain the purpose of this book and its goals, it is necessary to go back in time. The Covid-19 pandemic saw researchers in many fields rush to try to deliver global solutions, strategies, and safeguards. For instance, multiple partners came together across varied health systems to develop pandemic response plans (Schaye et al., 2020). There was also a tremendous amount of research conducted to support the creation of *personal protective equipment* (PPE) by medical and public health researchers (e.g., Woolverton et al., 2020).

Intrigued by this rapid release of information to the field, researchers in teacher education attempted to follow suit. There were special issues of journals (Hartshorne et al., 2020) and open access eBooks (Ferdig et al., 2020a) released to meet teachers and teacher educators in their time of need. Teacher education conferences that could not meet face-to-face moved online and shifted their focus to helping others during the pandemic (e.g., *SITE 2020, SITE Interactive 2020,* etc.).

Then something both inevitable and problematic happened. Teachers and teacher educators began talking about and longing for the time when things were going to 'get back to normal.' Who could blame them? Ignoring for a second the severity and fatality of the pandemic, people were sick of teaching in a medium in which most had never taught or learned. Educators were tired of being afraid to educate in person or to try to teach behind a mask to a sea of masks or screens. Again, the desire for normalcy was inevitable.

But this desire for normalcy was also problematic. While the COVID-19 pandemic brought a lot of bad things, it also brought a lot of good things. The pandemic, for instance, gave the world a breather—literally. There were significant decreases in CO2 emissions. Water became cleaner, like the stories of being able to see the bottom of the canals in Venice. As a result, fish and marine wildlife returned and became more abundant. People spent more time with family and enjoyed more of the outdoors.

There were also at least two positive outcomes for education. First, teachers from PreK to post-secondary began exploring and experimenting with new ways to teach and learn using innovative technologies. In doing so, they expanded their pedagogical strategies, tools, and skillsets. Second, educational problems were exposed in greater detail. A lot of people may want to blame these problems on the pandemic. However, it would be more accurate to say that most of these problems already existed—the pandemic was just a giant highlighter. We knew, for instance, about equity, inequality, and inaccessibility. It was not until educators attempted to reach all students electronically that they finally saw the gravity of students without computers, internet access, or—more importantly—food to eat while not in school. The pandemic was a highlighter and a magnifying glass, showing us where we needed to grow.

So, why are all these positive outcomes problematic? We are afraid that people are in such a rush to get over the pandemic, they are going to miss some important lessons. Teachers and teacher educators may be so desperate to return to normal that they will miss the chance to grow, and, in doing so, lose the opportunity to return to a **better normal**. Worse, the needs that were exposed might get swept back under the rug.

There will be articles, journals, and books written in the future looking back on this time. Those will bring important perspectives once people have the opportunity to digest all that has occurred. However, we believe that it is critical that we continue to acknowledge and write about these issues *in the present*, so that we do not lose the sweetness of some of the wins or the bitterness of some of the losses.

This book originated from a keynote given at the inaugural *Society for Information Technology & Teacher Education Interactive* (SITE Interactive) conference in October 2020 (Ferdig, 2020). Attendees were introduced to the topic and then given examples of lessons teacher educators should have learned. The following lessons were presented (Ferdig, 2020):

1. Teacher educators need to do a much better job of getting ideas out faster.

2. Teacher educators must prepare current and future teachers for online experiences.

3. Teacher educators need to lead the charge for the re-valuing of teachers.

4. Teacher educators need to find ways to defeat divisiveness.

5. Teacher educators need to be the social and emotional connection behind the screen.

6. Teacher educators must respond to equity and accessibility issues.

7. Teacher educators must return to instructional design roots.

8. Teacher educators must find different ways to reach students.

The conference was meant to be interactive; the presentation included two such opportunities. First, using *Padlet*, attendees were given time to share their own lessons learned. Second, an announcement was made about this book. The call was eventually sent to all SITE members (see Appendix A); however, participants had a sneak-peak and an early start on the opportunity to contribute. Papers were then due January 15, 2021 with an intended publication in March 2021.

The General Outline of Chapters

The rapid publishing cycle was something that we were familiar with (see Ferdig et al., 2020). One of our main lessons from our experiences in rapid publishing (Ferdig et al., 2021) was that there is tremendous value in using a template. Some authors initially find templates constricting. However, templates serve several purposes. For instance, they significantly increase production time. They also help focus a book or special issue. Finally, they improve readability for authors interested in the book's topic or overarching theme.

A template for this book was critical because of some of the misconceptions potential authors had when we shared this call. A lot of people around the world learned a lot of lessons from 2020. They heard our call as the opportunity to share their individual lessons from a single research study they completed during the pandemic. As a matter of fact, many of the 83 chapters we reviewed for this book contained such studies. There is such value in that work; we thank the authors for their submission, and we look forward to seeing all those important research studies as journal articles.

However, this book had a different purpose. Rather than focusing on individual studies, we wanted authors to capture the big picture and the overarching lessons that teacher educators should have learned. A great example comes from many of the chapters in this book that focus on social and emotional learning (SEL). An individual research study might show us the way that an author (or set of authors) tried to impact SEL in their individual context. We wanted our chapters to present a broader lesson about SEL in general, and the resulting implications for why and how teacher educators (preservice or inservice) needed to change their practices. To support this discussion, we asked authors to follow this template:

- **Front Material**

  o Chapter Title, Author(s), Affiliation(s), Email Address(es)

  o Abstract – Include an abstract of 150-250 words that provide an overview of the content covered in the chapter.

  o Lesson Learned – Include a one-sentence statement that summarizes the lesson learned. The statement must take the format of "Teacher educators should have learned…"

- **Introduction.** Use this section to broadly introduce the topic and explain the rationale. Be sure to discuss why this was important in light of what was happening to teacher education in 2020.

- **What We Know.** Use this section to ground the work. Think of this as a typical literature review. Explain what we know about the topic, particularly citing theoretical frameworks, existing literature, or even your own work that tells us what the field knows. You can go outside of TE as you need to, but always bring it back to inservice or preservice TE.

- **Lessons Learned for Research.** This section should tell the reader where the field needs to go next based on what we have learned and what might happen if teacher educators took your advice on the lesson learned that you are proposing in the main statement. Think of this as the needed future research section of a traditional paper.

- **Lessons Learned for Practice.** Use this section to give concrete and research-based, practical suggestions and implications for how a teacher educator would actually follow your lesson advice.

- **What You Should Read.** Pick 3-5 readings that you would recommend for people who want to know more about this topic.

- **References**

The Sections of the Book

It is somewhat unfair to categorize the chapters in this book. The authors wrote about topics that cut across sections, topics, needs, and even lessons learned. However, to help organize the book for the readers, we took the main themes of the chapters and divided them into three categories. Readers will quickly notice that there are multiple chapters under each section. Theoretically, we could have simply asked—or chosen—one chapter for each topic. We decided, however, that there was great value in Wittgenstein's notion of the *crisscrossed landscape* (1953/2010). There is merit in seeing one topic from multiple perspectives to understand its true complexity.

1. <u>Social and Emotional Learning for Teacher Education</u>. Social and emotional learning (SEL) can "broadly be understood as the process through which children and adults acquire and effectively apply the knowledge, attitudes, and skills necessary to manage their emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions" (Mahoney, Durlak, & Weissberg, 2018/2019, p. 18). While this all-encompassing definition captures many aspects of SEL, the chapters in this book examine the ways in which preservice and in-service teachers are learning about the broad constructs, as well as the specific instructional practices they can implement with, through, and because of technology. The chapters in these sections hone in on particular aspects of SEL, particularly as teachers were called upon to help students deal with the stress of the pandemic, remote online learning, and the potential increase in isolation.

2. <u>Online Teaching and Learning for Teacher Education</u>. While many universities and professional organizations saw future potential in increasing online learning opportunities for preservice and in-service teachers, the pandemic expedited the move to online teacher education and professional development. The call to prepare teachers to thrive in digital environments existed before the pandemic, but the events of 2020 focused the field's attention on the need for teachers to learn to teach online. The implications for research and practice highlight the fact that teachers do not solely need experience learning to implement digital tools, but rather need experiences that demonstrate the possibilities of teaching their content and grade bands in online spaces. Teacher educators need to shift their attention to teach preservice and in-service teachers how the pedagogical tools that they implement in face-to-face classrooms can be transferred to online settings.

3. <u>eXtended Reality (XR) for Teacher Education</u>. Teacher educators were reconceptualizing the experiences that preservice and in-service teachers needed in order to continue to have opportunities to work with and learn from students. From 360 video, to digital field trips, to virtual field experiences, teacher educators

were called to reimagine how to provide preservice teachers opportunities to interact virtually with students and to gain access for observation of teaching and learning. The chapters in this section not only respond to using XR in lieu of face-to-face experiences, they also address how to capitalize on XR in combination with face-to-face field experiences (e.g., a new and better normal).

Conclusion and Getting Involved

In his seminal work, *The Reflective Practitioner*, Schon (1983) reminds us reflection is a "certain kind of work" that must be initiated when there is a problem to be solved (p. 40). The events of 2020 certainly called teacher educators' attention to many problems that required creative and innovative solutions. As we continue to engage in deep understanding and reflective inquiry into the problems we encountered, we must continue to investigate how we can use the information we have gleaned from this year to make decisions about future instruction and research. While *Social Emotional Learning, Online Learning,* and *Extended Reality* were highlighted in this book, we wonder what important lessons are missing that require our attention. For instance, many of the original items we proposed in our call were not addressed by potential authors. We see this less as a gap and more of an opportunity. Finally, as teacher educators, we must remember to continue to engage as reflective practitioners in order to self-assess and move our field forward. In sum, we should continue to be reflective in bad and good times. We hope this book—or, more importantly, the opportunity hold an open dialogue about important lessons—is something we return to often.

Respectfully,

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CALL FOR BOOK CHAPTERS

WHAT TEACHER EDUCATORS SHOULD HAVE LEARNED FROM 2020

Full Chapters Due: January 15, 2021

Call for a fast-tracked, open access, book published by AACE on lessons learned and best practices from 2020. The chapters will focus on research and practical outcomes from 2020 that have implications for improving teacher education with or through technology.

- **Submission for practice and research brief due:** January 15, 2021
- **Chapter length:** 3000-5000 words maximum
- **Publication date**: March 2021
- **Proposed topics include (but are not limited to):**
    - Rapid publishing of ideas in tech and teacher education
    - Preparing current and future teachers for online experiences
    - Re-valuing teachers and the public perception of teachers and teacher education
    - Using technology to defeat divisiveness
    - Teaching teachers to be the social and emotional connection behind the technology
    - Teacher education responding to equity and accessibility issues
    - The role of instructional design in 2021 and beyond
    - Using innovative technologies for culturally responsive teaching (e.g., AR and VR)
    - Appreciating the role of synchronous, asynchronous, and self-paced learning
    - Teaching flexibility and resiliency
    - Examining technology and schools through social, cultural, and political contexts
    - Examining technology access and the influence of power and privilege
    - Teaching teachers to engage parents
    - Preparing students for technology-enhanced instruction

OVERVIEW

SITE Interactive 2020 was an inaugural online-only conference of the Society for Information Technology and Teacher Education (SITE). One of the keynotes was a presentation by Dr. Rick Ferdig about what teacher educators should have learned from 2020. Because the conference was interactive, attendees were asked to submit their own lessons learned. Moreover, they were invited to submit chapters to a book published in early spring, 2021. This CFP explains that opportunity to the broader SITE audience.

CALL FOR CHAPTERS

The year 2020 significantly impacted all facets of our lives, including education. Most will point to the COVID-19 pandemic and for good reason. The COVID-19 pandemic obviously pushed Prek-12 and postsecondary education online. It also changed how we publish and share ideas. However, it has also been a year of growing division, at least in the United States. Divisiveness has occurred politically, racially, and even in public health discussions about whether to open or close schools. There are several lessons that could have been learned—or should be learned—from a year of such experiences.

All of these lessons require action on the part of teacher educators and colleges of education. These lessons stem not from the bad news that emerged, but rather from the shining examples of teachers and teacher educators using technology to transform teaching and learning. This book will feature lessons learned, including but not limited to augmented and virtual reality for preservice teacher education, the need for continuous and situated professional development, rapid publishing for just-in-time response, and returning to our instructional design roots.

SUBMISSION GUIDELINES

The sole intent of these chapters is to inform research and practice in teacher education from specific challenges, events, or solutions that occurred in 2020.

- Chapters must address the intersection between technology and teacher education.
- The chapters should act as research summaries with direct implications; they must be between 3000-5000 words (not including abstract, tables, or references).
- Chapters are not intended to be reports of single research studies (e.g., an article); however, authors can use single research studies to contextualize the broader topic.
- Proposals are not required, but potential authors are encouraged to contact the editors for advice on their ideas.
- The chapter format should be:
  - Abstract
  - Introduction to the topic (introduction and relevance to 2020)
  - Literature Review (what do we know or what did we learn about the topic)
  - Specific implications for teacher education practice (including a conversation about how this changes current practice)
  - Specific implications for teacher education research
  - References
- The chapters should not attempt to sell software, commercial products, or specific university courses. It should include strategies or open-access products that can be widely disseminated and used by others.

Submissions Due: January 15, 2021
Submit to: http://publish.aace.org (select Book on "2020 Lessons Learned")
Inquiries should be sent to Rick Ferdig rferdig@gmail.com or **Kristine Pytash** (kpytash@kent.edu)

ACKNOWLEDGEMENTS

Social and Emotional Learning for Teacher Education

School Belonging Matters Now More Than Ever:
Preparing Teachers to Foster A Technology-Mediated Culture of Care

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Abstract: The coronavirus pandemic of 2020 exacerbated existing disparities in education, including differences in school belonging and access to caring school relationships. The abrupt transition to remote learning introduced a new challenge to fostering a culture of care and impacted how teachers support the whole child in K-12 schools. This chapter considers what recent research and practice reveal about how teacher educators can help teachers foster technology-mediated care practices and increase student connectedness. Specifically, it highlights the following approaches: a) establishing a warm tone and student-teacher rapport virtually, b) prioritizing students' social and emotional needs, c) extending care practices beyond the classroom by engaging parents as partners, and d) building a sense of belonging for culturally, racially, and ethnically diverse students. Lessons from the literature suggest the vital role of caring in education and teacher educators' need to prepare teachers in culturally-relevant, technology-mediated care practices. The chapter concludes with implications for future research as well as teacher preparation and development.

Lesson Learned: Teacher educators should have learned that teachers need initial preparation and ongoing development in culturally-relevant, technology-mediated care practices to combat students' declining sense of school belonging, especially as more students learn remotely and online.

AN INTRODUCTION TO SCHOOL BELONGING AND TECHNOLOGY-MEDIATED CARE IN K-12 EDUCATION

Online students weren't even mentioned ever because it wasn't ever a thing until March. So I think going forward for teacher prep programs is to figure out ways that you can build those relationships with students. What works? How can you include them in activities? How can you include them in...morning meetings or responding back and forth having conversations? I think some districts use Seesaw, and I guess you can do videos back and forth. [I would like to know] how to use those types of tools that you can implement to help build that classroom community and the relationships between the [online] students and yourself.

First-year teacher, Fall 2020

The pandemic of 2020 intensified existing disparities in education, including differences in school belonging and access to caring school relationships. When students enjoy nurturing relationships with school adults, feel connected to others within a school community, and experience a sense of belonging, their developing brains are better primed to learn (Riley & Terada, 2019). They are more engaged in the work, attendance increases, behavior improves, and they experience increased academic and personal success (Blum, 2005; Cohen et al., 2009; Kotok et al., 2016). While scholars have long argued that a culture of care is instrumental to students' success, it is often not a school-wide priority (Noddings, 2005; Tichnor-Wagner & Allen, 2016). Evidence suggests that as schools have shifted their focus from the whole student to measurable academic achievement, they have neglected to foster caring relationships (Lewis & Pearce, 2020). Concurrently, students' sense of school belonging has decreased, particularly among socio-economically disadvantaged students (OECD, 2019).

Within the context of this general trend, the coronavirus pandemic of 2020 introduced a new threat to establishing and maintaining caring school relationships--the medium of remote learning and the abrupt transition to technology-mediated interaction. Amid the pandemic, students disengaged at alarming rates and in ways that reflect the broader school belonging patterns. Absenteeism increased in the spring and fall of 2020 as many schools shifted to remote learning (Bauer et al., 2020); in Texas alone, more than 600,000 public school students failed to complete assignments or respond to teacher outreach (Swaby, 2020; TEA, 2020). Latino, African-American, and low-income students experienced lower engagement rates than their White, Asian, and higher-income peers (Dorn et al., 2020; TEA, 2020).

The reasons for this disengagement are complex and include issues of technology access, work demands for older teens, illness, and family responsibilities (Basu, 2020; Bauer et al., 2020). Although factors beyond schools' influence certainly contributed to students' disengagement, interview and focus group data from our own year-long investigation of teacher preparation during the pandemic also suggests that novice teachers struggled to foster virtual relationships. As one first-year teacher expressed in the opening quote, attending to virtual learners' needs, and learning how to establish caring relationships with them, was simply not part of her preparation. Another first-year teacher described her challenges connecting with disengaged virtual students:

> I have some students that are online that are really good at engaging, they're turning their stuff in every day, but there are some students that I've done everything I can. I've called their parents. I've reached out to them through ParentSquare. I've even talked to the principal. He's made some home visits and it's just very difficult to get some of those students engaged.

During the pandemic, novice and experienced teachers alike struggled to foster relationships and a broader culture of care. As one teacher reported in Borup, Jensen, et al. (2020), "For every success story I have in encouraging the students to engage, there is an instance where I am not successful" (p. 162). Experienced teachers found that the sudden transition to remote learning provided an opportunity to refocus on relationships with students and parents, which had withered over time as curricular and time demands intensified (Miller, 2021). When the pandemic disrupted students' support systems, at home and school, teachers and teacher educators were reminded that students' basic relational needs must be met for quality learning to occur (Darling-Hammond et al., 2020; Dorn et al., 2020; Miller, 2021).

The increase in remote learning has shed light on challenges to cultivating care in traditional and virtual environments, including a lack of teacher preparation and ongoing support in this area. However, given students' increased social isolation, anxiety, and general well-being needs (Kontoangelos, Economou & Papageirgiou, 2020), it is more important

than ever to address their fundamental needs to feel cared for and connected (Glasser, 1998; Maslow, 1962). As students experience trauma and tragedy associated with the pandemic, caring school relationships can help them manage adversity and develop resilience (Darling-Hammond et al., 2020; National Scientific Council on the Developing Child, 2015). Lessons from 2020 include the need for teacher educators to prioritize preparing teachers with the know-how and tools to foster relationships and build a culture of care in traditional and online classrooms. This chapter considers what teacher educators can learn from recent research and practice about how teachers can cultivate caring practices and increase student connectedness through technology. We conclude with implications for future research and teacher education practices.

WHAT WE KNOW

The primary expression of authentic care in schools is the development of interpersonal relationships (Valenzuela, 1999). When teachers emphasize nurturing relationships from the outset, they demonstrate that they care about their students' needs as people, build trust, and form a strong foundation for instruction and academic mastery (Noddings, 2005). In traditional face-to-face classrooms, teachers express authentic care by listening attentively, identifying students' academic and non-academic needs, and responding in such a way that students feel heard and cared for (Baker et al., 1997; Noddings, 2013). They foster warm interpersonal connections with and between students by using humor (Osterman, 2010), setting high expectations and holding students accountable fairly and consistently (Allen, 2018), communicating with students positively and respectfully (Ginot, 1972; Marshall, 2012), and encouraging peer interactions (Keyes, 2019; Osterman, 2010). They treat students familially and build trust in order to maximize students' potential and help them flourish (Held, 2006; Pang et al., 2000).

Technology-Mediated Caring in K-12 Education

Despite an exponential increase in K-12 distance and online learning (Barbour, 2019), preservice teachers receive minimal, if any, preparation for online settings (Archambault et al., 2016; Kennedy & Archambault, 2012). As our own experience with novice teachers suggests, first-year teachers are currently teaching in online environments with little or no preparation or prior knowledge about how to foster caring relationships with their virtual students. Considering that online students are even more likely to experience social isolation and a lack of belonging (Palloff & Pratt, 2007), this gap in teacher preparation is potentially catastrophic. Therefore, teacher educators must be familiar with the research on technology-mediated caring practices so that they can appropriately prepare pre and in-service teachers to engage students in multiple learning environments. This section examines the emerging research from K-12 schools on how online teachers practice authentic care by establishing teacher-student rapport, supporting students' social and emotional needs, and folding parents and families into a broader culture of care.

Establishing a Warm Tone and Teacher-Student Rapport

As in face-to-face classrooms, online teachers are the primary facilitators of the learning climate and their demeanors significantly impact the tone of their classrooms (Garret Dikkers et al., 2013; Kaufmann et al., 2016). When interactions with and between students are mediated by technology, teachers can intentionally set a warm tone by smiling, making eye-contact with the camera, communicating calmly and positively, and keeping students' focus on human faces rather than slides or videos, which are less engaging (O'Shaughnessy, 2020; Pearson, 2021). In higher education, early opportunities for social interaction, such as ice-breakers and introductions, can help foster belonging at the beginning of an online course (Martin & Bollinger, 2018; Mehall, 2020). In K-12 schools, O'Shaughnessy (2020) argues for increasing the frequency of such efforts and urges teachers to incorporate social connection activities into every synchronous class session through, for example, starting class with positive messaging, singing, deep breathing, or allowing students to share something personal. By taking the time to connect in an ongoing manner, teachers can provide reassurance and express empathy. This placement of relationship-building efforts before instructional content is consistent with Noddings' (2005) ethics of care in schools.

Positive teacher-student rapport, or communication, is linked to various benefits, including increased student connectedness, learning, motivation, and participation (Frisby & Martin, 2010; Ratliff, 2018/2019; Webb & Barrett, 2014). Positive teacher-student rapport in a virtual environment requires teachers' knowledge of students' preferences in terms of both communication frequency and methods. Teachers who demonstrate caring online a) communicate frequently and are readily available (Borup, Graham, & Velasquez, 2013; Borup et al., 2014; Velasquez, Graham, & Osguthorpe, 2013), and b) use student preferred forms of communication such as text messaging (Borup, Walters, et al., 2020; Velasquez, Graham, & West, 2013). During the pandemic, some school districts implemented at least one live teacher-student check-in per week. Check-ins were conducted with the whole class or in small groups and did not necessarily include academic instruction (Chambers et al., 2020). For young students, social interaction increases when live sessions are small (fewer than ten students) and short (15-20 minutes) (Szente, 2020). Beyond live class sessions, evidence suggests that teacher knowledge of, or familiarity with, students' technology-mediated communication preferences may not be widespread. For example, despite students' preference for chat technologies (Velasquez, Graham, & West, 2013), email was the most common form of communication at a virtual school; however, teachers expressed doubt about its usefulness (Ashe & Lopez, 2020).

Prioritizing Students' Social and Emotional Needs

At the core of a caring approach to teaching and learning is teachers' identification, understanding, and responsiveness to students' needs and interests (Noddings, 2005, 2013). During the pandemic, some districts reported prioritizing students' well-being and social/emotional needs over the completion of academic assignments (Chambers et al., 2020). Recent research suggests several ways teachers can use technology to address students' non-academic needs. While asynchronous learning offers students flexibility in terms of behavioral engagement, and potentially improves equitable access to academic content (Chambers et al., 2020; Lowenthal et al., 2020), synchronous instruction can provide unique opportunities for educators to identify and address students' non-academic needs (Chambers et al., 2020; Miller, 2021). Virtual K-12 students are more likely to form friendships with classmates when teachers use regular synchronous meetings to foster social interactions (Borup, Walters, et al., 2020). For example, during remote learning, teachers in two case study schools used weekly Zoom scavenger hunts to promote peer interactions and help mitigate isolation (Borup, Jensen, et al., 2020).

Teachers can encourage peer interaction and nonverbal emotional expression during synchronous class meetings through the use of technology tools like Zoom's meeting reactions, emoticons (York, Yang, & Dark 2007), chat features such as thumbs-up or down, and stopping lessons to quickly check-in with students (O'Shaughnessy, 2020). Journal assignments help teachers learn more about students' personal lives as well as their strengths and needs (Darling-Hammond et al., 2020); interactive online journals can increase students' sense of community and belonging (Hodkinson, 2007). Further, educators can provide both synchronous and asynchronous opportunities for students to reflect on their sense of connectedness and provide suggestions for improving community bonds (O'Shaughnessy, 2020).

Caring Beyond the Classroom

A caring approach to schooling values maximizing students' potential, which requires a collaborative approach between school administration, teachers, students, and parents (Pang et al., 2000). Parental engagement in children's schooling plays a critical role in supporting their sense of belonging and success (Allen et al., 2018; Borup et al., 2014; Wang & Eccles, 2012) and parents' role might be even more critical for K-12 online learners (Borup, Graham, et al., 2020; Curtis & Worth, 2015). Yet, parental engagement efforts are often overlooked and undervalued (Winthrop, 2020). During the pandemic, however, parents were required to play more active roles in their children's schooling. Many teachers found themselves partnering with parents in new ways to foster student well-being and success (Vegas & Winthrop, 2020).

Teachers can extend their care practices to parents by regularly calling home (Curtis Werth, 2015), sharing positive messages with parents about their children (Borup et al., 2014), and providing both academic and social support (Allen et al., 2018). During the pandemic, teachers increased personal contact with students and their families via numerous communication tools, including email, phone calls, text messages, and video conferencing (Borup, Jensen, et al., 2020). In

order to strengthen home-school partnerships, some teachers routinely reached out to parents on a weekly or bi-weekly basis (Borup, Jensen, et al., 2020; Chambers et al., 2020). If students missed weekly live check-ins, teachers followed up with emails or phone calls home (Chambers et al., 2020). As parents struggled to support their children's learning at home, expressing challenges with the content knowledge and time required to assist their children with school work (Garbe et al., 2020; Turner et al., 2020), caring teachers expressed patience and understanding (Szente, 2020).

The pandemic caused many teachers to revalue parents as partners and to look for technology-assisted ways to establish and maintain relationships with parents and families. Messaging apps, such as Remind, Class Dojo, and Bloomz can promote the frequent and reciprocal teacher-parent communication preferred by parents (Olmstead, 2013; Thompson et al., 2015), while Say Hi and Talking Points provide immediate translation to help overcome teacher-parent language barriers (PTHV, 2020). Amid the pandemic, some states, such as Oregon, recommended that school districts embrace virtual parent-teacher home visits, using video technology, such as Zoom, FaceTime, Google Hangouts, or Skype, to foster these vital relationships (Darling-Hammond et al., 2020; Oregon Department of Education & Oregon Health Authority, 2020; PTHV, 2020). Video home visits can demonstrate that teachers care, help teachers better understand their students' needs and backgrounds, establish a personal rapport with parents, and be more time-efficient for teachers relative to in-person home visits (Darling-Hammond et al., 2020; Stand for Children Leadership Center, 2020).

While some of these specific technology tools may be unfamiliar to teachers, the majority of K-12 teachers regularly use technology tools in the classroom (Gallup & New Schools Venture Fund, 2019). Recent research indicates that teachers can purposefully leverage established mediums of communication (e.g., email, phone calls, texting, and videoconferencing) to form and build partnerships with students and their families. For instance, when teachers in a second-grade classroom combined familiar technology (Class Dojo and Zoom) with daily content based on lower levels of Maslow's hierarchy, they were able to create a sense of normalcy and build community with students and their families (Dendy Mahaffey & Kinard, 2020). By using tools that had been previously introduced, teachers, parents, and students may avert the potential frustration that comes with using new technology (Guhlin, 2020).

The Cultural Dimension of Care

Caring relationships in schools benefit all students but may be especially important to building a sense of belonging for culturally, racially, and ethnically diverse students (Bingham & Okagaki, 2012; Green et al., 2008). Culturally relevant care practices acknowledge diverse students' cultural backgrounds, knowledge, interests, and needs (Antrop-Gonzalez & De Jesus, 2006; Gay, 2018). As the pandemic unequally impacted people of color and low-income families, scholars argued that educators, now more than ever, must be aware of, and sensitive to, the lived experiences of students and families and to reach out in culturally responsive ways (Lopez et al., 2020). African-American students, for instance, may perceive educators as caring when they foster relationships with their parents and families (Wandix-White, 2020) and warmly insist on high academic expectations (Ware, 2006). In contrast to White students, who perceived caring based on actions that reflect educators' kind dispositions, such as expressions of humor, Garza (2009) finds that Latino students were more likely to perceive caring teachers as those who scaffolded instruction and provided academic support. Katzman & Stanton (2020) argue that attention to cultural differences and culturally relevant practices is vital to students' success online.

How care is expressed and perceived is cultural; access to caring relationships with school adults is uneven. Students who often can benefit from such relationships attend schools where systematic care practices are not prioritized. For example, low-performing urban schools, which disproportionately serve low-income students, are less likely than high-performing urban schools to exhibit a school-wide culture of care (Tichnor-Wagner & Allen, 2016). Amid the pandemic, access issues were exacerbated by a deep digital divide. Historically, rural, low-income, and Black and Latino students have experienced more challenges with technology access than their urban, affluent, and White peers (Cleary, Pierce, & Trauth, 2005; NTIA, 2014); this disparity grew during the remote learning of 2020 (Lake & Makori, 2020). Without appropriate technology access, students missed opportunities for relationship-building and engagement.

Summary of What We Learned

K-12 student disengagement during the remote learning of 2020 amplified the existing downward trend in school belonging. Issues of technology access meant that the students who were more likely to be excluded from online learning

environments, African-American, Latino, and low-income students, were those who were already at risk of experiencing decreased school connectedness. To address these concerns, teachers explored new ways to deliver instruction and demonstrate caring, including exercising flexibility, reinforcing or developing new relationships, re-evaluating engagement, and intentionally checking on their students' welfare before, during, and after virtual class meetings.

The pandemic has shed light on students' need for connection and provided teachers, teacher educators, and policymakers with an opportunity to reconsider a more relational approach to schooling, one that bolsters interpersonal support systems and emphasizes care (Darling-Hammond et al., 2020; Hughes & Jones, 2020). Further, it has served as a challenge for teacher educators to help, "make today's education as humane, generous, caring, and yes, even as joyful as we possibly can" (Hughes & Jones, 2020). Novice and experienced teachers must be explicitly prepared to build connections with students and their families in multiple mediums, including online. Emerging research and practice during 2020 on technology-mediated care practices point to several implications for future research as well as teacher preparation and development.

LESSONS LEARNED FOR RESEARCH

Caring as a central component of online learning is a nascent area of study and has received more attention in higher education than K-12 (Robinson et al., 2017). While the widespread shift to remote learning during 2020 prompted new research on technology-mediated care practices, this remains an undeveloped area of study. Future research could consider how the concept of "online caring presence," developed by Mastel-Smith et al. (2015) in the context of nursing education, applies to the work of teacher educators. An examination of the ways in which teacher educators can effectively model care practices to preservice teachers in general, and through technology-enhanced methods specifically, would significantly contribute to the scant research on teacher educators as caring role models (Carr, 2016). Such research might explore how teacher educators perceive their role as carers and the ways in which they demonstrate care practices, face-to-face and online, in support of teacher candidates. Conversely, research on teacher candidates' perceptions and experiences of teacher educators' care efforts could help to inform teacher educators' practices and align their actions with candidates' needs.

An extension of this research agenda might consider K-12 teachers' perceptions of "online caring presence" as well as K-12 students' understanding and experiences of care in an online environment. Recent research provides limited insight into how students and parents perceive educators' efforts to foster relationships, particularly amid the pandemic. These perspectives can help educators determine whether their caring practices have the intended effect of fostering connectedness and belonging, especially for those students who have struggled with access to online platforms. Post-pandemic research could also examine technology-mediated care practices within a more normalized schooling context, rather than as a crisis-response, and whether new and lasting care practices in schools have emerged from our response to teaching and learning during the pandemic.

In addition, it is important to understand what role parents would like to have in their children's schooling post-pandemic (Vegas & Winthrop, 2020). Parents' preferences regarding their role, teacher-parent communication, and what a partnership might look like from their perspective can help teacher educators ensure they are preparing preservice teachers to meet parents' needs and engage appropriately. Scholars also suggest that extending outreach to communities more broadly may facilitate equity in virtual learning environments (Darling-Hammond et al., 2020). Further research could explore the effect of the pandemic on culturally-relevant teaching and teacher education practices, the role of teacher educators in promoting community partnerships, and how teacher educators can help pre and in-service teachers develop culturally-relevant curriculum suitable for synchronous and asynchronous virtual learning.

Teachers and teacher educators had to quickly adapt their practices during 2020, including finding new ways to practice and demonstrate care. Beyond care practices alone, the pandemic revealed the need for teachers to be able to take adaptive action or a problem-solving approach to change and uncertainty (Eoyang & Holladay, 2013). What problem-solving processes were evident as educators responded to the conditions imposed by the pandemic? Future research could also examine how, and to what extent, teacher educators are preparing teacher candidates to develop the adaptive capacity to sustain a culture of care and the role of technology in those efforts. Lastly, research might explore what factors determine whether teachers, once they are familiar with methods to facilitate technology-mediated care practices, will use the available technology, such as translation apps and virtual home visits.

LESSONS LEARNED FOR PRACTICE

Teacher educators have a critical role to play in explicitly preparing preservice teachers to enter the shifting educational landscape and embody a culture of care by modeling technology-mediated care practices to pre and in-service teachers, teaching strategies for fostering partnerships with parents, incorporating guided practice into coursework, developing their knowledge of culturally-relevant care practices, and leveraging teacher candidates' enthusiasm for student-centered approaches to teaching and learning.

Teacher Educators as Models of Technology-Mediated Caring Practices

In part, teachers learn their craft through "the apprenticeship of observation" or by observing, as students, the dispositions and practices of their own teachers (Lortie, 2002). Yet, teacher preparation programs are predominately face-to-face and offer preservice teachers limited to no opportunity to prepare for an online setting (Archambault et al., 2016; Kennedy & Archambault, 2012). To overcome this gap, teacher preparation programs can incorporate online coursework that serves as a model of practice (Rice & Deschaine, 2020). Lowenthal et al. (2020) describe using asynchronous communication tools, such as Edconnect, Flipgrid, VoiceThread, and Marco Polo, with teacher candidates during the pandemic to both provide and model wellness check-ins and demonstrate care for their students' well-being and social needs. Similarly, Johnson & Merrick (2020) explain how faculty offered music education candidates 30-minute "Zoom cafés" focused on wellness. During these virtual meetings, faculty invited the teacher candidates to contribute by asking them questions, such as, "What are you grateful for today?, What challenges have you experienced this week? What strategies have you found useful in managing your well-being?" (Johnson & Merrick, 2020, p. 261). By asking questions like these, teacher educators can model empathetic listening (Baran & AlZoubi, 2020) and how to create dedicated time and space to focus on student well-being.

Amid the pandemic, Santos Rogers (2020) noted positive outcomes when implementing morning meetings with teacher candidates and suggests that such interactions can provide a secure environment and sense of stability. Specifically, she explains how various forms of technology (e.g., Flipgrid, Nearpod, Remind) can be incorporated into meetings and offers concrete examples. For instance, face-to-face greetings can be adapted to an online synchronous environment by creating a virtual stadium "wave", where one person greets the next person in the chat, that person greets another, and so on. For asynchronous environments, teachers can use a texting platform to achieve a comparable result. Teacher educators can also model technology-mediated care practices by communicating with their preservice teachers via text or chat messaging rather than email, offering flexible and virtual office hours, and authentically praising teacher candidates through technology tools such as Remind and Class Dojo, simultaneously setting a warm tone for their candidates while demonstrating the use of commonly used platforms in many K-12 schools (Carr, 2016).

Explicit Preparation for Parent Relationship-Building

Despite clear evidence of the role parental involvement has in promoting school belonging, teachers feel unprepared to communicate with students' families, particularly when there are linguistic or cultural differences (Sewell, 2012). There are a number of ways that teacher educators can explicitly prepare teachers to positively and directly communicate with parents and engage them as partners. First, teacher preparation programs can provide opportunities for preservice teachers to learn about parents' perspectives, hopes, needs, and the challenges they have encountered navigating home-school communication and relationships. Teacher education faculty could host a moderated, diverse panel of parents, encourage parents to share their experiences interacting with their children's schools and teachers, and facilitate a dialogue between preservice teachers and parents about potential ways in which school/teacher-parent partnerships could be strengthened. Moreover, preservice teachers could participate in mock virtual home visits with parents, which would allow them to practice effective and warm communication strategies and gain comfortability with video technology. Communication rubrics, such as a modified version of the Family-Care rubric developed for nursing (Van Gelderen et al., 2019), in addition to peer and instructor feedback could be used to help preservice teachers identify strengths and improve weaknesses in this area as well as gain confidence in their ability to foster positive relationships with students' families.

Initial and Ongoing Development of Teachers' Culturally Relevant Care Practices

A culture of care in schools requires knowledge of students, their families, and their community. By increasing parents' direct role in schooling, the pandemic provided teachers and teacher educators an opportunity to reconsider parent partnerships and how best to, "leverage home and community settings as reservoirs of knowledge" (Richmond et al., 2020, p. 503). One way to prepare preservice teachers to develop an asset mindset, particularly regarding culturally and socio-economically diverse learners, is to increase collaboration between teacher preparation programs and communities (Blasi, 2002), such as the innovative community mentor model described by Zygmunt et al. (2018). In this model, preservice teachers spend a semester developing a close relationship with a caring community mentor and participating in critical service learning. Through the mentorship, preservice teachers learn about the historically Black neighborhood where they complete their student teaching. Community mentors take preservice teachers to community events, walk around their neighborhood together, introduce them to people in the community, and invite them to church. The mentor relationship and community exposure help preservice teachers consider their own cultural norms and background while developing an understanding of their students' lives outside of school (Zygmunt el at., 2018).

The pandemic points to a need for expanding these types of community collaborations. Teacher educators can develop virtual community mentorship programs that, perhaps not as robust as the program described by Zygmunt et al. (2018), could still help preservice teachers broaden their perspectives and learn about the lives of the people in the community. This would be particularly advantageous when there is a cultural mismatch between preservice teachers and their students, which can lead to distrust and serve as a barrier to caring teacher-student relationships (Davis, 2003). Further, teacher preparation programs and district professional development planners could partner with community health workers to help educators develop a better understanding of the immediate and evolving needs in their community, as well as culturally responsive strategies for fostering communication and relationships with community members, students, and their families (Lopez et al., 2020). These approaches can help to soften cultural divides between educators and students, encourage an asset, rather than a deficit, mindset (Gay, 2018), and provide educators with increased cultural competency to help students feel at home in their classrooms (Zygmunt et al., 2018).

Build on Teacher Candidates' Enthusiasm for Student-Centered Learning

Our own conversations with teacher candidates and new teachers suggest that although they may need additional support learning *how* to build a culture of care, their preparation helps them understand the value of doing so. When asked to compare the classroom they feel they are being prepared to teach in relative to the classroom they experienced as a student, one teacher candidate responded:

> Whenever I look back onto my educational past, I think the one thing that stands out the most to me…
> [is that the biggest difference between when] I was in school and me teaching is...there is a much bigger value placed on the student themselves and their personal growth. And I think that's something that I didn't feel from a teacher…. And so that's something that is really positive, that I'm really excited to see as I've been going through my courses. It makes me feel really confident, not only in me in the classroom, but...in my cohort….They know how important [student-centered care] is too, and are going to make sure that that's a focus in the classroom.

Teacher educators have an opportunity to leverage this optimism and belief that school relationships matter by helping teachers develop the knowledge and tools they need to build them. The shining examples of teachers and teacher educators fostering caring relationships in support of student success during 2020 provide direction for how to move forward and increase school connectedness for all students.

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Navigating the Social and Emotional Needs of Preservice Teachers During the Anxious Uncertainties of 2020

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Abstract: Based on guidance that sought to slow the progress of the COVID-19 pandemic, in the spring of 2020, many college classrooms rapidly transitioned in-person teaching to an online format. For some classes, coursework remained online throughout the entire fall 2020 semester. These conditions necessitated the use of educational technologies to achieve this transition. This chapter shares lessons learned from two instructors who used digital tools to help foster connection with students. In addition to teaching course content, their classes became spaces where social and emotional learning (SEL) and caring pedagogies were embedded and modeled. Implications include best practices ideas for designing to meet students' social and emotional needs during and after crises. A review of SEL literature relating to teacher education is shared, as is the research on caring pedagogies. Based on each author's experiences teaching in 2020, five recommendations for embedding SEL and CP in teacher education courses are shared. Strategies for writing inclusive syllabi and promoting caring pedagogical approaches conclude the chapter.

Lesson Learned: Teacher educators should have learned to embed SEL and caring pedagogies in teacher education coursework.

AN INTRODUCTION TO PANDEMIC PEDAGOGY IN PRESERVICE TEACHER EDUCATION

A beginning of a new year generally brings hope for renewed energies and new endeavors. However, the 2020 university academic year was fraught with uncertainties and stressors. Partisan politics on campuses became increasingly divisive, mirroring how society itself seemingly became less open to accepting others' viewpoints and perspectives (Mirra, 2018; Pew Research Center, 2017). Social and racial justice issues were also part of the discourse, spurring some students to become activists.

Complicating life was the rapid spread of COVID-19, a pandemic that disrupted everyone's life in the spring of 2020. Many colleges transitioned face-to-face coursework to online formats out of necessity for safety during the COVID-19 pandemic. This shift followed a recommendation by the Centers for Disease Control and Prevention (CDC) and state and local guidance (Marshall et al., 2020). Students suddenly found themselves socially and physically isolated from their peers.

Schools at all levels, including colleges, temporarily shifted the vast majority of instructional delivery to remote formats (Hodges et al., 2020). This quick scramble to emergency remote teaching (ERT) in late spring 2020 was a "pandemic pedagogy" (Milman, 2020, para. 1), a pivot differentiated from other online teaching models. Typically planned, online teaching includes blended, hybrid, flipped, and mobile learning approaches (Hodges et al., 2020; Marshall et al., 2020).

The fall of 2020 differed from the spring as faculty and students had more time to prepare for alternate instructional methods. For in-person classes, the CDC recommended (but did not mandate) that faculty and students wear masks, meet in smaller cohort groups, and maintain social distancing measures (Considerations for Institutions of Higher Education, 2020). Other modes of course delivery suggested included hybrid, where smaller student cohorts meet on a rotating schedule, and "hyflex," in-person classes streamed online for remote learners (Considerations for Institutions of Higher Education, 2020). Virtual learning was deemed the lowest risk environment for student learning (Considerations for Institutions of Higher Education, 2020).

When coursework is intentionally delivered online, often, instructors are trained, university infrastructure is set, and students are prepared (Cavanaugh & DeWeese, 2020; Hodges et al., 2020). During ERT, faculty and students had little time afforded to many for online learning (Cavanaugh & DeWeese, 2020; Hodges et al., 2020; Marshall et al., 2020). Some educators confronted their inexperience with teaching digitally and inequitable internet availability among students (Trust & Whalen, 2020). Others grappled with mental health and well-being issues (Trust & Whalen, 2020).

The authors of this chapter are both teacher education faculty at a university located in the Rocky Mountain region of the US. Both authors taught courses with undergraduate preservice students during the spring and fall of 2020. One of the authors is faculty in the educational technology department, teaching secondary education majors in various content areas (math, English language arts, social studies, and theater). The second author teaches students in early childhood education (ECE) courses, where she also coordinates the program for the university. This chapter reviews the existing literature on SEL and caring pedagogy and then shares our lessons learned from practice.

WHAT WE KNOW

Emotions and their connection to the process of learning have been extensively researched and documented (Ben-Eliyahu, 2019). Social and emotional learning (SEL) and caring pedagogies are critical aspects of teacher education programs that support well-being. The literature on SEL and caring pedagogy are shared next.

SEL and Teacher Education

Maslow's (1943) theory of motivation, also known as the hierarchy of needs, consists of five stages. The theory emphasizes that before humans are ready to self-actualize, they must have a sense of belonging and that said belonging comes from the connectedness to others (Fisher & Crawford, 2020; Maslow, 1943). In other words, an emotional connection is an essential aspect of cognitive function (Allen et al., 2016). This emotional connection, in the field of education, is often referred to as SEL.

SEL describes a set of competencies fundamental to succeeding in school and life (Brackett et al., 2015; CASEL SEL Framework, 2020; Schonert-Reichl, 2017). SEL competencies include emotional regulation and management, self

and social awareness cultivation, and the abilities to make responsible and ethical decisions that lead to prosocial outcomes (CASEL SEL Framework, 2020). When people's social and emotional needs are met, a sense of well-being can be engendered (Wilson-Mendenhall et al., 2019; Ryan & Deci, 2018).

Emotional identification is the starting point for being emotionally intelligent (Brackett, 2019). When children are emotionally intelligent, healthier peer relationships result (Reyes et al., 2012; Cipriano et al., 2017). Emotional intelligence is also a predictor of academic achievement, with students being more likely to experience success in school (Ashdown & Bernard, 2012; Bernard et al., 2009). In a meta-analysis, Durlak et al. (2011) linked SEL outcomes to the 11-percentile increases observed in student academic achievements.

Systemic SEL describes how children develop social and emotional competencies in the nested environments they inhabit (CASEL SEL Framework, 2020). The Collaborative for Academic, Social, and Emotional Learning (CASEL) recommends that each of its domain competencies be part of a schoolwide culture and other social environments (CASEL SEL Framework, 2020). Environments that influence SEL skill acquisition and development include classrooms, schools, homes, and communities (Brackett et al., 2015; CASEL SEL Framework, 2020).

Eighteen US states have adopted SEL standards or competencies for K12 students (Shriver & Weissberg, 2020). At a more local level, guiding documents have been developed across many more schools and districts referencing SEL strategies (Shriver & Weissberg, 2020). Despite the rapid adoption, few teacher preparation programs beyond early childhood education programs offer SEL implementation instruction (Jennings et al., 2020; Schonert-Reichl et al., 2017). Further complicating matters, many schools and districts do not provide professional development training for teachers on SEL implementation (Jennings et al., 2020). As a result, new teachers entering the field may be ill-prepared to embed SEL in everyday practice, affecting their abilities to cultivate student well-being and positive classroom cultures (Schonert-Reichl et al., 2017).

Teacher education programs can model behavior and tools that promote emotional intelligence. For example, Maslow's hierarchy of needs can be used as a framework for teacher educators when constructing their face-to-face and online courses (Milheim, 2012). Ways to leverage technology to support SEL include digital check-in tools, where students click face icons that match their moods or feelings, and emotional assessment surveys.

The Mood Meter is an instrument adopted in many K12 classrooms (Brackett, 2019). The Mood Meter lists a taxonomy of emotions in four color-specific quadrants: red for unpleasant, high-energy emotions (e.g., anxiety, anger, fear), blue for unpleasantness (disappointment, sadness), green for calm and relaxed, and yellow representing joy and elation (Brackett, 2019). There is a deficit in the literature on teacher education courses that use emotion check-in to model SEL teaching or assess future teachers' feelings in these classes (Jennings et al., 2020; Schonert-Reichl et al., 2017). In addition to emotional intelligence strategies, teacher educators can model empathy, responsible decision-making, teamwork, and relationship-building in coursework (Schonert-Reichl, 2017).

Caring Pedagogy

While few would argue that good teachers must have pedagogical content knowledge, education has been criticized for its lack of attending to the pedagogy of care. In the field of education, care isn't merely a behavior; it is about the reciprocal relationship between educators and students and seeing the student as a whole person (O'Shaughnessy, 2020; Velasquez et al., 2013). Pedagogy of care, also referred to as caring pedagogy (CP), "is the strategies that foster care and nurturance in education" (Velasquez et al., 2013, p.163).

CP is the combination of caring for the subject matter or content as well as caring for the students, which, when combined, can lead to effective teaching (Owusu-Ansah & Kyei-Blankson, 2016). As such, CP is a method that fosters and models pedagogical content knowledge and SEL. Students' self-confidence can also be promoted when teachers engage in CP (Johnson & Thomas, 2009). In a research study by Larsen (2015), eight factors were identified by college students to indicate that CP was integrated within the college classroom by faculty. The eight factors included: knowing students names, making efforts to get to know students on a more personal level, creating a classroom environment in which a "feeling of care" existed, verbal and nonverbal expressions of care, addressing the concerns of students during class, displaying concern and care during office hours, and creating engaging lessons.

Another critical way teacher preparation programs can model CP is to create a classroom environment where students are provided opportunities to collaborate and integrate knowledge "while valuing diversity" (Johnson & Thomas, 2009, p. 9). Moreover, educators can establish the expectations that preservice teachers will continuously strive to do

their best in their coursework and field experiences. Upholding high expectations fosters personal responsibility within students to exert effort. High expectations invite students to utilize and apply their learned strategies as challenges arise and to pursue new challenges that continue their growth (Johnson & Thomas, 2009).

Demonstrating high expectations for all students is not a new notion. It has existed in the field of education since the 1960s (Marzano, 2010). Research has found that a significant impact on students' learning stems from teachers' beliefs about their students and their capabilities for achievement and success (Turner et al., 2009). Teachers who have high expectations believe in all of their students' capabilities, don't give up on nor make excuses for students, and provide high levels of support for students. Additionally, there is evidence that effective teachers with high expectations for student success strive to provide meaningful and engaging learning experiences and value collaborative learning, encouraging students to work with their peers (Rubie-Davies, 2007).

Collaborative learning (CL) is an approach in which students work in groups "to solve a problem, complete a task, or create a product" (Laal & Laal, 2012, p. 491). However, one key distinction between collaborative and cooperative learning is that collaborative learning emphasizes the *process* of working with others rather than the end result (Hernández, 2012). CL provides an opportunity for students to engage in student-centered learning. Through CL, students can converse, hear different perspectives, exchange ideas, and be more immersed in the learning process (Laal & Laal, 2012). As a result, CL can increase student motivation (Hernández, 2012).

Teacher preparation programs should recognize the impact of CP and SEL. According to Calloway-Thomas (2018), "pedagogy of [care] is a meaningful way of... generating trust and goodwill among global citizens" (p. 496). Creating global citizens is precisely part of the task of teacher educators. In essence, teacher preparation programs prepare future classroom teachers to meet diverse learners' intellectual and emotional needs. Thus, although higher education and educators are upheld to professional and academic standards, they cannot ignore their students' human needs (O'Shaughnessy, 2020). COVID-19 has especially put this at the forefront of educational practices, reinforcing the notion that addressing students' emotional needs is critical to effective teaching.

LESSONS LEARNED FOR RESEARCH

In the context of schooling and learning, the role of teachers is primary. Research suggests that children learn social and emotional skills through observation and interaction with adults (Jennings et al., 2020). In a meta-analysis, researchers found that SEL interventions facilitated improvements in positive attitudes, prosocial behavior, and academic performance (Taylor et al., 2017). Instructors can cultivate prosocial behaviors by modeling positive interactions with students, peers, and other adults (Jennings et al., 2020).

Much of the research in SEL remains limited to early childhood and adolescent populations. Open questions remain about ways to promote SEL with adults in college courses. Can teacher education coursework go beyond modeling SEL approaches intended for children to be specific to college students? Teachers who embed SEL in their teaching have stronger foundational relationships with their students and their parents (Jennings et al., 2020). However, teacher education programs need to go beyond SEL knowledge to include tools and strategies for candidates to build their own social and emotional competence (Schonert-Reichl, 2017). It is recommended that more research is needed amongst college student cohorts who are post-adolescent and adult learners.

Research on mindfulness may be an approach for embedding SEL in teacher education programs. Some studies on mindful practices in professional development programs have been effective "in promoting teacher well-being, reducing psychological distress and improving the quality of classroom interactions" (Jennings et al., 2020, p. 128). Mindful practices can include emotion check-ins and guided breathing exercises, both of which are sometimes taught to young children, led by teachers, or with videos (e.g., GoNoodle).

The capacity to be mindful relates to emotional awareness centers in the brain (Jazaieri et al., 2014; Zeidan, 2014), and some research suggests that mindfulness can improve mental well-being and cognition (e.g., Brown & Ryan, 2003). Yet, there remains little to no research on how embedding mindful practices in teacher education programs can promote well-being or how it may inform students' future practices.

More research is suggested on embedding CL in coursework. For instance, to what extent does CL engender community in courses? Where are the intersections of care with SEL? In the next section, some of the lessons learned from this chapter's co-authors' teacher education courses in 2020 are shared. Some lessons learned were applied during ERT, while others were integrated in the fall of 2020 when more time was afforded for thoughtful planning.

LESSONS LEARNED FOR PRACTICE

In 2020, we were particularly mindful of two stressors during the COVID-19 pandemic: the sudden transition to ERT and the growing unpredictability of the epidemic itself. As such, we considered ways to promote students' social and emotional well-being with caring pedagogies through coursework. For instance, some technology tools can encourage communication and connections by establishing or extending the sense of community between students and teachers while also providing students with the opportunities to leverage their voice with some anonymity.

Based on our experience in 2020, we aggregated six recommendations for embedding SEL and CP in teacher education courses. We suggest that instructors in teacher education programs do the following: 1) Check-in often with students; 2) Rethink office hours; 3) Create an inclusive syllabus that emphasizes student success; 4) Model SEL and CP in coursework; 5) Nurture students' intrinsic motivations in courses; and 6) Promote CP for all. Each recommendation is detailed next.

1. Check-in Often with Students

At the onset, weekly reflection surveys were embedded into both authors' courses. The educational technology course conducted multiple surveys throughout semesters, both spring and fall. When posted, students were informed that participation was optional and anonymous. The first survey was used to assess students' comfort and confidence using technology tools, including those used in the delivery of synchronous class meetings. Students were also asked about internet access, including wireless capabilities, shared devices at home, and issues related to cell phone data use restrictions. Students' abilities to find a quiet workspace for class meetings were also in the initial survey.

Subsequent check-in surveys used mood boards, asking students to identify how they felt that day compared to a spectrum of emotions (lonely, stressed, sad, happy). During direct instruction with slides, the instructor used Pear Deck, a web-based technology tool that creates interactive lessons built into slideshow decks (e.g., Google Slides). In these lessons, students entered a code and then followed the instructor-led presentation. Some shared slides included SEL templates from Pear Deck that enabled students to annotate and interact. One was a stress meter, where students dragged an icon along a meter to illustrate their ability to manage emotions and focus.

When instruction transitioned to ERT, students were surveyed multiple times. These surveys had a twofold purpose: first, to check-in on students' well-being and comfort with remote technologies; second, to give instructors feedback data to glean when considering any course adjustments to meet students' needs, intellectually and emotionally. Other survey questions asked about internet access and stability and prior knowledge of online learning tools, such as Flipgrid, an asynchronous video reflection tool, and Padlet, a digital sticky note application.

Additionally, weekly surveys through SurveyMonkey were implemented in the ECE course, such as mood boards to monitor student stress levels and engagement. Students utilized either the link or quick response [QR] code provided within the lecture to confidently access the survey. In addition to their well-being, questions were asked about students' perspectives on course content. The instructor utilized the feedback from the survey responses to inform the next lecture session.

2. Rethink Office Hours

In both authors' courses, office hours became virtual, hosted on Zoom. Instead of stating this shift to students, time was dedicated in class to explain the purpose of voluntarily attending office hours. For some students, office hours are viewed as a time to visit only when grades are falling or if absences are excessive. However, office hours can be a positive experience, a time for students to connect one-on-one with instructors. Office hours can be when mentorship opportunities arise, and when meaningful relationships flourish (Nadworny, 2019).

One of the authors uses an online schedule for additional appointments outside of office hours. There were also "I just want to talk" meetings blocked off to assist students seeking one-on-one support during the COVID-19 pandemic. This flexibility in office hours and appointments increased the sense of support and community between the instructors and students despite shifting to online modalities. Subsequently, several students arrived for office hours at the start of the fall semester. This practice should continue after the pandemic, as it can help demystify the college experience (Nadworny, 2019).

3. Create an Inclusive Syllabus that Emphasizes Student Success

Like office hours, course syllabi may intimidate students (Ludy et al., 2016). Some instructors introduce syllabi as an unbreakable contract. They are typically filled with rules, assignments, and policy mandates often written in confusing jargon (Palmer et al., 2014). However, the purpose of syllabi can be more than sharing students' contractual obligations required to pass. Instead, syllabi can be written to provide students with the critical information they need to succeed (McGuire et al., 2015).

A syllabus can be a starting point for creating an environment of openness, transparency, and inclusivity (Ludy et al., 2016). As such, information should be presented in ways that first-time college students can understand (McGuire et al., 2015). In addition to sharing clear expectations, students should be informed that coursework is organized to maximize their academic success opportunities. Time and care should also occur for instructors to learn students' preferred names and pronouns.

Language in syllabi can be formatted and written in clear and straightforward language, with limited jargon. The goal of friendly and inviting language is to engender a sense of warmth and approachability from instructors. Rather than presenting a rigid contract, syllabi can also be written to suggest a partnership between an instructor and students (Ludy et al., 2016). This can be afforded through the use of inclusive pronouns in syllabi, such a "we," "us," and "our," instead of "I," "you," or "the student."

Modeling care in syllabi frames the expectations that courses are a safe space to learn during uncertain times. In a message shared with the International Society for Technology in Education (ISTE) Teacher Education Network, past-president Torrey Trust suggested role-modeling caring pedagogy and inclusive teaching by adding syllabi statements. Trust shared one of her *Designing Digital Media for Teaching & Learning* 2021 spring course statements that reflect her lessons learned from the previous academic year. She wrote:

> *Teaching & Learning in 2021*: Learning isn't easy. Learning in the midst of a global pandemic, climate change and increasing natural disasters, mass shootings, political and social upheaval, and civil rights movements, can seem impossible at times. I understand that there may be days/hours/moments where you don't feel like learning or engaging in class. I hope that you can find the courage to communicate this with me. I am committed to providing a learning experience that is inclusive, flexible, and meaningful. I need you to commit to prioritizing your well-being, asking for help and accommodations to support your learning, and being willing to have tough conversations in class (and with others outside of class) about how we, as a society, can collectively repair, heal, learn together, and move toward a more equitable and hopeful future. (Trust, 2021, p. 2)

In the educational technology course, class time was set aside each semester to read and collaboratively annotate the syllabus. Using Hypothesis, a web-based markup tool, students were able to comment in real-time on policies using the digital sticky note and highlight features. This activity modeled an educational technology tool while also promoting positive discourse between the instructor and students. In one course section, next to the attendance policy, one student commented, "Communication is key."

Students were also informed that different forms of assessments would be offered throughout the course, including multiple ways to demonstrate their learning and strengths. Other flexibilities were detailed, including the attendance policy, as the pandemic's impact posed a continual unknown. Policies were revised to highlight the need to have students engage with peers in a community of learning.

In the ECE course, due dates become more flexible to accommodate unpredictable students' schedules. For instance, some students needed part-time work to meet their personal financial needs. Additionally, course assignments were altered to tie in new learning from COVID-19. For example, one project transitioned so that the pre-service teachers researched and created a presentation on how to talk to young children about COVID-19 and the changes we experienced in day-to-day life using child-friendly language and concrete examples.

4. Model SEL and CP in Coursework

Implications exist when designing for care and the social and emotional needs of students during a crisis. We adapted a flexible curriculum intended to be responsive to students' needs. The early childhood education students were given the option to meet asynchronously. Other modifications to coursework included engaging students to take part in SEL activities typically conducted with children.

In mid-March 2020, when classes shifted online, the educational technology course instructor shared a video from Fred Rogers with students. Rogers, the late children's television host, is considered by some to be the "father of SEL" (Kamenetz, 2018, para. 1). In the video, Rogers said, "When I was a boy, and I would see scary things in the news, my mother would say to me, 'Look for the helpers. You will always find people who are helping.'"

A Padlet sticky note application accompanied Rogers' video. In Padlet, students can create a written post, share a link, an image, or a video. Posts can be anonymous or have an attributed author. Moreover, students could "like" notes by clicking a heart icon on each other's posts and provide anonymous or authored comments. This may engender a sense of social engagement with students in coursework.

The above described Padlet became a digital "Gratitude Wall." Gratitude is "an emotion that is typically evoked when one receives costly, unexpected, and intentionally rendered benefits, and is thought to play a key role in regulating the initiation and maintenance of social relationships" (Forster et al., 2017). Inspired by the "A Time I Felt Grateful" SEL resources from the University of California, Berkeley's Greater Good in Education, this activity is typically conducted with middle school children. In this case, they were sharing notes of gratitude, which also modeled SEL instruction in practice. The activity provided an opportunity for self-expression and reflection with peers in a safe setting. Students anonymously respond to the prompt, "Think of someone that you said 'Thank you' to recently. Please share an example of a time you said "Thank you" to someone, and why." Nearly all students responded; one student thanked her family for being supportive. Another expressed gratitude for their roommates and best friend, and how technology helped serve as a social connector for her well-being. Other notes were also fraught with worry and uncertainty.

In the early childhood program, a similar Padlet activity was implemented. A program-wide Padlet board entitled "Inspiration Board" provided students with an opportunity to "share uplifting and/or funny quotes, pictures, comments, etc., to help keep each other stay positive and motivated during social distancing and online learning." Participation in the Padlet board was optional; however, several students engaged and connected outside of scheduled class instruction and activities. It is well-known that motivation is crucial to knowledge acquisition regardless of the learning context. However, "it is particularly critical when learning online" (Sansone et al., 2011, p. 200).

Partnered with lecture content, Padlet boards for other interactive assignments were also used in the ECE class. For example, preservice teachers explored engaging in "thick" conversations with young children and the importance of open-ended questions. Through a Padlet, the preservice teachers shared converting a closed-ended question to an open-ended question and how this transformation could influence the conversation between a teacher and student. The preservice teachers not only shared their examples, but they also were asked to respond to at least two other classmates' examples. Although many educators prefer face-to-face classes as it enables them to engage in in-depth content exploration, tools such as Padlet provide an alternative format for interactive engagement.

5. Nurture Students' Intrinsic Motivations in Courses

Designing with self-determination theory in mind has implications for student well-being, as it meets students' innate human needs to feel socially connected and valued (Aguilar et al., 2018; Ryan & Deci, 2018). SDT, which can lead to a sense of well-being, has three components: autonomy, relatedness, and competence (Deci & Ryan, 1985; 2000; Ryan & Deci, 2018). In the context of coursework, autonomy is when students see themselves "as the primary locus of control in a learning environment" (Aguilar et al., 2018, para. 46). Relatedness is the feeling of belongingness with peers and instructors (Deci & Ryan, 1985; 2000; Ryan & Deci, 2018). Competence describes how students feel when newly introduced skills or concepts are just within grasp. According to Blackburn and Armstrong (2011), value and success are the two components of motivation. Students are more motivated when they see the value of learning and "[when they] experience success" (Williamson, 2012, p. 1).

Extrinsic motivation describes when outside factors are in place to drive engagement and refer to "doing something because it leads to a separable outcome" (Deci & Ryan, 2000, p. 55). These include rewards common in online learning platforms (e.g., Canvas), including assessments that teachers assign, points connected to discussion questions, and grades (Stommel, 2020). An overreliance on extrinsic motivators such as these can demotivate learners (Kohn, 1997; 1999; Ryan & Deci, 2018). Reading logs are an example of an extrinsic incentive that can discourage struggling readers (Pak & Weseley, 2012). Like education itself, reading should be a pleasurable and fulfilling experience. As an instructional design strategy, SDT considers mainly intrinsic motivating factors (Aguilar et al., 2018; Ryan & Deci, 2018). Intrinsic motivation refers to "doing something because it is inherently interesting or enjoyable" (Deci & Ryan, 2000, p. 55).

In the educational technology course, SDT was embedded in coursework and during synchronous class meetings. At the students' request, rather than randomizing small group breakout rooms in Zoom, everyone was sorted by their specific content areas (math, history, English language arts, and theater). This helped engender a sense of relatedness. Students were also given the options for CL on assignments. Regarding autonomy, students had the agency to select technologies and topics in assignments. Lastly, competence was afforded by scaffolding the use of certain technologies through modeling. First, the instructor demonstrated technologies during whole class synchronous meetings. Next, students met in small group breakout rooms to practice. Students were also graded on a mastery basis, allowed to redo work based on instructor feedback.

In the ECE course, the instructor modeled how to navigate the course technologies through screen capture videos, which were embedded in the course. Additionally, the instructor provided practice spaces on Flipgrid and Padlet. Students were afforded low-stakes (or no-stakes) time to explore and gain confidence in utilizing online tools through experiential use. Additionally, students in the ECE class were provided the opportunity to design their own literature review paper on a topic of their choosing, which provided them with autonomy over a deeper dive into any specific burning questions they had related to course content.

6. Promote CP for All

Would students desire a caring pedagogical approach, regardless of disruptions stemming from crises? Are there students who require more attention to their emotional needs than others? How would instructors know how to identify such students? Students need to feel safe and secure before they will be ready to learn (Berger, 2020).

Unless students share anxieties with instructors, the needs of particular students may be unknown. This can be amplified when teachers use videoconferencing tools (e.g., Zoom) with students who do not use or have web cameras. Stommel (2020) wrote, "Flexibility and trust are key principles of any pedagogy, but they are particularly important when we're in crisis" (p. 12). During and after crises like ERT, educators should think about the long-term sustainability of caring pedagogies. Adapting guidance from Teaching Tolerance, Stommel suggested that during crisis, educators should:
- Establish a routine and maintain clear communication.
- Relationships and wellbeing should take priority over assignments and compliance.
- Actively encourage and support a sense of safety, connectedness, and hope.
- Acknowledge that trauma is not distributed equally. (A Trauma-Informed Approach, 2020, as cited in Stommel, 2020, p. 12)

Based on our experiences teaching during ERT in 2020, we recommend following universal design for learning (UDL) principles as guidance. Rather than designing coursework for perceived "average" students, UDL is an approach that considers the needs of students who are "in the margins" (Center for Applied Special Technology, 2021; Rose, 2017, p. 19). For instance, Padlet (digital sticky notes) and Hypothesis (social web annotation) are examples of tools that promote social learning without the need for web cameras.

Instructors should also look beyond their university-issued technology tools, like learning management systems (LMSs) that focus on cycles of assignments and grades (Stommel, 2020). In our courses, we used a suite of different technologies in addition to an LMS. This approach of avoiding one-size-fits-all technologies helped us to focus on students' individualized needs.

Instructors should reconsider rigid course policies. For instance, requiring a note from a doctor for an excused absence may need flexibility. Missed assignments should not necessarily be an automatic zero, nor should arbitrary point deductions for late work. If students miss an exam, a no make-up exam policy may be too harsh. Instead, policies should be equitable, encouraging students to be accountable while also allowing them to master content without fear of arbitrary penalty. For example, in 2020, we ceased the doctor's note requirement for excused absences. Missed assignments were no longer automatic zeroes, nor were there arbitrary point deductions for late work. If students missed an exam, a no make-up exam policy was deemed too harsh. Instead, policies were flexible, emphasizing equity with student success as the goal.

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Narrowing the Digital Divide in Teacher Education Programs through the Arts and Social Emotional Learning

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Abstract: The impact of COVID-19 has emphasized the need not only to prepare teacher candidates for a variety of modalities, but also to develop strategies for self-care and supporting students' wellbeing. The arts have historically shown a responsive approach to multiple initiatives, and it may be to arts teacher education programs that teacher educators can/should look for guidance. Prior to the pandemic, the connection between social emotional learning (SEL) and the arts was becoming more prevalent in literature. Hellman & Milling (2020) recently cross-walked the connection between SEL competencies with arts teacher education standards. This study requires careful consideration not just by arts teacher educators, but by all education preparation providers (EPP) considering how to support teacher candidates' wellbeing. It is possible that the connection between SEL and the arts can serve as a catalyst for how teacher education programs develop future educators that can quickly adapt to shifting circumstances. Many EPPs focus on in-person learning with limited opportunities for candidates to intentionally consider virtual modalities and address how to engage self-care when confronted with uncertainty. Arts teacher preparation programs may serve as a model for other PreK-12 licensure areas for developing a more flexible practitioner. This chapter expands on Hellman & Milling's (2020) findings regarding how non-arts teacher education programs can look to the arts in connecting social emotional competencies in their curriculum.

Lesson Learned: Teacher educators should have learned how to strengthen teacher candidates' social emotional competences that help them navigate uncertainty and shifting instructional modalities.

INTRODUCTION

The unexpected migration to virtual learning in schools across the globe filled teacher education programs with much uncertainty. Many teacher candidates were concerned that they would not meet licensure requirements as the opportunity to complete clinical experiences required careful consideration regarding student safety. While the pandemic has created a stressful situation for teacher education programs, it also encouraged a much-needed conversation regarding how teacher candidates are equipped in adapting to change. One of the questions many teacher educators asked when forced to migrate online due to COVID-19, was how they will continue preparing teaching candidates through a virtual learning environment. This question seemed even more daunting to arts teacher education programs that thrive in in-person learning situations, but it is our arts teacher education programs that may serve as a model for training teacher candidates on how to respond and adapt to changing circumstances including shifting modalities.

Hellman & Milling (2020) recently cross-walked the connection between social emotional learning competencies with arts teacher education standards. This study requires careful consideration not just by arts teacher educators but all education preparation providers (EPPs) that are wondering how to strengthen teacher candidates' social emotional competencies. COVID-19 not only required us to quickly shift how we function day-to-day, but it also spotlighted the importance of self-care, especially in PreK-12 education. Many have recognized the need to focus on students' wellbeing (Hauge, 2020) while others have taken note that teachers need to engage self-care as well (Schonert-Reichel, 2017). Social emotional wellbeing needs to be considered in teacher education programs, but this may be challenging for programs with limited room for curricular changes and/or additions. However, Hellman & Milling (2020) offer insights that may position arts teacher education programs as a catalyst for integrating social emotional learning training in a program's pre-existing curriculum. This chapter expands on Hellman & Milling's (2020) findings to engage a discussion regarding how non-arts teacher education programs can look to the arts in connecting social emotional competencies in their curriculum.

WHAT WE KNOW

Social Emotional Learning (SEL) and the Arts

The Collaborative for Academic, Social, and Emotional Learning (CASEL) is a SEL framework utilized by many states for developing PreK-12 curriculum focused in SEL competencies (Raschdorf et al., 2021). CASEL defines SEL as the following:

> The process in which all young people and adults acquire and apply the knowledge, skills, and attitudes to develop healthy identities, manage emotions and achieve personal and collective goals, feel and show empathy for others, establish and maintain supportive relationships, and make responsible and caring decisions (CASEL, 2020, para. 1).

SEL "core competence areas" identified as "the CASEL 5" focus on self-awareness, self-management, social awareness, relationship skills, and responsible decision-making" (CASEL, 2020). CASEL is the framework that many arts education leaders consult when describing connections between SEL and the arts (Edgar & Morrison, 2020).

Over the past year, multiple professional development convenings have focused on the connection between SEL and the arts. A recent conference provided by the State Education Agency Directors of Arts Education (SEADAE) focused on SEL and the arts and included a presentation of the state of New Jersey's *Arts Education and Social Emotional Learning (SEL) Framework* (SELVPA, 2021). The framework provides a crosswalk between SEL competences and the artistic process embedded in New Jersey's arts education standards, which are based on the national standards developed by the National Coalition of Core Arts Standards (NCCAS, 2014). This resource presents how SEL and the arts can serve as partners in support of the whole child and underscores the importance of students having ongoing access to arts education throughout their PreK-12 career.

We are also seeing publications address how COVID-19 might be encouraging more arts educators to integrate SEL strategies into their practice, such as a recent issue of *Arts Education Policy Review* that focused on SEL and the arts (Edgar & Elias, 2020). In the context of remote learning, Raschdorf et al. (2021) recognizes how COVID-19 is impacting the music classroom and suggests that music educators can integrate practical strategies that reinforce SEL competencies as they develop students' musical abilities through distance learning. Given the presence of arts and SEL in literature before

the pandemic and the emergence of discussions during COVID-19, it is possible we will see more research about how the pandemic emphasized the need not only for SEL but how arts education may serve as a key collaborator for helping students develop SEL competencies.

SEL and the Arts in Teacher Education Programs

Hellman and Milling (2020, p. 5) explored the alignment between AAQEP, CAEP, and arts teacher education programs and noticed alignment between SEL competencies rooted in social awareness and relationships. These standards identified by Hellman and Milling (2020) are based on their interpretation of how SEL intersects when considering the four sets of arts teacher education standards (National Schools of Art and Design (NASAD), the National Schools of Dance (NASD), the National Association of Schools of Music (NASM), and the National Schools of Theatre (NAST)). The selection of social-awareness and relationship as SEL competences stems from Hellman and Milling's (2020, pg. 4) recognition that while they searched for connections regarding multiple SEL competencies (self-awareness, self-management, social awareness, relationships, responsible decision-making), they found more "direct relationships" regarding social awareness and relationship. From their study, we are able to discern that much alignment between SEL and teacher education standards may exist, but limitations due to how the researchers interpret SEL competencies needs to be considered.

SEL in Teacher Education

We do not contend that SEL in teacher education only happens in the context of arts teacher education programs. However, it is important to understand what we know regarding SEL in teacher education programs in general. Schonert-Reichl (2017) posits, "teachers are the engines that drive social and emotional learning (SEL) programs and practices in schools and classrooms, and their own social-emotional competence and wellbeing strongly influence their students" (p. 137). Schonert-Reichl (2017) recognized the growing body of research focused on SEL and aimed to study how teachers' SEL competencies connected with their ability to enhance similar areas of their students. Teachers having knowledge of SEL-based instructional strategies may not be as impactful for students as much as having developed SEL competencies within themselves (Schonert-Reichl, 2017). If teachers need to develop SEL competencies, then this may be an area that both arts and non-arts teacher education programs can impact given the potential alignment between SEL and accreditation standards (Hellman & Milling, 2020).

Research indicates that teachers value the importance of SEL competencies for their students and themselves (Education Week Research Center, 2015). Education Week Research Center (2015) conducted a study to better understand how teachers viewed SEL. Their study consisted of over 500 participants drawn from registered users of edweek.org. The study asked about many factors related to SEL including preparation and training, which findings showed that 57% of the respondents "indicated that their educator preparation programs had not adequately prepared them to address students' social and emotional wellbeing" (Education Week Research Center, 2015, pg. 3). Understanding why teacher education programs may not adequately prepare teacher candidates to address SEL competencies warrants further research, but implications may be drawn from Schonert-Reichl (2017) who analyzed 3,916 required courses offered by 304 teacher education programs, which represented approximately 30% of U.S. colleges that offered teacher preparation courses at the time of their study. The study found that few teacher education programs addressed all 5 competencies from CASEL. "Specifically, only 13 percent had at least one course that included information on relationship skills. For responsible decision-making, self-management, social awareness, and self-awareness, the numbers were 7 percent, 6 percent, 2 percent, and 1 percent, respectively" (Schonert-Reichl, 2017, p. 149).

Preparing Teacher Candidates to Teach Online

The use of technology in PreK-12 has been evolving at a rapid pace with teachers integrating online tools in varied ways to enhance student learning. Farjon et al., (2019) suggests that some teacher candidates struggle with technology integration because they may not be taught how online tools can enhance student learning, which may offer helpful in-

sights for arts and non-arts teacher education programs. When pre-service teachers only experience technology as useful tools to increase engagement, it is possible that technology integration is limited to occasional strategies (Farjon et al., 2019). COVID-19 required teachers to fully embrace online learning and many arts and non-arts teacher candidates had to navigate teaching entire lessons through a virtual modality as a new experience. It is possible that many arts and non-arts teacher education programs do not train teacher candidates how to facilitate instruction through distance learning, which merits more research.

Teacher Attitudes Regarding Online Teaching due to COVID-19

As school districts across the U.S. migrated online with limited notice due to the COVID-19 pandemic, inequitable access to technology and the internet were sometimes insurmountable (Mahnken, 2020) and the need to isolate from others escalated mental health issues (Minkos & Gelbar, 2020). The combination of social distancing and quickly shifting from in-person to remote learning has increased teacher stress and concerns regarding students' wellbeing continue to be expressed throughout literature. Kaden (2020) contends, "Confined to working from home, with existing lesson plans no longer adequate, challenged to quickly learn new technologies and removed from students themselves, many teachers experienced the single most traumatic and transformative event of the modern era" (p. 1).

Anderson et al. (2021) studied potential links between creative self-efficacy and teacher well-being during the first few months of COVID-19 that quickly transitioned schools from in-person to remote learning. This study may be important for understanding how to help arts and non-arts teacher candidates both embrace and adapt to a variety of teaching modalities. For example, Anderson et al. (2021) suggests that a teacher's creative growth mindset might determine their openness for exploring new ideas and ability to respond to uncertainty in a more positive way. A teacher who embraces creativity in themselves and their students, but is also encouraged to do so at work, might be more resilient to change.

Anderson et al.'s (2021) study pulled from a sample of teachers participating in a virtual arts integration professional development program. Part of the study asked questions regarding how distance learning was impacting teaching and learning. Some teachers shared that they felt disconnected from their students when teaching in a virtual modality, but some educators also shared that COVID-19 "forced" them to be more creative (Anderson et al., 2021, p. 11). When teachers commented on what was their biggest stressors, one included "the increased workload and expectations in moving work to the remote learning environment and needing to create new online learning materials" (Anderson et al., 2021, p. 11). While shifting modalities may be stressful for teachers, it seems that when educators embrace their creativity, they may be better able to adapt to a variety of teaching situations. This is reflected in Anderson et al.'s (2021, p.11) study when the researchers recognized that teachers with higher levels of creative self-efficacy were able to respond to teaching challenges due to COVID-19 as an opportunity to be creative and explore what might be possible in distance learning due to being forced to adapt to different modalities.

LESSONS LEARNED FOR RESEARCH

SEL Alignment in Teacher Education Programs

If teacher educators should have learned how to strengthen teacher candidates' social emotional competences to help them navigate uncertainty and shifting instructional modalities, then we need to research how teacher education programs are aligning with SEL. Research from Schoner-Reichl (2017) and Hellman and Milling (2020) implies that a lack of consistency may exist in which SEL competencies arts and non-arts teacher education programs address. This merits further investigation as research may be lacking in understanding how arts and non-arts teacher education programs specifically address SEL competencies. While research indicates that teachers value SEL (Education Week Research Center, 2015), it was difficult to discern if teacher education programs demonstrate similar support for developing SEL competencies amongst their teacher candidates. The emphasis on educator dispositions in accreditation standards (e.g., AAQEP and CAEP) may suggest that teacher education programs should value SEL, but more research is needed to better understand this.

When Hellman and Milling (2020, p. 4) explored the relationship between SEL competencies with AAQEP and CAEP standards, they discovered an overlap with self-awareness, self-management, social awareness, relationships, and

responsible decision-making. However, when Hellman and Milling (2020) looked at the arts teacher education standards, the only direct connections with SEL competencies they could discern focused on social awareness and relationships. While they mention that the more "general terms" used in arts teacher education standards provided limitations in finding more direct relationships with SEL competencies (Hellman and Milling, 2020, p. 4), we still need to learn how SEL is implemented in teacher education programs. If teacher education programs are not aligning with all SEL competencies as described by CASEL (2020), then we need to learn why this is happening.

SEL in Preparing Teacher Candidates to Shift Between In-Person and Virtual Environments

Research suggests that integrating SEL into arts and non-arts teacher education programs may strengthen the teacher candidate's social emotional wellbeing. In turn, this might also expand their capacity to adapt to shifting learning modalities. Minkos and Gelbar (2020) provide a psychological perspective and suggest, "what is certain is that for the foreseeable future, educators must become highly skilled at flexibly adjusting to an instructional landscape that is continually changing while also meeting the needs of a student population that is rapidly increasing in need and diversity" (p. 418). The impacts of COVID-19 will likely be felt for many years and how teacher education programs will navigate shifting modalities post pandemic remains unknown. However, research suggests that cultivating teachers' creative capacities might help them better navigate uncertainty (Anderson et al., 2021). More research is needed to help teacher educators better understand how to build SEL competencies in teacher candidates while preparing them to teach in a virtual modality. Given the unknown impacts of COVID-19 on learning environments, teacher education programs may greatly benefit from lessons learned from researching this further.

LESSONS LEARNED FOR PRACTICE

Preparing Teacher Candidates for Shifting Modalities in Consideration of Current Licensure Requirements

We suggest that licensure requirements impacted by COVID-19 may need to be researched further. While we did not look deeply into how COVID-19 impacted licensure requirements for this discussion, it was still present in their thinking as they are currently supporting teacher candidates on completing licensure requirements during the pandemic. It is possible that some licensure requirements may be based on the assumption that all teacher candidates will teach in-person and considerations for demonstrating field-ready competencies in a virtual learning environment may have been lacking. This may be the case in states that use edTPA, a subject-specific performance assessment administered by Pearson that was developed at Stanford University's the Stanford Center for Assessment, Learning, and Equity (SCALE) (Pearson Education, 2021a).

For this assessment, teacher candidates complete three tasks that focus on Planning (Task 1), Instruction (Task 2), and Assessment (Task 3). In Task 2 and 3, teacher candidates analyze artifacts that occurred during synchronous teaching. Prior to the pandemic, many teacher candidates submitted artifacts for edTPA from teaching in a face-to-face modality in a PreK-12 school setting. Pearson recently provided guidance for completing edTPA in a virtual learning environment due to the pandemic (Pearson Education, 2021b), but teacher education programs may need prepare teacher candidates for facilitating synchronous instruction in both in-person and online modalities post COVID-19. More research is needed to understand how teacher education programs support their teacher candidate's ability to facilitate learning in a virtual learning environment while meeting licensure requirements.

Many teacher candidates may be facilitating lessons through distance learning for the first time as they complete edTPA. When considering findings from Anderson, et al. (2021), part of this study focused on how a teacher's level of creative self-efficacy helped that individual navigate distance learning as a new endeavor. This implies that many teachers were teaching virtually for the first time, which might mean mentor teachers working with teacher candidates were also experiencing distance learning as something new to them. We are not suggesting that teacher candidates avoid submitting to edTPA due to the newness of teaching virtually, but that teacher education programs may need to consider more training for facilitating synchronous, online learning experiences. Given the stress that migrating online may have caused both pre-service and in-service teachers due to COVID-19, more research could help us understand how developing SEL competencies may strengthen a teacher's ability to shift between in-person and virtual instruction.

Collaborating with Arts Teacher Educators on Supporting SEL Competencies

The combination of findings from Hellman and Milling (2020) as well as Anderson et al. (2021) position arts teacher education programs as a potential vehicle for exploring how SEL can help future educators better navigate uncertainty and embrace technology as more than a tool but also as a modality that warrants as much training as preparing teachers for in-person learning environments. While we do not advocate positioning SEL solely in the context of arts education, we do believe seeing the arts as a natural partner with SEL (Edgar and Morrison, 2020) as being worth consideration. The collection of findings regarding how SEL aligns with the arts in this chapter (Edgar and Elias, 2020; Edgar and Morrison, 2020; Hellman and Milling, 2020; and SELVPA, 2021) may encourage non-arts teacher education programs to engage arts education faculty in thinking through ways to develop SEL competencies while preparing teacher candidates for a post COVID-19 educational landscape.

We do need to learn more about how arts and non-teacher programs work together. One reason why arts and non-arts teacher education programs may be isolated from each other might be due to standards from accrediting agencies in each artistic discipline. Hellman and Milling (2020) identified each accrediting body (e.g., NASAD, NASD, NASM, and NAST) that arts teacher education programs may address. However, not all arts teacher education programs navigate arts teacher education standards in addition to those that EPPs may need to follow. Research could help us learn whether arts teacher education programs that follow arts teacher education standards (in addition to other standards EPPs need to consider) are more or less conducive to collaborate with non-arts teacher education programs from the same institution. We do not suggest that the arts and non-arts do not want to collaborate but rather that being housed under separate units might encourage more work in isolation than together.

In moving forward, teacher education programs may benefit from collaborating with arts education faculty on crosswalking SEL competencies with their teacher education standards. This is the process that Hellman and Milling (2020) engaged in their study of arts teacher education programs, but this process may benefit non-arts teacher education programs as well. However, a limitation they recognized was that they were sometimes confined by their own interpretations of how SEL competences were reflected in accreditation standards. This suggests that a shared vision of what SEL competencies mean may be needed before arts and non-arts education faculty work together to explore this alignment. This shared vision may be guided by arts and non-arts teacher educators consulting the SEL competencies as defined by CASEL (2020) and using these definitions as starting point for discussion. This discussion could start by inventorying what kinds of activities currently exist in their programs that support the development of SEL competencies amongst their teacher candidates. This might then lead into a discussion about how SEL competencies from CASEL (2020) align with both arts and non-arts teach education standards.

Offering an Arts Integration Course in Teacher Education Programs

Considering that Anderson, et al.'s (2021) study drew a sample of teachers that were participating in a professional development program on arts integration, a course in arts integration might be worth pursuing for teacher candidates. If in-service teachers cultivate creative self-efficacy in arts integrated professional development, then it might be possible for teacher candidates to develop similar competencies in an arts integration course. Non-arts preservice teachers taking an arts integration course is present in the literature and may be a strong lesson to considered for practice. Some teacher education programs encourage non-arts teacher candidates to take an arts integration course to deepen their content understandings through an arts-based lens (Donahue and Stuart, 2008), while other may use it as an opportunity to strengthen cultural competence (Shockley and Krakaur, 2020), which aligns with SEL competencies described by CASEL (2020). Shockley and Krakaur (2020) contend that the "development in the practice of arts integration prepares teachers not only to focus on skills, knowledge, and dispositions, but also to exhibit cultural responsiveness and adopt reflexive practices" (p. 3). The reflexive practices described by Shockley and Krakaur (2020) aligns with the skills reinforced by Anderson et al. (2021) in regard to SEL-rooted competencies that might explain why some teachers are more open to engaging in distance learning and why some may not, which is based on their creative self-efficacy.

An arts integration course might also serve as a means to help teacher candidates develop online teaching strategies. Fusing technology into arts integration could not only reinforce creativity but also foster SEL competencies that are strengthened by the teacher candidate's creative self-efficacy. For example, the course could focus on arts integration in content areas conducive for online engagement such as STEM while also aligning with SEL competencies. The

intersection of arts integration, STEM, and SEL may seem complicated but examples are available for us to consider. Liao (2016) provides examples of integrating visual art into STEM through students creating 3-D storybooks that also taught them the concept of "embracing difference" (p. 46). "For example, one group created the *Turtle and the Pig*, a story about a turtle working together to save the other turtles in a crisis" (Liao, 2016, p. 46). In this example, teacher candidates would not only learn how to engage online tools in a creative way but also support SEL competencies that will help build positive relationships and strengthen their social awareness.

While the example provided by Liao (2016) helps us envision the kinds of instructional strategies a teacher candidate might experience in a technology and SEL infused arts integration course, it is limiting in regard to online learning. Teacher education programs might need to consider additional ways for teacher candidates to practice teaching in virtual learning environments and consider technology as more than an instructional strategy. It is possible that education post-COVID may include increased remote learning opportunities, especially since so many educators have had to learn how to teach online. We have seen instances where school closings due to weather have shifted to remote learning days. It is possible that this will occur more often, which mean art and non-arts teacher education programs may need to consider more preparation in online learning. This merits further investigation as we see the impacts of COVID-19 on teacher education programs.

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Mindfulness and Compassion in Teacher Education

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Abstract: In this chapter, the authors explore lessons learned from 2020 and discuss why these lessons resonate beyond current circumstances to inform the ways teacher educators teach, learn, and interact with pre-service, in-service, and teachers in training. The authors illustrate how centering mindfulness in teaching and learning invites teacher educators to expand social and community learning to build compassionate relationships with pre-service teachers, in-service teachers, and teachers-in-training. By connecting research and practice, the authors illustrate ways that teacher educators can implement instructional practices that nurture resilience, adaptability, and flexibility. These educational practices in turn have the potential to deepen human connections and transform attitudes about learning and impact lives of future students. The research and practical ideas in this chapter are not an exhaustive list but instead serve as examples that teacher educators can adapt and customize to develop their own approaches for incorporating mindfulness and compassion.

In face of unprecedented challenges in 2020, teacher educators should foreground three mindful and compassionate practices in their teaching: (1) communication, (2) community building, and (3) creativity (3 Cs). These practices can be useful for guiding instruction whether instruction is delivered through distance learning or face-to-face. Lessons learned from 2020 extend beyond 2020 and will help the teacher education field evolve in response to the needs of changing educational contexts well into the future.

Lesson Learned: Teacher educators should have learned ways to enact mindfulness and compassion in their teaching and learning.

INTRODUCTION TO MINDFULNESS AND COMPASSION

The year 2020 was a year like no other. It brought challenges large and small, personal and professional. Unprecedented lockdown regulations and restrictions caused disruptions in daily life. Educators faced challenges across the education sphere due to the global pandemic, economic and political uncertainty, and surmounting calls for social justice amidst a racial reckoning, and school closures. Across the educational spectrum, educators turned their homes into makeshift spaces for teaching online while simultaneously parenting, caregiving, and navigating numerous uncertainties. Above all else, 2020 was an exercise in patience that required individuals to find ways to adapt resiliently and flexibly.

Before 2020, the demands of teaching were already challenging, requiring educators to find creative ways to balance work, personal lives, and need for exercise and relaxation. Even before the pandemic, many teacher educators brought their work home with little physical and mental separation between work and home. Schedules were never quite regular with high demands placed on teaching quality and meeting the diverse needs of learners. In the teaching profession, balancing priorities has always been stressful. However, the challenges faced in 2020 amplified educators' stress significantly. Considerations of health and safety became a central focus. Previously relied on common-sense strategies of positive mental attitude, self-management, and organizational skills did not provide a robust enough toolkit to combat the uncertainty of 2020.

Mindfulness and compassion, if more widely adopted in 2020, might have brought a universal sense of calm and peace. Mindfulness and compassion can help educators recognize their emotions and develop ways to process and manage those emotions. Affirmations, for example, can be used to channel feelings associated with being overwhelmed into positive self-talk. Active strategies associated with mindfulness help center thoughts and improve focus.

While teacher educators foregrounded the acquisition of learning theories, teaching techniques, and content knowledge previous to 2020, the heart of teacher education lies in mindfulness and compassion for each other. What matters most is cultivating and demonstrating genuine care for ourselves, and the pre-service, in-service, and teacher candidates with whom we work. Becoming more mindful, in turn, encourages compassion for others and solidifies human connection. Teacher education enacted in this way can build resilience, adaptability, and flexibility as individuals, as collaborators, and as humans equipped to tackle the shifting sands of uncertainty. Mindful choices consider the lived experiences of all learners, including their health and mental state, access to the internet, and the human need for connection. This chapter centers resilience, adaptability, and flexibility as essential qualities for transformative teacher education.

Reflecting on 2020 revealed three important practices for centering mindfulness and compassion in teacher education including: (1) communication, (2) community building, and (3) creativity. This chapter illustrates how mindful and compassionate teaching and learning place greater emphasis on building quality relationships. Forming stronger relationships creates a support mechanism that may diminish stress and promote well-being.

Moving forward into 2021 and beyond, teacher educators should give more priority to practicing mindfulness and compassion to provide safer and more supportive contexts for learning. The connections we make with the future teachers also bring personal satisfaction. As pre-service teachers become independent learners, exercising mindfulness and compassion can help ground their teaching in caring practices. Being mindful can encourage creative instructional choices to include practices that promote mental and physical wellbeing.

The lesson learned in 2020 is to exercise mindfulness and compassion in all facets of teacher education in order to recognize the importance of human connection over outcomes. Finding ways to increase resilience, adaptability, flexibility is essential in the face of change. The organization of this approach is illustrated in Figure 1.

Mindfulness & Compassion in Teacher Education

Goal (What?): to instill mindfulness and compassion into teachers of tomorrow to be equipped with resilience, adaptability, and flexibility.

Mindfulness

Compassion = mindful empathy

lead to

Resilience

Flexibility

Adaptability

Impact

How? 3 Cs Practices

Why?

Body of literature on mindfulness, compassion, Social Theory of Learning, resilience, adaptability, and flexibility

Communication

Community building

Creativity

Impact

School Culture

Health and Wellbeing

Student Learning

Figure 1. Conceptual Framework for Mindfulness and Compassion in Teacher Education.

Lived Experience with Mindfulness and Compassion

Looking across disciplinary fields, this chapter highlights the importance of mindfulness and compassion in teacher education. The authors are both teachers and researchers, each with a strong commitment to ensuring the success of in-service, pre-service, and teachers-in-training, as well as the learners with whom they work, through the continuous improvement of instructional practice. The authors' expertise includes scholarship in the areas of literacy instruction, the use of digital tools and pedagogies, educational administration and information sciences and technology, and academic integrity and faculty development. The authors' projects focus on Science, Technology, Engineering, and Math (STEM) innovations with implications for teacher education and professional learning. Consider the themes of mindfulness and compassion in the following vignette that illustrates how one teacher-in-training reflects on mindfulness and compassion within her student teaching placement, widening the discussion with colleagues in her teacher education class.

> Looking into any education space, whether offered on Zoom or face-to-face, is like opening a door into a world full of possibilities. Victoria, a pre-service teacher in training, describes an example of mindfulness and compassionate practices from her virtual student teaching placement in 2020 in her teacher education class.
>
> Victoria shares with her pre-service teacher colleagues, "Mrs. Escobar (Victoria's collaborating teacher) was inspired by other teachers' Flat Stanley projects (see examples at https://tinyurl.com/1eo9xgps). She created a flat bitmoji version of herself, printed it out in color, and glued it to a popsicle stick for each of her 4th grade students. The 4th graders took pictures and wrote stories. They placed Flat Mrs. Escobar next to them as they completed their school work. They took Flat Mrs. Escobar on adventures in their homes, yards, communities, and beyond. They felt her companionship and presence even when she could not be there in person."

Victoria continues, "Mrs. Escobar goes the extra mile to personalize the distance learning packets the school district mails out. Not all students can connect online, so Mrs. Escobar makes the packets as interactive as her Zoom lessons. Personalizing the work packet mailer has helped these 4th graders connect with Mrs. Escobar and stay connected to school."

Victoria summarizes, "Distance learning is about connection. Its purpose extends beyond a grammar lesson or the use of descriptive adjectives. It helps combat students' isolation and offers friendship. Friendship extends to students' families who often make appearances in these   4th graders Flat Mrs. Escobar's stories and picture-based personal narratives."

This vignette illustrates a creative way that mindfulness and compassion can become a central part of teaching and learning. The stories that Flat Ms. Escobar inspired encouraged deep personal connections. These connections value that learning is grounded in human interaction, that learning occurs through creative problem-solving, and that learning happens by creating and sharing ourselves. Educational experiences with these characteristics promote perseverance in challenging times. Making room for teachers-in-training like Victoria to discuss learning practices that bridge home and school, even though these experiences took different forms in 2020, illustrates that teacher education programs can be responsive, adaptive learning environments that center lived experiences and lead to instructional innovation.

WHAT WE KNOW

Mindfulness and compassion play an essential role as both catalysts and enablers in teacher education. They are drivers that nourish desired qualities such as resilience, adaptability, and flexibility. Mindfulness and compassion help anchor us to our individual and shared personal histories, which in turn deepen our commitment to each other. Through the enactment of mindful and compassionate practices, teacher educators can develop a way of talking about resources, frameworks, and perspectives that help move the teacher education field collectively forward. Mindfulness and compassion foster the three core qualities our teacher educators want to instill into their students.

Resilience, adaptability, and flexibility are interconnected and act in tandem, which Figure 1 and the literature illustrate. The sections that follow dig into the definitions and the interdependencies of these concepts. Background from the literature, drawn from within and beyond the education field, is offered to help ground these terms in a teacher education context. The details of mindfulness and compassion are presented followed by a discussion of how these concepts fit into social theories of learning in teacher education. The authors then describe how mindfulness and compassion support the development of resilience, adaptability, and flexibility.

Mindfulness

The idea of mindfulness has been around for thousands of years. The term, mindfulness originates from the Buddhist concept of *sati* whose literal meaning is *to remember* (Olendzki, 2020). According to philosophers, mindfulness is an intervention practice aimed at alleviating human suffering. Mindfulness pursues *equanimity* in our mind, which refers to maintaining calm in the midst of disturbances, negative thoughts, and volatile emotions (Desbordes et al., 2015). To be mindful involves focusing on the present. Staying in the moment is crucial because concentrating on the task at hand is not possible if we are preoccupied with thoughts like regrets and worries (Lemon & McDonough, 2018). Therefore, mindfulness involves developing heightened awareness of your environment in the moment without judgement and cultivating enhanced attention and curiosity in the present. An attitude of acceptance is another central mindfulness practice that facilitates the process of detaching oneself from the thoughts of the past and future (Kabat-Zinn & Hanh, 2009) to improve clarity of thought and feelings of calm.

Discussions about the importance of mindfulness training are occurring more frequently in education settings (Contemplative Practices and Mental Training, 2012; Meiklejohn et al., 2012; Roeser, 2014). Mindful Schools (https://www.mindfulschools.org/) is a non-profit that partners with schools to empower educators to spark change from the inside out by cultivating awareness, resilience, and compassionate action. The Mindful Schools initiative explains mindfulness as a condition of being present here and now, paying attention to our thoughts, emotions, bodily sensations, and our external environment with kindness, non-judgment, and curiosity.

In teacher education, developing one's mindfulness unlocks the ability to increase focus and think clearly, and address what is important at the moment, putting out of one's mind the worry or negative emotions that may preoccupy it at any given time. Mindfulness practices also support increased self-awareness. For younger students, who may behave impulsively, the ability to think twice before taking action is a vital strategy for exercising self-control (Kemeny, et al., 2012). For adults and youth alike, research has shown the benefits of mindfulness in relieving stress and promoting mental health (Grossman et al., 2004) by laying a foundation to grow resilience in our minds. Many organizations (including schools) are adopting moments of mindfulness because of the immediate and practical benefits which include:

- improvements in concentration and creativity (Armstrong, 2019; Henriksen et al., 2020; Rabois, 2016);
- reduction in stress, anxiety, and depression (Grossman et al., 2004; Klawonn et al., 2019);
- positive effects on relationships enhanced by pro-social behaviors (Jennings, 2015);
- decreases in physical pain (Kabat-Zinn et al., 1985);
- increases in immunity to harmful conditions (Black & Slavich, 2016);
- improved executive function, enhanced self-regulation, and increases in school connectedness (Jennings, et al., 2013).

Simply being aware of mindfulness is not enough to weather the trying times of 2020 and beyond. Teacher educators need to build thriving learning communities to engage students more effectively and invite their active participation. Meditation practices, in all contexts including schools, can play a central role in training one's mind (Ireland, n.d.) through practices such as breathing exercises, positive self-talk, and Yoga.

There is an abundance of mindfulness approaches and a multitude of places where mindfulness practices are referenced, including: 1) medical care settings (Aherne et al., 2016; Dobkin & Hutchinson, 2013), 2) physical education (Mulhearn et al., 2017), 3) travel (e.g., https://www.mindfulnesstravels.com), and 4) coaching (e.g., https://www.better-up.com/) and 5) business productivity solutions (e.g., https://get.headspace.com/). Given the documented benefits across industry sectors, increasing the implementation of mindfulness practices in teacher education, schools, classrooms and at home suggests further positive effects. The literature also documents the increasing adoption of mindfulness in the classrooms (Flook et al., 2013; Grant, 2017; Harris, 2017; Hartigan, 2017; Rabois, 2016; Rechtschaffen, 2014; Roeser et al., 2012; Shapiro et al., 2016).

Mindfulness practices may be coupled with community building and movement exercises, guided visualizations, or stretching. For example, Social and Emotional Learning (SEL) allows students of all ages to learn and apply skills necessary to "manage emotions, set and achieve positive goals, feel and show empathy for others, establish and maintain positive relationships, and make responsible decisions" (Collaborative for Academic, Social, & and Emotional Learning, n.d.). Researchers are still exploring the link between mindfulness and SEL (Mussey, 2019) and their combined potential to manage stress and improve quality of life.

Compassion

The literal meaning of compassion is 'suffering together.' Generally speaking, what this means is seeing the world through someone else's eyes. However, compassion is not the same as *empathy,* which signals the ability to share the feelings of another. Compassion goes beyond commiserating and could involve actions to help those in misery (Peters & Calvo, 2014). Therefore, compassion can lead to the acts of caring and kindness, such as assisting others in relieving their suffering.

Individuals can become overwhelmed by the emotions involved in the 'suffering together' aspect of compassion and lose sight of taking concrete actions that can help others overcome their suffering. A useful analogy can be putting on one's oxygen mask first on an airplane during an emergency before assisting others around oneself. The research and associated benefits of expressing compassion act as a reminder to incorporate self-care into teaching and in daily lives. Teacher educators can lead the way in cultivating compassion, as words and actions manifest and extend compassion to teachers-in-training and educational colleagues. In turn, these practices make space for self-care and nurture aspects of that caring can create ripple effects across teaching and learning settings whether in teacher education, in student teaching placements, or in pre K-12 classrooms (Smeets et al., 2014).

Developing compassion in teacher education means listening actively and coming to understand the lived experiences and perspectives of others. In the process, educators exercise greater empathy for families, showing compassion for

those in need. An educator's job centers on caring for, guiding, and helping others. These selfless acts of teaching create human connections between mindfulness and compassion; teacher education researchers and practitioners can draw on lessons from the mindfulness literature to cultivate compassion in teacher education (Akpan & Saunders, 2017; Hulburt et al., 2020; Lavelle Heineberg, 2016).

Social Theories of Learning

Teacher education is built around the idea that learners make meaning within a community (Bransford, Brown, & Cocking, 2000). Learning in a community provides opportunities to socially construct knowledge (Lynch, 2016) which has the potential to extend perspectives and expand world views. In teacher education programs, teachers-in-training collectively experience moments of deep learning through connections to their lives, families, and the world. These social connections give meaning to their acts of teaching, learning, interacting, and connecting. In discussions, and through the enactment of teaching practices, teachers-in-training think together and share openly constructing their learning in community.

Mindfulness and compassion are compatible with theories of social practice (Wenger, 1998). Social practices align common goals as humans and recognize that at the heart, learning is largely a social activity. Wenger suggests that the social practices of learning address the production and reproduction of specific ways of engaging with the world, ourselves, and each other. Through this lens, everyday activities and real-life experiences are acknowledged as learning opportunities.

Using mindfulness and compassion, teachers-in-training can share experiences and resources, organize and coordinate their activities, and develop mutual relationships, which in turn drive their interpretations of the world, giving learning meaning.

According to National Council of Teachers of English & National Writing Project (2011) learning socially can help develop habits of mind that are compatible with mindfulness and compassionate teaching and learning including:

- Curiosity: the desire to know more about the world;
- Openness: the willingness to consider new ways of being and thinking in the world;
- Engagement: a sense of investment and involvement in learning;
- Creativity: the ability to use approaches for generating, investigating, and representing ideas;
- Persistence: the ability to sustain interest in and attention to short- and long-term projects;
- Flexibility: the ability to adapt to situations, expectations, or technological demands;
- Metacognition: the ability to reflect on one's own thinking as well as on the individual and
- cultural processes used to structure knowledge.

When learning occurs socially, discourse encourages human connections. Discussions generate knowledge that is then negotiated and shared expanding empathy (Mussey, 2019). Connection with others conveys enthusiasm for learning and helps learners grow into a learning community. Activity cycles that include sharing, commenting, responding, synthesizing, and reflecting together communally promote community-building and collective meaning making that extends empathy and shared responsibility. As a result, community-centered learning rises above any one learner's individual understanding.

Resilience

Resilience is an ability to respond positively (Luthar et al., 2000) to and recover from difficult situations ranging from embarrassing moments to major adversities in life. Teachers continually have to confront challenging moments in their classrooms, which Day and Gu (2013) characterize as "testing times." Day and Gu (2013) explain what it means to be a resilient teacher of quality; and just like their students, teachers learn how to become resilient over time and through opportunities to develop resiliency.

Researchers have been studying the nature of resilience and are coming to fresher understanding of resilience in teachers. One finding suggests that resilience is *dynamic* (Masten et al., 1999). Socio-cultural factors such as relation-

ships can either strengthen or erode resilience over time. Resilience is not an *innate* quality, rather, it can be learned or acquired through practices of mindfulness (Higgins, 1994). Therefore, one can gain or lose resilience just as bodybuilders gain more muscle by lifting weights or astronauts lose theirs due to weightlessness. Then, what shapes one's mind muscle? Researchers report that mindfulness is the answer. Bajaj and Pande (2015) find that mindful people show more resilience; mindfulness training can provide a practical means of enhancing resilience.

Adaptability

As in the case of resilience, adaptability is also an acquired skill. One can view adaptability as an individual's ability to react quickly to changes (e.g., shifts in trends, pandemic situations, etc.) to produce the best outcomes. Van Dam (2013) defines adaptability as underlying potential derived from cognitive, affective, and behavioral resources that can be applied to adjust to task-related, environmental, and vocational demands. Adaptability for teachers is crucial due to the always-in-flux nature of their teaching environment. Their students change; content they teach changes, and technologies they rely on change. Van Dam (2013) elaborates on each of the adaptability resources as shown in Figure 2. Based on the breakdown of the resources, adaptability's connection to mindfulness surfaces naturally. For example, resilience (fostered by mindfulness) is one of the resources under the affective category.
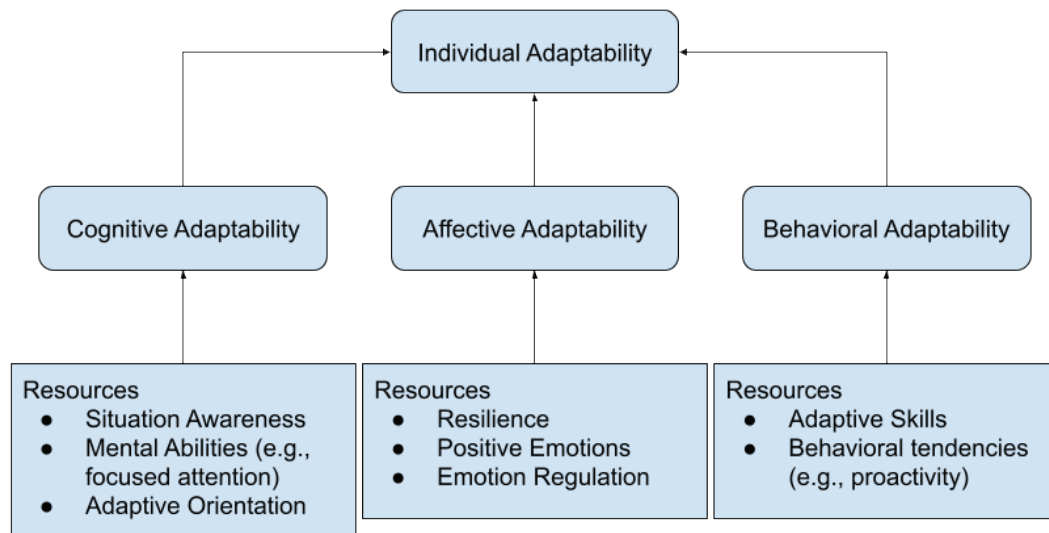
Figure 2. Van Dam's Framework for Individual Adaptability.

Positive emotions and emotion regulation are what mindfulness promotes. The cognitive resources such as situation awareness and mental abilities are what underpins mindfulness.

Flexibility

Flexibility is part of a set of cognitive mental processes that enable humans to plan, focus attention, remember instructions, and juggle multiple tasks successfully. Flexibility is important in life and in learning. It refers to the ability to be adaptable, to improvise, and to shift to meet different kinds of challenges (Bigum & Rowan, 2004). A learner who has developed flexibility easily adapts to changes and responds positively to unfamiliar situations, even in the face of adversity or uncertainty. A lack of flexibility in learning situations may produce stress responses, have an impact on mood, and negatively affect learning motivation and academic performance. Flexibility is often called upon in collaboration when situations call for compromises in decision making. According to Willis (2016) learners with flexible mindsets are characterized by:

- Open-mindedness to different opinions, perspectives, and points of view;
- Willingness to take risks and make mistakes;
- Consideration of multiple approaches to problem solving;
- Ability to listen, reflect, and plan before taking action.

An international review published by OECD (2020) suggests that mindfulness interventions have the potential to help learners become more flexible, and to encourage conscious control of their thoughts, feelings, and actions for greater adaptability in new situations. Mindfulness practice has also been shown to improve cognitive flexibility which in turn supports openness to new information, learning new ways of looking at the world, and seeing situations from various perspectives (OECD, 2020).

LESSONS LEARNED FOR RESEARCH

Education researchers play an important role in redefining and re-conceptualizing teaching and learning practices. If teacher educators took up the advice offered around mindfulness and compassionate teacher education, future teachers could experience a reduction in the amount of job-related stress and embrace greater joy and creativity in their teaching and learning. Mindfulness and compassion could pave the way for greater job satisfaction, greater feelings of accomplishment, and the ability to take on new tasks with confidence.

Mindful and compassionate research practices require that educators and practitioners be simultaneously conscientious of social realities and inequities and find ways to make systemic changes to education systems. These practices center humanity and pave the way for high quality learning experiences that position learners as knowledgeable and creative people who work in service of each other. Mindfulness and compassionate practices aim to create intergenerational spaces for education that foster lasting relationships among learners and their community. Moreover, they aim to encourage the value of lifelong and life wide learning.

From a research standpoint, teacher educators may intuitively know when instruction makes an impact on students by collecting anecdotal evidence of students' preferences and moments of transformation. However, more systematic approaches to collecting data around mindfulness and compassion are needed. Longitudinal data collected over time that connects mindful practices with outcomes through data collection such as journaling, surveys, and interviews is needed. These methods can be employed to track changing attitudes and behaviors of learners and facilitators at all levels of the education system. Additional assessment measures still need to be developed to evaluate the effectiveness of mindfulness instruction and relationships to learning outcomes. Data that tracks teacher education programs as well as pre K-12 school-wide impacts of mindful and compassionate human-centered educational approaches can yield impactful and actionable results that drive the field beyond 2020.

LESSONS LEARNED FOR PRACTICE

Teaching practices can be supported by a range of practical strategies to advance pedagogies that are mindful and compassionate. Whether teacher education classrooms are online or face-to-face, designing instruction that is interest-driven, interactive, and multimodal is paramount to supporting engagement. In the sections that follow, several ideas are offered. These illustrative examples, strategies, and techniques are not exhaustive but are instead meant to inspire a wide array of adaptations and innovations. With the intention of helping teacher educators in their work with in-service, pre-service, and teachers-in-training, the sections that follow introduce a flexible set of mindful practices that applied within diverse teaching contexts.

Enacting Mindfulness and Compassion

With social distancing and the rapid shift to fully distance learning in 2020, many teacher educators may have felt less connected to the pre-service and in-service teachers whom they serve. However, it is possible to include mindfulness and compassion through daily practices of communication, community building, and creativity (3Cs), even when teach-

ing remotely. When teacher educators exercise mindfulness and compassion, they become better communicators, community builders, and creators. In the following sections, we discuss these traits of mindful and compassionate teaching in the form of techniques and strategies.

Before delving into the details of the 3Cs, it's important to point out that there are tools educators have traditionally used to empower themselves to gain strengths necessary to carry on with their 3Cs. However, what sounds good in theory does not always translate in practice. Teacher educators need to have the capacity to be resilient, adaptable, and flexible in the moment at the right places and times.

What tools can help teachers develop their mindfulness and compassion muscles? The authors are cautious in addressing this question because there are numerous options that may or may not work for different individuals. Meditation is one of the most widely practiced ways to enhance one's mindfulness and compassion. Immediately, some readers may start to visualize a person doing breathing exercises, sitting on a cushion with eyes closed. However, meditation comes in many different shapes and forms. For some, meditation is taking a stroll in the sunset, which we call 'walking meditation.' For others, it is playing a musical instrument and developing their ability to focus on the present (e.g., concentrating on the performance and nothing else).

Regardless of personal choices and preferences, it is crucial to have support and guidance in one's mindfulness and compassion journey. Otherwise, one is prone to developing habits that may be detrimental to reaching one's full mindfulness and compassion potential. Therefore, we recommend finding learning communities and mentors who can answer questions and provide necessary course corrections while navigating through challenging times ahead. Through daily practices of mindfulness and compassion, especially in the face of unprecedented challenges, teacher educators can persevere. Foregrounding the 3Cs -- communication, community building, and creativity support teachers-in-training to create and sustain quality education practices. The 3Cs are also compatible with the use of digital technologies, which can be useful for guiding instruction whether delivered through distance learning or face-to-face.

Communication

Being a mindful communicator means *being present and actively listening* (Prince-Paul & Kelley, 2017) and being responsive to other's needs. It is not simple to fully attend in conversations at all times. As educators, we need to train ourselves to remain present, listen actively, minimize distractions, and stay in the conversational moment. Listening opens up opportunities to learn about the concerns and worries of teachers-in-training personally as well as professionally. Ask questions and find out about their goals and challenges. Ask about their lives and families. Listen actively, take note of commonalities to make personal connections.

One of the keys to mindful communication is *attending to others' assumptions, cognitions, and emotions as well as one's own* (Lane et al., 2009). To accomplish this behavior, knowledge of the culture of one's communication partners is essential. There are often various cultural barriers to overcome (e.g., generational, linguistic, ethnic, etc.). To this end, offer opportunities for learners to respond and create responses in different ways (orally, in writing, pictorially, and through creative means). The use of different modalities paves the way for humor and empathy, and encourages learners to appreciate multiple unique forms of expression, which transcends cultural boundaries.

Being a mindful communicator involves practicing *unconditional friendliness* (Chapman, 2012). Whether online or offline, arrange a predictable time and space for drop-in support for answering questions or for open-ended socializing. Making space for personal connections, sharing stories, and inviting teachers-in-training to let down their guard and be themselves can make communication more effective. The sections that follow offer guidance on ways to think about communication in ways that are mindful, compassionate, and respectful.

Be available in different ways. During 2020, educators should have learned that a single communication method cannot be reliable for everyone. Not all people can be reached the same way, or prefer to interact the same way. Each person has preferred means they choose for communication. Adopt a variety of strategies and use different platforms to reach everyone. For example, offer times to connect right before and right after classes are held. Showing up a little early before a Zoom session or staying after your formal class ends to connect takes a bit of effort and can be more convenient. No additional time needs to be spent on confirming appointments or sharing video conference links. When deciding which platform and method to use for communication, think about the urgency of the message and the ease of communication immediacy given the purpose. Consider reaching out in multiple ways. When one approach does not yield results, try another. The important idea is to keep trying. Continue reaching out in different ways to establish connections. Use multiple communication channels including:

- Connecting one on one (Zoom, Skype, FaceTime, Phone calls);
- Using Messaging groups (WhatsApp; Signal);
- Sending frequent personal and group email;
- Posting to a shared website or learning management system (D2L, Canvas);
- Social media platforms (Facebook, Twitter, Instagram, Reddit).

Keep lines of communication open and free flowing. It is vitally important to consistently and systematically communicate with teachers-in-training, not just out of necessity but for the purpose of staying connected in times of uncertainty. Stay connected whether or not there are vital communications to share or not. Use frequent communication as an entry point to strengthen relationships. Then, when important messages need to be conveyed, educators are not scrambling to find the means to push out information quickly.

Set a positive tone of trust and care. Listen to better understand the concerns of teachers in training. Be gentle, warm, and positive to everyone, whether the communications take place via phone, email, text, in person, or on social media. Be welcoming and positive and offer encouragement and support without judgement. Foster a sense of trust by assuring teachers-in-training that communication with you will be kept confidential and that you will act in their best interest. Be mindful that teachers-in-training have different backgrounds, communication styles, and beliefs. Engage them in regular conversations. They may feel overwhelmed, and taking extra time to connect may be reassuring.

Infuse personality into communications. One of the most rewarding parts of teaching future teachers is forming relationships and watching them grow, learn, and thrive as they launch their teaching careers. Future teachers are motivated and inspired to see the excitement of learning through your enthusiasm for teaching. Foster connection by injecting your personality into teaching. Do not shy away from using memes to communicate or from making a joke that connects learning experiences to popular culture. Being human can build the foundation for connection in multiple ways.

Community Building

Humans do not learn in a void, instead, for many learners, the act of learning is primarily a social activity (Bruner, 1996). Social learning creates community and can be used affirming and sustaining practices that illustrate respect for all learners (Manderino & Castek, 2020). Community building is a safe place to explore relational trust in a way that is sustaining, deeply rooted, with a sense of groundedness. A phrase common to community building has been "sharing is caring". Sharing means thinking together, negotiating, collaborating, and co-creating. In addition, the learning community is flexible and adaptable to changing conditions.

In many ways teacher education learning communities in 2020 promoted connection over content. Schools adapted to meet the needs of the community. Many school districts became the central node in meal distribution fighting food insecurity for those who depend on free and reduced-price breakfast and lunch for their nutritional needs. These connections with other educators were reassuring as much as they were important sounding boards for testing new ideas. By showing care and giving care to teachers-in-training, teacher educators promote stability and human-centered connection.

Community building activities can develop empathy and provide outlets for connection. Ice-breakers, for example, act as warm-up exercises that support personal connection through shared human experiences. Drawing on a shared Zoom whiteboard space at the start of class can tap into creativity and help learners relax and feel more comfortable in the moment. In Figure 3, a teacher educator asked the class to draw their favorite fall treat, followed by a short discussion.
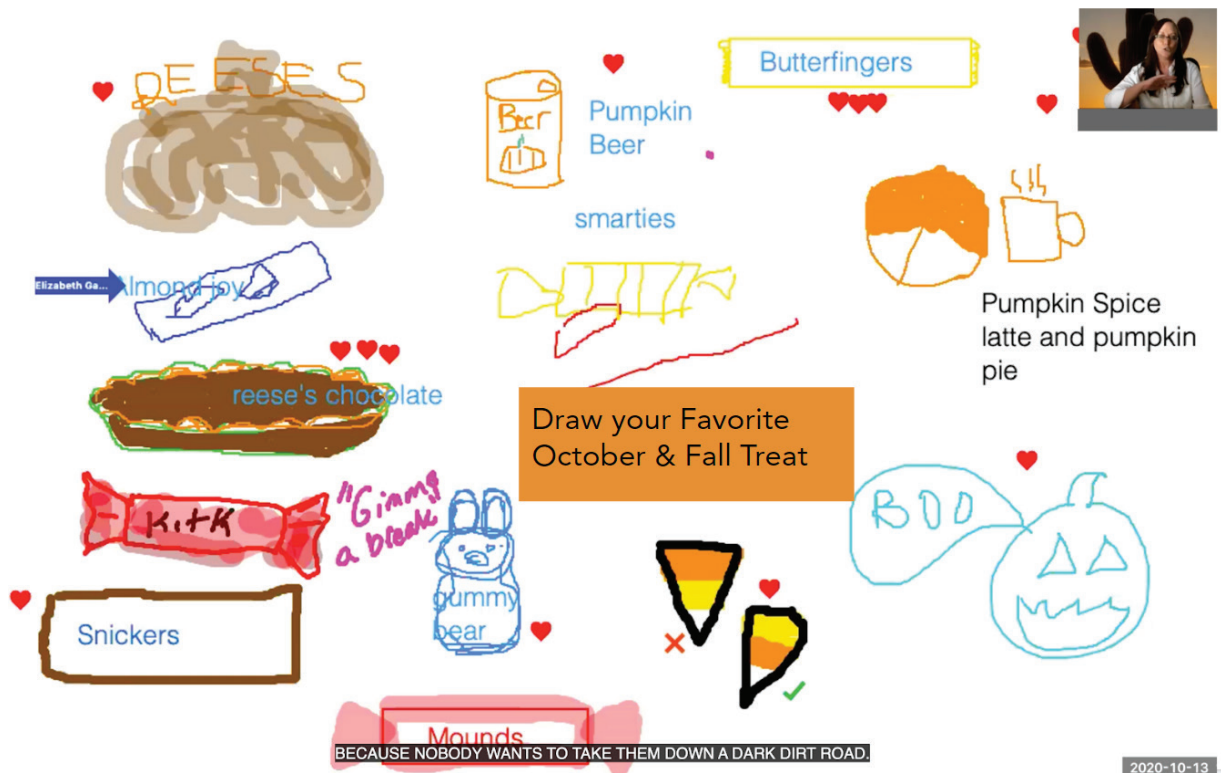
Figure 3. Community-Building Drawing Exercise through the Zoom Whiteboard Feature.

Creative forms of connection help personalize instruction and provide touchstones for learners (Hetland, 2013). In addition, connections, both personal and professional, encourage learners to get to know one another and support friendships which can be used as learning supports combatting feelings of isolation.

Many learning contexts are built on community principles of discussion, collaboration, risk taking, and cooperation among learners with different experience and knowledge. While learning is the main goal for teacher education classes, taking time to discuss feelings, for example displaying an emoji chart and asking teachers-in-training to circle the emoji that represents how they are feeling, can open up safe spaces for dialogue and act as an outlet for connection and empathy (Mussey, 2019). Mindfulness techniques can be used as strategies that help learners cope when feelings of doubt become overwhelming.

Creativity

As humans, we use our creativity to tell stories; we use these stories to make sense of experiences (Bruner, 1996). These stories can bring humanity into the forefront of our thinking. Stories contextualize facts and ideas and help teachers-in-training apply them. Creativity can shape and transform our thinking, expand our outlook, anchor our learning, and deepen our thinking about the physical, geographical, and cultural world.

Everyone has the potential for creativity. In teacher education, learners are encouraged to experiment with their own creativity and welcome new ideas with an open mind. Hetland (2013) suggests that "creativity makes new things and makes old things new—new problems, new solutions, new realities—things not conceived before" p. 68. Creativity can be unleashed in many ways and creativity embodies important aspects of mindfulness. Creative teaching may support active learning encouraging the expression of ideas and opinions in multiple forms. In addition, creativity may encourage the transmission of meaningful and mindful thoughts in unique ways. Tapping into our own creativity, and supporting the creativity of others, may encourage investment in learning and in turn may deepen commitment to learning.

Learning is an experience through which learners experiment with their own creativity (Hobbs, 2017). For creativity to surface and flourish, mindfulness and compassion are needed. Mindfulness unlocks creativity and frees creativity.

Mindfulness encourages energy to be channeled toward self-expression. Reflecting on expressions of creativity and celebrating artifacts of creativity are acts of mindfulness that unleash human connection. Creating to learn (Hobbs, 2017) involves immersing learners in the act of meaning making not by viewing or listening to how others have come to understand but instead by engaging and constructing their own understanding.

Teacher education programs support teachers-in-training in building a solid foundation of instructional strategies which include creativity in the expression of ideas as well as in problem solving. In the digital age, a range of technologies can be used to encourage multiple ways of representing learning. Ryoo & Winkelmann (2021) compiled resources and ideas for use of technologies that include multimodal learning, personalized and adaptive learning, and use of cross-reality (XR) in learning, each of which are compatible with mindful learning. For example, multimodal learning encourages the development of literacies that adapt readily to changes in the instructional context (Bouchey, et al, 2021), mindsets that accommodate flexibility in the face of changing conditions (Taylor, et al., 2021), and adaptability to all situations, which supports teachers in training in lifelong, life wide learning pursuits that continually support learning how to learn (Leu, et al., 2017). Creativity can become even more transformative when mindfulness and compassion are exercised as demonstrated in the examples that follow.

Creating Immersive Virtual Field Experiences. In the pandemic, restrictions on gatherings opened up new opportunities for immersive virtual exchanges. Many teacher educators have explored the creation of immersive virtual field experiences to expand the connections and help combat feelings of isolation. During these experiences learners are transported into visually and auditory learning environments, that they navigate and investigate using an inquiry process.

Thinglink (https://www.thinglink.com/en-us/edu) is a free program for educators that can be used to create interactive experiences. By linking images, videos, and 360-degree content with text, links, images, and videos a creative, multi-layered visual story emerges. Thinglink makes it seamless for a creator to upload their own source images, and then to embed hotspots enhanced with multimodal annotations, narrations, or links to online media that allow a creator to design a custom, personalized, and immersive experience.

An example of an Thinglink based immersive virtual experience that encourages connection with the natural world is *Save the Black Crested Gibbon from Extinction* (https://www.thinglink.com/video/1058329139414564866). This project advocates for saving habitat and protecting endangered species. Using numbered annotations, sounds, and imagery, viewers engage with the visual and auditory content in expansive ways. Virtual field experiences that most resonate are those that link out to accurate and relevant information that enhances the meaning-making experience. Sights, sounds, images, and captions are creative ways to guide a learner through an immersive 360-degree experience. Learners who engage with virtual field experiences are transported to new places through engaging and creatively presented content.

There are thousands of pre-made virtual experiences on the internet that integrate virtual and augmented reality and can make them more engaging (Castelo, 2020). However, scaffolding teachers-in-training to create their own immersive materials engages them in interest-driven, learner-inspired acts of creativity. In this way, the experience of creation deepens engagement and offers opportunities to be creative and to engage with different locations and cultures in context (Hobbs, 2017), further connecting creativity with human connections.

Digital Storytelling. Digital storytelling is the modern expression of the ancient art of storytelling (Barrett, 2005); a mindful practice that unleashes creativity through the integration of multiple modes of expression and meaning making. Digital storytelling has become increasingly popular in recent years, as shown well in the examples of YouTube, podcasting, or Second Life (https://secondlife.com/). Teachers-in-training are often familiar with diverse platforms and tools for content creation such as Second Life, OpenSim: http://opensimulator.org/wiki/Main_Page, Xtranormal: http://www.xtranormal.com/, or Garry's Mod: https://gmod.facepunch.com/). Within these platforms, interactive videos can be easily made, played, and shared.

In a recent project, "Building a Big Data Analytics Workforce in iSchools" (https://sites.psu.edu/bigdata/), digital storytelling was used to examine big data and bring awareness. Learners developed digital stories that raised awareness about big data in diverse disciplines and applications. While putting together a story, participants used their personalized creativity to learn incidentally. Their mindfulness encouraged forms of creative self-expression. On a conceptual level, they expressed where and when a large amount of complex data is generated (continuously), why it is difficult to handle it with conventional approaches, why it is important to be able to deal with big data, and how to analyze big data. Participants selected topics from a precompiled list that cuts across different disciplines (e.g., astronomy, meteorology, computer science) and data types (e.g., video clips on YouTube, tweets on Twitter, mobile sensor data), or they could customize their own options. An example of big data awareness storytelling was a plot featuring a big data use case in computational physics as shown in Figure 4.
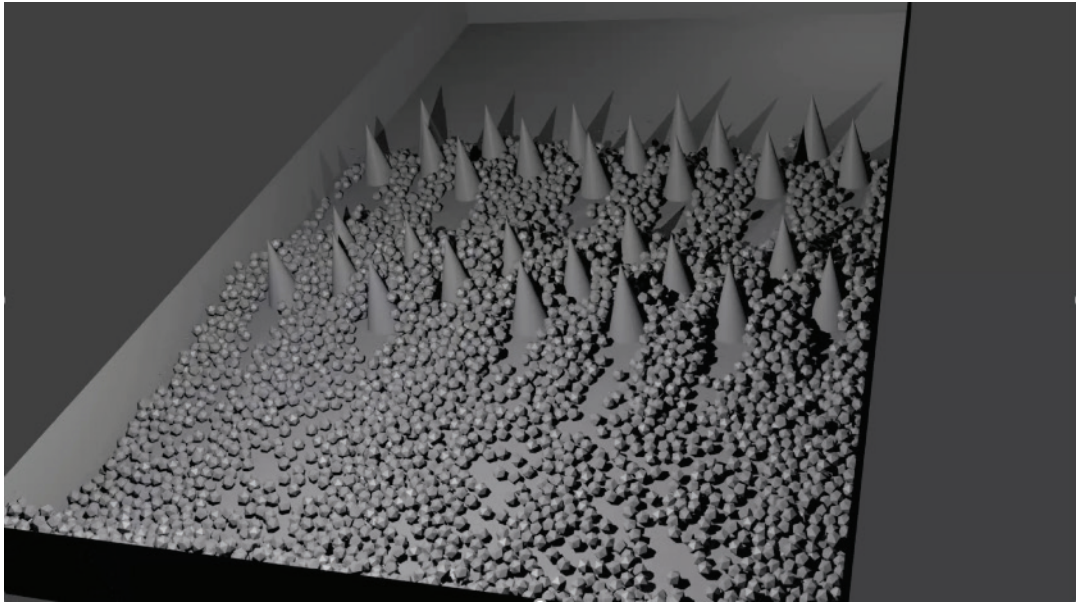
Figure 4. An Excerpt from a Learner's Digital Storytelling Video Explaining Big Data in Computational Physics.

Lessons Learned for Practice: A Summary

Implementation of compassionate learning in our teacher education classrooms and beyond requires a proactive stance. It is never too early or too late to begin centering mindfulness and compassion in our practices. With concerted efforts, these practices can make a big difference. There are no perfect ways to connect the three practices we highlighted in this section to instructional design solutions that work for all learners in all situations. Likewise, no single strategy or technique will meet the goal of responsive, quality instruction without cultivating and demonstrating genuine caring for learners, which stems from mindfulness and compassion. As educators, we strive to listen, empathize, and re-design to meet the needs of those around us. The strategies offered in this piece are offered not as a roadmap but instead as an inspirational way to build on lessons learned from 2020 to help re-conceptualize what it means to be a teacher educator, learner, researcher, and leader in uncertain times.

Exercising mindfulness and compassion in teaching and learning pursuits provides teacher educators with strategies and techniques to face adversity and weather changing times. It is important to think in small increments, and to try to make tiny incremental steps toward mindfulness and compassion every day. Being mindful is about being curious and asking questions, and being reflective. Every new journey is a time to seek out mentors and to take advice from knowledgeable others. Even small scale changes make a positive impact. Just as teaching is an act of becoming, enacting mindfulness and compassion is an evolutionary process.

WHAT YOU SHOULD READ

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Designing for Students in the Margins Online: Applications of UDL in 2021 and Beyond

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Abstract: The year 2020 was rife with crises, from the global pandemic, to the effects of systemic racism, and ongoing challenges due to climate change. As education systems across the United States grappled with the rapid shift to remote instruction, existing inequities were brought to the forefront. Recognizing the power of historical moments to drive systemic change, this chapter identifies lessons learned from the efforts to meet the needs of students with disabilities through the provision of online learning in 2020. Our key lesson of focusing on designing online learning environments for students in the margins highlights a solution that special education teacher preparation programs can pursue in supporting their candidates in creating a more just and inclusive educational system online or otherwise. As opportunities to engage in online learning environments expand for all students, it is imperative that all teachers be prepared to develop and implement practices aligned to the tenets of UDL in order to support the needs of all learners.

Lesson Learned: Teacher educators should have learned that there is no one-size-fits-all approach to designing learning environments.

AN INTRODUCTION TO DESIGNING FOR STUDENTS IN THE MARGINS

Equity, access, and inclusion have been long standing issues in special education that ultimately created numerous challenges for districts, schools, and teachers during the transition to remote learning in response to the coronavirus pandemic in 2020. Without minimizing the difficulties faced by many throughout the past year, it is our aim to explore how responses to the challenges that were faced in 2020 might point to solutions to problems that plagued our schools *before* the onset of the crisis and that will likely be more pronounced when students finally return to school for face-to-face instruction full time (Dorn et al., 2020). If history can provide us any comfort, it would suggest that 2020 has the potential to be a year that spurs positive change, both societally and in the classroom. Looking back on other globally significant events throughout history (e.g., world wars, political and industrial revolutions, periods of societal unrest), the hardships experienced during these events have the power to unleash our collective innovative spirit in ways that impact all aspects of society, from the jobs we do, the ways we spend our leisure time, and the tools that enable these pursuits. These changes ultimately permeate the classroom, influencing how we teach and what it means to be educated (Edgar, 2012).

In this moment, schools are grappling with addressing the learning needs of students who remain in distance or hybrid learning while at the same time preparing to address the anticipated gaps in student knowledge and abilities when they return to school buildings full time, recognizing that some students have been able to excel in the distanced format while others have barely been able to connect with their teachers. This is the time for teacher educators to embrace the principles of universal design for learning (UDL; CAST, 2018) and to ensure teacher candidates are prepared to employ the UDL framework in their future classrooms. This framework encourages educators to develop instruction that allows for multiple means of engagement, representation, and action and expression. Undergirding this framework is the belief that by reaching to students in the margins - those students who have historically been overlooked in traditional education settings, including those with disabilities - schools will be better suited to support the learning of *all* students. Framed within multiple instructional design frameworks are lessons for teacher educators and professional development providers to consider as they prepare and support pre- and in-service educators to support students with disabilities in post-pandemic classrooms. This chapter will review some of the lessons teacher educators should focus on to support the effective deployment of technology in classrooms to support the diverse learning needs of all learners by focusing on the needs of students with disabilities. Specific focus will be paid to how online instruction can be made more accessible by preparing future special education teachers to engage students effectively in the medium as these environments inevitably become a larger part of the K-12 instructional ecosystem.

WHAT WE KNOW

Despite the many challenges faced by school systems during their transition to virtual and hybrid instruction (and there have been many), this shift has spurred innovations that may, ultimately, be beneficial for students and teachers. In particular, this shift has pushed schools to adopt and employ technological tools like never before. Prior to 2020, trends pointed to the increased use of online instruction in both K-12 and postsecondary settings (National Center for Educational Statistics, 2020). This trend is not particularly surprising. Throughout the 20th and 21st century, there was a clear pattern of the adoption of technologies that were not developed for the classroom (e.g., radios, televisions, personal computers, and the internet) ultimately being adopted for pedagogical purposes as educators became familiar with the pedagogical affordances of these technologies (Crouse, et al., 2018). Given the increased investment in technological infrastructure to deliver instruction to students over the course of the pandemic, however, it is projected this trend will not just continue but will accelerate (Dwahan, 2020; Rapanta et al., 2020).

While the current reliance on technology has been borne primarily out of need due to the pandemic, it is clear that the thoughtful adoption of instructional technology (IT) holds a significant promise for meeting the needs of a wide range of learners given the flexibility with which many of these technologies can be adapted. Technology adoption in the classroom should ideally be rooted in pedagogy that builds upon the core ideas of instructional design, emphasizes the use of evidenced-based frameworks and practices, and involves ongoing evaluation of specific technology-based pedagogical approaches (Admiraal et al., 2017; Darling-Hammond et al., 2020). This is particularly true for educators interested in utilizing technology to support students with disabilities, for whom the use of assistive and instructional technology (AT/IT) has long been a key component of their educational experience (Andersen & Putman, 2020).

Despite the evidence that AT/IT can be used to benefit students receiving special education services, it is evident from the number of lawsuits related to the provision of free and appropriate public education (FAPE) over the past year that the strategies being employed in distance learning during the pandemic are not meeting the needs of students with disabilities (Kamenetz, 2020). This is likely due to the fact that technological choices made during the pandemic were not necessarily based on pedagogical rationales that addressed the individual learning needs of students and should not be taken as evidence that AT/IT is not beneficial for many students with disabilities. Instead, it points to the need to consider a student's unique learning needs when adopting AT/IT.

While providing instruction on the use of the UDL framework, teacher educators also need to be cognizant of the needs of future teachers to be able to evaluate the affordances and constraints of new technologies before they are adopted into classrooms. The TPACK framework illustrates the relationship between teachers' technological, pedagogical, and content knowledge in adopting and applying technologies to their instruction (Courduff et al., 2016). Just as teacher efficacy may be limited if they have weak knowledge of either the content they are teaching or of effective strategies for instruction, so too will their efficacy be limited if they do not have knowledge how to employ AT/IT. In this regard, as teacher preparation programs infuse UDL into their curricula, they must consider how they prepare future teachers to evaluate new technologies, recognizing that it is difficult to predict what technologies will be developed in the next several decades. At the same time, teacher educators should consider how future teachers are prepared to collaborate with their colleagues both through and about technology as a way to ensure any AT/IT that is adopted is useful for all students.

Technology Trends and Issues in Special Education

AT/IT have long played a critical role when it comes to supporting students with disabilities (Edyburn, 2013). Traditionally, technology has been seen as a way to augment students' abilities to facilitate access to various educational tasks or environments that may be inaccessible due to their disability (Bouck, 2016). For students with disabilities, technology are not merely tools of convenience, but instead provide students avenues for expressing themselves and their knowledge, engaging with otherwise inaccessible content, and accessing the communities they inhabit (Okolo & Dietrich, 2014). In classrooms and in society at large, there is a tangible link between innovations in technology and increased access for individuals with disabilities (Anderson & Putman, 2020). The progress made in the advent of tools that create access for students with disabilities in the last decade alone has been astonishing. This includes tools made for mass utilization with accessibility features built right in (e.g., phones, personal devices, tablets) and tools made specifically for individuals with disabilities (e.g., communication devices, mobility supports).

As access to personal devices and widespread internet availability have become somewhat of a norm, there is an increased opportunity for technology not only to provide access points into learning environments or tasks, but also entirely alternative routes to engaging in the teaching and learning process as well. As a result of this rapid expansion in the availability of technology and the increasing capabilities of AT/IT, the field of online special education has also been on the rise (Smith & Basham, 2016). This includes a pre-COVID-19 trend highlighting increased enrollment of all students in K-12 and postsecondary online settings (NCES, 2020). Highlighted in this growing field of practice and research is the idea that online instructional materials, through which multimedia learning tools can be delivered, offer students options in their learning that play more to student assets and eliminate barriers to learning (Smith, et al., 2019). For example, for students with reading difficulties, access to assistive technologies that read to students or even instructional videos that cover the same content only continue to grow in availability in schools.

Development and the Research to Practice Gap

As technology has made rapid advancements to meet market demands, research into the specific technologies schools or districts invest in often have limited empirical evidence supporting their use or guiding their implementation. This includes the utilization and implementation of online learning environments for special education service provision (Thomas, et al., 2019). This dynamic often leaves new and even veteran teachers with little guidance for implementing newer technologies or the technology available to them when they enter their classrooms. Knowing that we live in an interconnected global economy driven by technological advancement and innovation, it can be assumed that the market will continue to drive the ubiquity of personal devices, and that ubiquity will ultimately trickle into the classroom. Given

this reality and the likelihood that online work and instruction will continue to grow, there is a clear need for special education teacher preparation programs to prepare candidates to critically analyze technology to address their curricular needs and to meet the needs of their students across instructional environments. As witnessed by the frustrations experienced by students with disabilities, their families, and teachers during the transition to remote learning in response to the COVID-19 pandemic, students with disabilities will continue to experience opportunity and achievement gaps in not only virtual environments but face to face ones as well.

UDL in Special Education Teacher Preparation

To address these issues and support comprehensive teacher preparation program in developing experiences for special educators, a core lesson to be learned is that guiding conceptual frameworks for planning and evaluating online instruction are key. Most prevalent among these frameworks in the online learning in special education literature are the UDL Guidelines (CAST, 2018). In fact, when surveyed a majority of special education teacher preparation personnel reported UDL as a critical component for preparing future special education teachers to serve students with disabilities online (Smith, et al., 2016). When included in preparation programs, technology can lead to deeper levels of UDL implementation (i.e., more inclusive learning environments) that can translate to online environments (Moore, et al., 2018). To realize the promise technology and online learning environments for students with disabilities. The following provides research-based insights for how the inclusion of UDL as a foundational aspect of special education teacher preparation programs can foster candidates' abilities to develop and implement inclusive online learning environments.

What UDL provides teacher candidates and those who implement preparation programs is a framework for considering the needs of all students, regardless of the instructional environment or academic discipline. As described in education legislation, "Universal Design for Learning (UDL) means a scientifically valid framework for guiding educational practice that — (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient" (Every Student Succeeds Act, 2015). It is noticeable that the focus here is on developing systems that are supportive of all students, not just those with disabilities. However, as we have posited in this chapter, by focusing on the students in the margins (i.e., students with disabilities), proactive development of systems that address the needs of these populations provide support for all students to access (Darling-Hammond, et al., 2019; Rose, 2016). Put simply, by building environments that support our most diverse learners, the rising level of support lifts all learners.

Special education teacher preparation programs that foster their candidates' UDL implementation skills foster their ability to thoughtfully align their instructional goals, teaching methods and materials, and assessments to address their student's unique needs and curricular objectives (Rao and Meo, 2016). Teacher candidates who are able to thoughtfully consider academic standards, identify specific knowledge and skills targets from those standards, and then identify barriers that may be present to students will be primed for success in any learning environment. In online spaces in particular, teacher candidates steeped in UDL aligned practice will be able to thoughtfully and iteratively plan lessons that evaluate how their available AT/IT meet the needs of their students and address their content standards. Successful special education service delivery has always hinged on this style of systematic planning and evaluation and teaching students with disabilities online should be no different. Even as technology rapidly advances, preparing special educators to critically evaluate their pedagogy or available learning materials in relation to their students' needs and curricular objectives will prepare those candidates for success now and in the future.

LESSONS LEARNED FOR RESEARCH

Educators can no longer make assumptions about curriculum design and the factors that impact student achievement. While the effort to rapidly transition to remote instruction was a monumental accomplishment, the decisions for managing the logistics of this transition in response to the COVID-19 pandemic often left the most vulnerable student populations (e.g., students with disabilities, English language learners) at a disadvantage (Golloher & Love, 2020). The lesson to be learned from this experience is that when planning systems-level change, the best way to support *all* learners is to

focus on building systems that proactively consider students with the most extensive and diverse learning needs first. As Rose (2016) described, the foundation for the development of an innovative 21st century educational system is one that is built on options, customization, and an instructional design approach rooted in UDL.

In order to reach students in the margins, it is important that candidates develop skills in designing and implementing accessible and systematic standards-based instruction. Underlying this instruction should be approaches that provide students options and addresses barriers to success. This systematic approach to considering student needs in the alignment of standards, accessible instructional methods and materials, and assessment also provide a clear avenue for the implementation of the types of AT/IT that are critical to UDL, the elimination of curricular barriers, and inclusive practices (Smith et al., 2019). While initial evidence exists that highlights how teacher preparation programs can develop candidate's knowledge and self-efficacy in these areas, research needs to address the most crucial next step in the process, implementation. Specifically, future research is needed to highlight: (a) experiences programs can provide to increase candidates opportunities and skills for implementing AT/IT across classroom settings, (b) how special education and general education teacher candidates can collaboratively plan and implement technology in pre-service coursework, and (c) strategies for utilizing the UDL framework to plan, implement, and reflect on the delivery of instruction online.

LESSONS LEARNED FOR PRACTICE

The response to the COVID-19 pandemic provided critical insights into the role teacher preparation will play in preparing future special educators for the changing landscape of service provision to students with disabilities. Special educators already serve students with disabilities across a continuum of least restrictive environments, it is hard to envision systems of education existing without online offerings in the future. Therefore, preparing pre-service candidates to meet the needs of students with disabilities across multiple online instructional models is crucial. Though the response to the COVID-19 pandemic highlighted the challenges associated with providing services to students with disabilities online, abandoning the digital medium can have negative impacts on both students with disabilities and the teachers that serve them. For example, as online learning environments inevitably grow in use in K-12 environments, limiting students with disabilities to face to face only instruction creates an opportunity gap for students and hampering their college and career readiness in a professional landscape with growing utilization of remote work and learning. It is also counterproductive and a step backward to the professional responsibilities of special educators who would be forced to siloize their service provision to students in segregated environments rather than work collaboratively with their colleagues to deliver services in inclusive physical and/or digital spaces. To provide guidance for preparing future special educators to meet the challenge of providing inclusive online instruction, the following provides core areas of programmatic planning and implementation special education teacher preparation programs can address to prepare special educators for digital teaching.

Develop Core Competencies with a Focus on Online Learning

There is a considerable body of literature that highlights the ability of special education teacher preparation to increase candidates' self-efficacy and planning abilities for successfully including students with disabilities in learning environments with their peers (Li & Ruppar, 2021). Guiding much of this work is the utilization of the UDL Guidelines (CAST, 2018) that provide a framework for evaluating and implementing curriculum that is accessible for all learners. Highlighted by the Every Student Succeeds Act (ESSA, 2015), UDL provides a pathway for teachers to create learning environments that are inclusive of all students and their needs, regardless of delivery mode (i.e., face to face, online) or content area. While there are detractors to the framework (Murphy, 2020), there is evidence to suggest that as a framework, the UDL Guidelines provide a conceptual underpinning for how educators communicate for and plan to address the diverse learning needs presented by all students in inclusive classrooms (Courey, et al., 2013; Evans, et al., 2010; Gritful-Freixnet, et al., 2020).

What is missing from this research however, is the crucial next step in developing preservice teacher's skills, supporting and measuring candidates' abilities to implement practices aligned to the UDL Guidelines (Hollingshead, et al., 2020; Rao, et al., 2014). These challenges related to the implementation of inclusive practice or practices aligned to UDL that address the diverse needs of students with disabilities often contribute to teacher stress, job dissatisfaction, and ultimately attrition (Billingsley & Bettini, 2019). These challenges with implementation were evident throughout the sus-

tained response to the pandemic as frustration around implementing services inclusive of student needs often led to calls for a return to face to face instruction for students with disabilities, leaving the future of online learning in K-12 environments for this population in question.

What special education teacher preparation programs can do to learn from the response to COVID-19 is that implementation of the practices covered in coursework should begin prior to fieldwork. While most preparation programs follow an introduce, practice, and apply model for core programmatic topics, application of pedagogy should extend from the beginning to the end of a candidate's preparation. This is especially true for the developing field of online special education service delivery. As it relates to online learning in special education, this focus on increasing teacher candidates' capacity for effectively delivering instruction across online instructional models should be comprehensive as well. In special education teacher preparation programs where AT/IT, methods, and assessment focused courses lead into one or more cycles of pre-service fieldwork, meaningful opportunities for practicing and applying evidenced-based and high-leverage special education strategies in online environments is key.

Technology Focused Coursework

AT/IT have a long history of supporting students with disabilities. In fact, technology is seen as key to implementing UDL aligned practice in special education (Edyburn, 2010). While coursework in this area has traditionally focused on using AT/IT to provide students with disabilities pathways into general education classrooms, an added focus of preparing pre-service candidates for inclusive online instruction is necessary post-COVID. To prepare candidates for effective online instruction delivery, AT/IT focused courses should make clear connections to the technological, pedagogical, and content knowledge (TPACK) framework (Kohler, et al., 2013) to highlight how instruction that is rooted in effective discipline specific teaching practices and is delivered through technology effectively can augment and supplement teacher led instruction across online, hybrid, and flipped classrooms.

While the UDL Guidelines (CAST, 2018) will continue to play a key role in developing teachers capacity to identify barriers to student learning, AT/IT focused courses should take the next step and support candidates in clearly articulating the role AT plays in allowing students to access specific curricular environments or tasks; and how IT provides students multiple means of content representation via multimedia that provide alternatives to a medium (e.g., text, audio, video) that may not be accessible due to their disability. Then finding ways to deliver this content through available technological means (i.e., learning management systems, video platforms, teacher created websites) in a way that supports independent student navigation will be key in providing candidates with initial opportunities to explore teaching online. Allowing students to identify key learning objectives from academic standards and developing or curating digital instructional materials to meet those standards early on in their coursework is a key first step in developing their capacity for teaching online.

Methodology and Assessment Coursework

While special education teacher preparation programs are often more focused on strategies that support student access to content areas and not necessarily discipline specific pedagogy, methods courses can play a key role in providing candidates their initial opportunities for the implementation of new pedagogies. Additionally, assessment courses can support teachers in becoming more reflective practitioners. In their methods courses, candidates can further their ability to plan standards-based instruction and develop instructional materials that align to discipline specific strategies. Because special educators are typically trained to work in a variety of classroom settings across all grades K-12, providing thoughtful preparation for delivering standards-based instruction via technology in a variety of delivery modes (e.g., synchronous, asynchronous) is important. Highlighting how thoughtful planning and implementation of technology to meet standards can allow candidates to utilize the skills necessary for teaching in synchronous, asynchronous, and even hybrid or flipped classrooms. Allowing students to plan, design, and implement instruction via technology across the various online learning models is a key next step to preparing candidates to utilize technology to teach online or provide supplemental learning opportunities to their students to augment their face to face instruction.

Additionally, in their assessment courses, teachers should be prepared with the necessary skills for reflecting on the efficacy of their instruction. Using student performance as a reflective tool allows candidates to engage in the iterative

nature of lesson development key to instruction in any environment. Combined, methods and assessment courses should prepare teachers to answer the following questions: (1) What will I be teaching?, (2) How will instruction be delivered? (3) What methods and materials will I utilize? and (4) How will I know students have mastered the learning objectives? Answers to these questions should include thoughtful consideration of academic standards, alignment of specific AT/IT to student needs and learning objectives, and assessments that will allow students to authentically demonstrate what they have learned. Providing opportunities for candidates to design and present these materials to their peers and instructors can allow them to present their rationale for how they aligned their standards-based objectives to their specific online instructional methods and materials while receiving critical constructive feedback. In addition to preparing candidates to implement online materials, these exercises prepare them for the collaboration and co-planning necessary for teaching in special education.

Interdisciplinary Preparation

In addition to providing candidates opportunities to develop their skills related to delivering instruction online it is important to provide candidates with opportunities to work collaboratively with their peers in other disciplines. Collaboration is a reality of special educators day to day tasks and preparation programs should reflect that as well. If special educators are going to provide inclusive online instruction, it is key that both special and general education teachers be prepared to utilize each other's skill sets to design and implement inclusive online learning environments. In teacher preparation programs this can include cross listed course offerings that have general and special educators receive methods, assessment, and technology training together; planned structured learning opportunities or student conferences; or structured course activities that embed cross course and interprofessional practice opportunities. Where appropriate, these opportunities should extend to the related service personnel (e.g., speech pathology, occupational therapy) preparation programs training candidates to serve students with disabilities in K-12 schools as well.

Fieldwork

As online learning opportunities expand post-COVID, it will be important for teacher preparation programs to partner with districts that provide teacher candidates the opportunity to teach online. As a culminating experience, fieldwork should allow candidates to implement all they have learned and practiced in their coursework. This should come with supervision from expert mentor teachers and program personnel who will guide the candidate in all necessary planning and implementation efforts. In this stage, it is important for all involved that the focus be on candidate growth. The field of online special education is a growing one and expecting candidates to be experts in the area in their pre-service fieldwork can place undue stress upon them. Instead, small design and implementation efforts that lead into fuller utilizations of online or technology-based instruction can help candidates prepare for the variety of instructional environments and student populations they will work with. As is true with traditional fieldwork experiences, finding ways to gradually release responsibilities to candidates is key for preparing them to teach online.

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The Four Pillars of Digitally Infused Education:
Transcending Modalities in a Post-COVID Learning Environment

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Abstract: Historically, face-to-face and online learning modalities were distinct, requiring teacher educators to use pedagogical approaches uniquely aligned to these modalities. However, as high-speed Internet and technological innovations such as videoconferencing became more readily available, these modalities have blurred. When the COVID-19 pandemic hit, teacher educators were forced to mix and match technologies across learning environments. What the COVID-19 pandemic primarily achieved is to create impetus and urgency on a global scale for teacher educators to continually mix and match these modes to meet changing circumstances, thereby permanently erasing the lines. Post-COVID learning environments are more likely to be digitally infused at varying levels, with the use of technology defined more by the activity, lesson, or student need at the moment rather than the setting in which the learning takes place. Consequently, teacher educators will need to implement four pillars of academic and emotional supports to teach in a digitally infused learning environment: (1) Technology, innovation, and instructional design, (2) Flexibility and adaptability, (3) Building relationships, and (4) Pedagogy of Care.

Lesson Learned: Teacher educators should have learned from the COVID-19 pandemic that the distinction between online and face-to-face learning environments is now blurred, paving the way for digitally infused education that includes academic and emotional supports to ensure student success.

INTRODUCTION TO DIGITALLY INFUSED EDUCATION

Historically, face-to-face and online learning modalities were distinct, requiring teacher educators to use pedagogical approaches uniquely aligned to these modalities primarily because the capacity of the available technology limited these pedagogical applications. However, in the last decade, readily accessible high-speed Internet and videoconferencing systems that students and teacher educators can access on personal laptops or mobile devices has blurred the lines, creating a merging of modalities that are now enmeshed, providing teacher educators limitless options for merging these modes (Irvine, 2020). The current COVID-19 pandemic has further expedited this merger and, although the resulting emergency remote teaching practices implemented out of necessity are not generalizable to online learning per se, they have brought digital learning to the forefront, prompting teacher educators with varying levels of technological knowledge and skill sets to actively engage with technology in new ways to help students learn.

What the COVID-19 pandemic has primarily achieved is to create impetus and urgency on a global scale for teacher educators to continually mix and match these modes to meet changing circumstances, thereby permanently erasing the lines. While the frenzy of the emergency remote education itself will fade, the resulting pedagogical approaches will likely remain, and instead transcend modalities that will not fit neatly into the current descriptors for various types of digital learning (e.g., hybrid instruction, blended instruction, virtual learning, online learning, etc.). Future learning environments are more likely to be digitally infused at varying levels, with the use of technology defined more by the activity, lesson, or student need at the moment rather than the setting in which the learning takes place.

Instead of serving as a temporary "stop gap" in the instructional process until teacher educators can return to the face-to-face classrooms of the pre-pandemic era, emergency remote education in hindsight may actually become a transitional phase for future educational practices which will be primarily dynamic and equip teacher educators with a set of pedagogical tools that are not modality-specific but can be mixed and matched across educational settings and formats to meet student needs. Current research suggests that most of the strategies that appear to be effective in online environments are the same as those considered to be effective in face-to-face environments, including the use of multiple pedagogies and learning resources to address individual student needs (Lockman & Schirmer, 2020). Consequently, teacher educators in a post-pandemic era can expect to apply multiple pedagogical supports more flexibly to accommodate students who may be accessing their learning online, face-to-face, or remote, depending on their circumstances, and further provide learning resources to help these students navigate digitally infused learning environments to construct their own learning.

WHAT WE KNOW

The Constructivist Approach to Digital Education

Constructivism is a widely accepted learning theory that focuses on the student's use of their prior knowledge and experiences to help them make sense of new information by developing meaningful connections that extend their learning. The constructivist perspective also shifts the responsibility for learning information to the student away from the instructor as a primary source of knowledge (Jarvis, 2006). As online, blended, and digital based education continue to grow at the global level, the principles of constructivism theory seem to transfer seamlessly to these new modalities (Hoic-Bozic, 2009). Research indicates that instructors with constructivist orientation are more likely to integrate technology than instructors with a different philosophical orientation (Judson, 2006), and when constructivist learning and the use of technology are combined, the combination produces an effective instructional design that has the potential to naturally transform every aspect of the instruction from the instructional design stage to assessment practices (Rakes et al., 2006) When applied to digital education, constructivism often becomes a socially constructed experience where online learners connect and engage via technologies such as videoconferencing, social media, discussion forums, and chats. The relationships students generate and connections they make build meaningful learning opportunities that strengthen their learning (Jonassen, 1992).

When students are able to interact and have experiences with a variety of online resources, media, simulations and meaningful exchanges with others, they are active in their learning and likely to develop the level of thinking needed to be able to understand and solve the intended complex problems. This active stage is mostly desirable by constructivists and has significant implications from an instructional design point of view. Instructional design for digital learning

requires extensive planning, preparation, and technological expertise in order to be fully realized; however, by utilizing instructional technology with a constructive approach, instructors are able to provide for different learning levels and styles and diversify the range of resources provided to students. Constructivism and technology complement each other and seem to work together to provide the best results from both an application and theoretical perspective (Gilakjani et al., 2013).

Digital Education and The Remote Learning Experience

Digital education has been part of learning environments for more than a decade, and it is well-established in higher education institutions. In 2013, Martin et al. defined it as "learning that takes place in a variety of contexts, within and beyond traditional learning environments, utilising any type of mobile device" (p. 51). While this definition is certainly apropos, the COVID-19 pandemic challenged both teacher educators and students in new ways, primarily because of the external influences that necessitated rapid changes in the teaching and learning environments. Online education, for example, has been generally viewed as a thoughtful, well-planned process where teacher educators have at their disposal learning theories, instructional design approaches, and technologies they can manipulate to create the backbone of the learning experience. However, during the COVID-19 pandemic such planning did not happen due to time constraints which resulted in what is known as "emergency remote education" (Bozkurt et al., 2020; Hodges et al., 2020), now being recognized as its own branch of distance education, which allowed teacher educators to keep learning on the forefront but denied them the ability to "test-drive" strategies prior to implementation. Emergency remote learning/teaching is distinct from online learning because it reflects hurried, ad-hoc, emergency responses guided by faculty to ensure instructional continuity while online learning is web-based and "deployed as a deliberate and well-coordinated effort born out of an overall institutional plan and embedded in institutional curriculum and pedagogy" (Chaka, 2020, p. 6). These quickly planned changes to provide remote education rapidly created both challenges and opportunities that teacher educators were only able to ascertain through periods of reflection afforded briefly before the next semester when remote learning was needed, and further changes were made.

For students, the learning environment was interrupted because in-class experiences during periods of lockdown ceased and the physical environments, whether at home or in-residence halls, were not always conducive to learning. Remote learning, whether this included synchronous experiences via videoconferencing or asynchronous learning through online instruction, required students to exhibit greater independence and responsibility for learning as well as feelings of isolation, which increased anxiety (Son et al., 2020). Remote learning also required greater technical expertise and digital pedagogy skills, which was especially hard on those students who had little or no experience with digital technology and who had no expectations of taking classes online. Even when "face-to-face" classes resumed, social distance measures created communication challenges with peers who might be several feet away or who were remote on a screen. Consequently, the pandemic impacted social and societal aspects that affected students both emotionally and psychologically (Miller, 2020).

Teacher educators responded by building learning communities, sharing resources, tools, and knowledge, caring for others by keeping social and spatial distances, and taking advantage of transactional distance (Moore, 2013), which served to keep students psychologically and emotionally engaged and connected. This resulted in a set of pedagogical strategies that complemented the academic supports by creating a social support framework that offered emotional, instrumental, and informational supports while continuing to practice the skills of coaching, caring, and collaborating (Lloyd-Jones, 2020). Students surveyed during the pandemic indicated that these emotional supports were as important as the instructional design elements used to support academic aspects of learning (Mollenkopf & Gaskill, 2020). Given the influential nature of these social-emotional connections in the learning process, students' well-being should be recognized as a priority over the need to only teach the curriculum (Bozkurt et al., 2020).

As teacher educators began to reevaluate the teaching experience during the pandemic, what emerged were several pedagogical strategies that made student learning possible when the instructional environments shifted across multiple modalities that were no longer well-defined. These strategies, which reflect both academic and emotional supports and incorporate digital technologies based on need rather than modality, allow teacher educators to provide both academic and emotional supports and to incorporate instruction on how, as well as what, to learn, with the "how" including a range of digital learning skills as one of the many tools that can be applied to multiple learning conditions. These pedagogical supports can be summarized into four main strands, or pillars (see Figure 1), that will continue to be relevant for digitally infused learning of the future and provide teacher educators with the means to reevaluate the form and function of

student learning through relocating and repositioning (Moorhouse, 2020), and engage students in meaningful learning regardless of where or how the learning takes place.
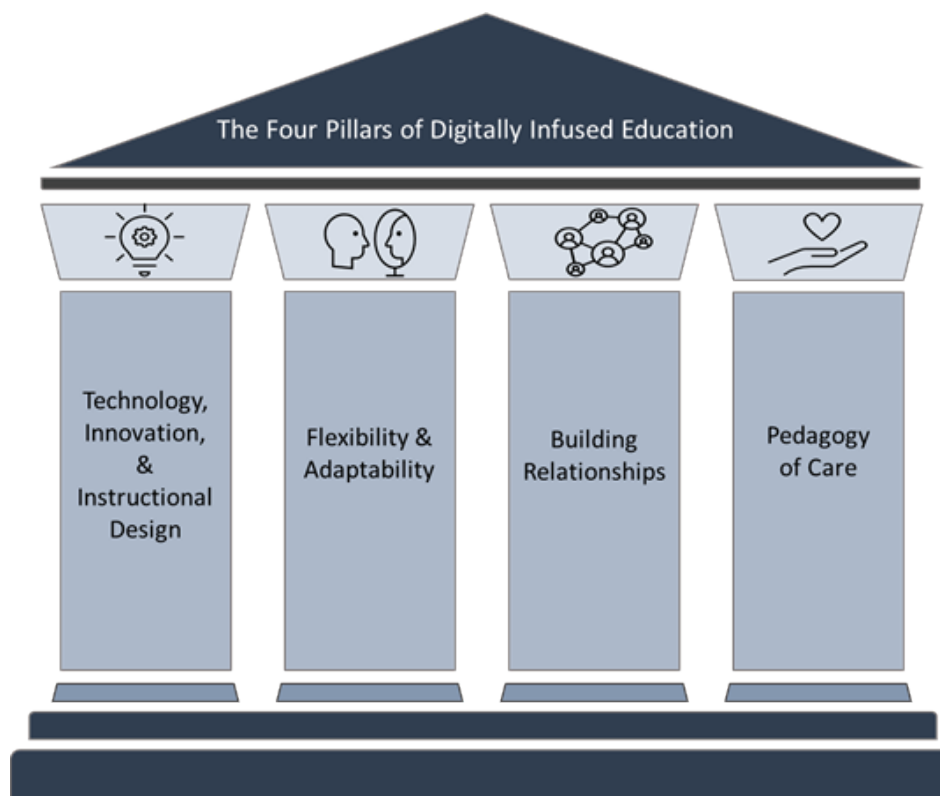
Figure 1. The Four Pillars of Digitally Infused Education.

Pillar One: Technology, Innovation, and Instructional Design

When the pandemic hit, teacher educators were forced to adopt alternate ways of teaching in order to enable students to continue to learn. Videoconferencing technology (e.g., Zoom, Google Meet), which was not regularly used before, became an essential platform for collaboration and communication, and technology applications such as Google Docs became commonplace. Teacher educators' use of technology, innovation, and instructional design during the pandemic was an important strategy to build student success. Although many students had good working knowledge of different kinds of technologies for personal use, they needed skills to apply these to educational contexts that would enable them to navigate and analyze online resources, self-regulate and manage their learning, and critically analyze the information they accessed (Greene et al., 2014). Consequently, teacher educators had to use instructional design supports that outlined and taught these digital learning skills so that students could raise their skills levels from functional, authentic technology to generalized educational applications to what they needed to learn (Ting, 2015).

Teacher educators also had to take into account cognitive load because the remote learning environment requires increased student independence in the learning process, time to locate relevant material, and processing time to reflect on large amounts of information before they could apply what is learned to the assignment at hand, making this cognitive load more difficult to manage (McClendon et al., 2017). Teacher educators also needed to use an instructional process that helped facilitate students' learning of these cognitive processes (Gutiérrez-Santiuste et al., 2015) and when they intentionally embedded logical reasoning and analytical thinking skills in relevant ways, students could make meaningful connections to what they are learning (Cavanaugh, 2005). In summary, the pandemic challenged teacher educators to go beyond their comfort zones to experiment with technologies which allowed them to innovate to address student needs.

Pillar Two: Flexibility and Adaptability

Even with the best of technology, innovations, and design both teacher educators and students were challenged with an ever-evolving environment during the pandemic that made teaching and learning more difficult. In addition to the uncertainties of whether universities would remain open or how classes would be offered, schools which regularly hosted teacher education students for field-based experiences or student teaching experienced periodic quarantine periods even after lockdowns were no longer occurring. During the times that schools were accessible, students, teachers, or children at any time could be quarantined or ill. Past research has found that students' experiences with sudden transitions in the learning environment affected their level of involvement and motivation to engage with school related activities such as learning new content and completing schoolwork (Pintrich & de Groot, 1990; West et al., 2010). Consequently, teacher educators had to be more flexible and adaptable during the pandemic to help students succeed. Strategies included allowing student to negotiate learning and choose from flexible assignment options that matched their needs (Ting, 2015) or utilizing flexible due dates and alternate assignments (Linder-VanBershot & Summers, 2015) which empowered students to persevere and continue to learn when personal, technological, or environmental challenges made certain learning opportunities inaccessible.

Pillar Three: Building Relationships

Teacher educators also valued the connections they had with their students and recognized that these relationships were essential for learning (Leadbeater, 2008); however, the roles they were used to holding and the strategies they normally used in face-to-face interactions were not readily applicable in remote learning environments which were largely online and differed meaningfully from traditional roles in face-to-face classrooms (Guri-Rosenblit, 2018). Technology, rather than in-person contact, became the venue for the instructor-student and student-information connections, requiring teacher educators to adjust their environment to match (Ladell-Thomas, 2012). One primary way that teacher educators built these relationships was to create a sense of social presence. Research shows that students judge an instructor's social presence by the level to which they perceive the instructor reacting and responding to them in the learning environment (Chen, 2007); consequently, these strategies were particularly important during remote learning when changing environments added uncertainties and increased stress. Teacher educators also found that when they created a social presence and responded promptly, did regular check-ins, provided feedback and interacted with their students, the students responded positively, and their stress level went down (Weiner, 2013).

Pillar Four: Pedagogy of Care

A pedagogy of care had been shown to be an important factor in learning even before the pandemic, but it became particularly critical in remote learning situations where students were experiencing trauma and their lives were repeatedly disrupted (Bali, 2020). This type of care carries a moral element that leads individuals to: (a) demonstrate genuine care through actions and interactions to develop stronger relationships built on trust and respect, (b) engage in dialogue to learn about others and use that feedback to improve the caring experience, (c) provide opportunities for others to participate in a culture of care, and (d) give confirmation to those who exercise those ideals (Noddings, 2016). During the pandemic, teacher educators were able to build a pedagogy of care digitally by: (a) modeling an "inclusive and culturally safe online environment" so that students were able to experience care within the online classroom, (b) creating a "shared sense of connection with the authentic personhood of the educator" so that students could identify with the materials and develop a deeper sense of value through shared experiences, (c) demonstrating respectful and timely communication practices that encouraged continued dialogue to build a sense of community and increase student participation, and (d) confirming and supporting students in their process of building a caring identity as they worked to become future leaders within educational settings where modeling a pedagogy of caring is essential (Burke & Larmar, 2020).

In summary, these pedagogical supports: (a) technology, innovation, and instructional design; (b) flexibility and adaptability; (c) building relationships; and (d) pedagogy of care allowed teacher educators to provide both academic and emotional supports and infuse digital learning skills that could adapt to the continually changing learning environments, even while teacher educators themselves might be learning the technology. These pillars of supports have the capacity to extend beyond the remote learning experience to inform digitally infused learning of the future and provide implications for both research and practice.

LESSONS LEARNED FOR RESEARCH

Even before the COVID-19 pandemic, the blurring of online and face-to-face modalities was redefining delivery modes and combining these in new ways that did not reflect either face-to-face or online learning. Although the shift from binary thinking has resulted in improvements in educational instruction and delivery, it has created a variety of evolving models (e.g., blended or hybrid learning, HyFlex learning, multi-access learning) that are not well articulated which, in turn, present semantic challenges that limit shared understanding (Irvine, 2020). The imposed restrictions that the pandemic has placed on educational delivery and the remote education models that have resulted out of necessity have accelerated the modality merger and further muddied the semantic waters by creating endless combinations that are difficult to define. Furthermore, the speed at which the stories, literature, and resulting research have come together have made it difficult to ascertain what worked and what did not, and how to categorize what worked so that emerging best practices can be replicated.

Given the complexity and limitless possibilities for combinations of teaching models, teacher educators conducting research on their teaching practices or that of their colleagues during and beyond the pandemic will need to label and clearly describe the conditions and related design components in which they implemented their strategies. What is normally thought of as online learning, for example, may include both synchronous and asynchronous elements, and face-to-face teaching may include multi-access options with some students attending class physically while others attend digitally via videoconferencing software. A blended or hybrid class may use the same multi-access option to allow concurrent modality mixing of both online and on-campus students simultaneously or it may offer a combination of online and in-person learning sessions that all students participate in consecutively via the same modality (e.g., all students meet in person on Tuesdays and online on Thursdays). Some classes may have high levels of flexibility and choice for how students access their learning and others may not. Knowing the conditions teaching practices were implemented will not only make it possible for teacher educators to replicate a study, but it will allow them to better understand a study's results and the conditions under which certain teaching practices were effective. Future research should help define which practices are specific to a limited number of teaching situations and which may be generally applied.

In an era of digitally infused learning, teacher education researchers may want to test teaching practices to see how they hold up under multiple digitally infused learning conditions. It many cases, the function may be more important than the form. For example, if students collaborate on a project and create a video to display the end project, does it matter whether the students met in person and used pencil and paper, met online using multiple electronic devices to type on a Google doc, or met concurrently in-person or via telecommunication software to create a document in Pages while sharing a screen? Future research will need to capture the dynamic nature of the learning environment while teaching practices occur and the most effective teaching practices will be those that allow teachers to use pedagogical tools that can be mixed and matched across educational settings and formats to meet student needs and produce similar student learning outcomes regardless of how they are applied.

One unique research aspect arising from the pandemic is the number of anecdotal, case-study, qualitative, and quasi-research studies that were created and published in record time primarily because there was insufficient time to create studies with methodological and design rigor and getting some information on promising practices out rapidly was more important than verifying best practices that would need to stand the test of time. Given the value that this body of emergent research can provide in a post-pandemic digitally infused educational setting, teacher education researchers should analyze this research, identify patterns of promising practices, and develop future studies that can test these practices more thoroughly with rigorous methodologies and research designs under a variety of learning conditions and environments, taking into account multiple types and levels of digitally infused learning. Teacher educators could then apply the resulting best practices to ensure student learning regardless of setting, condition, or modality.

Although teachers educators should continue to expand current research on specific forms of technology, innovation, and instructional design, they will also want to go beyond those that directly provide academic supports to better understand the emotional supports students need and how to best apply these to encourage student success. More research is needed to determine what types of flexibility and adaptability best promote student learning and under what conditions these are most effective. Researchers will also want to more closely examine the elements that influence the instructor-student and student-student relationships and how teacher educators can effectively cultivate those relationships to improve learning. Finally, teacher educators will need to more closely document the strategies and practices used to create a pedagogy of care that will allow students to persevere, stay engaged, and utilize resiliency that will enable them to demonstrate positive long-term student learning outcomes. Knowing how to engage all four pillars of support in a digi-

tally infused learning environment will enable teacher educators to successfully enable students to learn effectively in a post-pandemic era.

LESSONS LEARNED FOR PRACTICE

Implications for Technology, Innovation and Instructional Design

When higher education institutions closed to help slow the spread of COVID-19, many approaches to continue the education process emerged with technology as the front and center of the educational experience. Regardless of the format or approach used by different institutions, education became dependent on access to the Internet, online databases, and ultimately on access to reliable devices, requiring teacher educators to be strategic, innovative, and open to experimenting with different digital tools and options available to them and their students, even while their students experienced technical complications and educators did not have sufficient training (Mouchantaf, 2020). While not ideal, the situation helped to build tolerance for technological disequilibrium as instructors and students worked to engage in the learning process. In post-COVID classrooms, teacher educators will need to continue to accept a certain level of technological disequilibrium as they experiment with and implement an array of technologies and teach their students how to problem solve the use of technologies to became facile users of these tools for learning.

Teacher educators will also need to continue to be open to using technologies they have not yet mastered because those technologies will be essential to the functionality of digitally infused learning environments. For example, during the pandemic, as educators worked to shift their classes to a blended digital learning environment, many adopted cloud-based technology such as Google Docs to collaborate on assignments and Google Drive to share resources and files. The advantage was that these technologies could create digital classroom learning spaces and allow students to access with more than one type of device if one became unreliable. However, the implementation was not without its challenges and the process was not always smooth. In post-pandemic classrooms where digital and physical classroom learning spaces are fused, cloud-based technologies will become commonplace and evolve to further integrate the learning environment. Consequently, development and training will need to be a priority in order for cloud-based technology to fully evolve to the needs of post-pandemic classrooms (Khan et al., 2020).

Another technological innovation that became widespread during the pandemic was videoconferencing systems that could readily be accessed on multiple personal devices. This allowed classroom learning spaces to become multi-faceted, extending traditional physical classroom spaces to "Zoom Rooms" which instructors and students accessed from wherever they were located on whatever device worked at the time. Video technology not only allowed synchronous remote connections, but it also enabled instructors to post video tutorials, announcements, or video-based learning content to help guide student learning asynchronously to review, enhance, or even replace synchronous connections as needed. In some instances, video-based options replaced in-person experiences that could not occur during the pandemic such as video-based case studies in lieu of actual field experiences or tutoring activities via videoconferencing vs. in-person classroom settings. Video technology also made it possible for instructors to personalize learning according to student need rather than presenting a "one-size-fits-all" model for student engagement with learning materials. In a post-COVID learning environment, teacher educators will need to utilize video technology to enable students to experience learning that they would not be able to otherwise personally experience and engage with others in learning spaces that transcend physical walls. Even when in-person classroom settings for field-based and student teaching experiences become readily available again, teacher educators will likely continue to use video-based case studies and simulations to supplement those experiences.

Although digital literacy has been recognized as one of the most important factors making technology-related education effective (Adam, 2020), it became even more critical during COVID-19 partly due to the amount of Internet and social media information that requires sufficient analysis to ascertain what is both accurate and relevant to what is being learned (Depoux et al., 2020). Consequently, instructors found themselves adding instructional design elements such as tutorials, screenshots, video demonstrations, or written examples, to help students not only understand the material for learning, but also how to apply the digital literacy skills needed to actually learn. In a post-COVID digitally infused learning environment, "how to learn the material to complete an assignment" will be just as important as learning the content knowledge and applying it to the assignment itself. Teacher educators, then, will need to plan assignments that will take into account the time students need to locate relevant material, the cognitive load necessary to process the in-

formation, and the time needed to do the actual assignment once the requisite knowledge has been acquired (McClendon et al., 2017). Educators will also need to facilitate students' learning of these cognitive processes and intentially embed these in relevant ways so students can make meaningful connections to what they have learned. (Cavanaugh, 2005).

Implications for Flexibility and Adaptibility

When the COVID-19 pandemic began, flexibility became a crucial factor in instructors' efforts to survive while providing their students with the best possible educational scenario that could be created. Initially, face-to-face classes were quickly moved online to create disembodied spaces, but educators were able to "innovate around previous practices and values to navigate the transition from 'initial pedagogic discomfort' to 'pedagogic agility' within the new spaces (Kidd & Murray, 2020, p. 552). This concept of "pedagogic agility" became key to maintaining a flexible and adaptable learning environment which included strategies such as flexible deadlines, multiple access options for attendance and participation, alternate assignments, and student choice in how assignments were completed. The constant need to adapt to instructor-student circumstances because of personal, social, and environmental factors created a culture of flexibility and adaptability that allowed the educational experience to be more accessible, equitable, and empowering because it was responsive to learner and societal needs, thereby creating "radical flexibility" that was dynamic, relational, and student-centered (Veletsianos & Houlden, 2020).

Given the importance of allowing student to negotiate learning and choose from flexible assignment options that matched their needs (Ting, 2015) or providing flexible due dates and alternate assignments (Linder-VanBershot & Summers, 2015) to give students more control of their learning, teacher educators in a post-COVID learning environment can expect to utilize greater levels of flexibility and adaptability than they did prior to the pandemic. Function wil be more important than form, so having students accomplish things the same way will be less important than accomplishing the same goal. For example, a student who cannot attend a physical class in person will have the means to either digitally attend simultaneously or asynchronously watch a video of the class interactions they missed and then digitally respond to document their participation. In a digitally infused learning environment where students have more responsibility for their learning, teacher educators will be able to provide assignment options that are functionally equivalent and allow students to negotiate the options that maximize their learning. Flexible due dates can allow students more time to process cognitive load when completing assignments or accommodate personal circumstances a student may encounter.

Implications for Relationship Building and Providing a Pedagogy of Care

Although the instructor-student relationship has always been an integral part of the learning process, relationship building became even more critical during the pandemic where "social distancing" and remote education made it difficult for instructors and students to interact in person or interpret nonverbal cues such as body language, tone, and interpersonal interactions. However, instructors and students learned to use technological means to connect. Instructors created social presence by responding promptly to student concerns using email, phone, or videoconferencing, creating video and written announcements, providing regular "check-ins" with students, and communicating clear expectations—strategies which students found positively helped them persevere and stay engaged (Mollenkopf & Gaskill, 2020). Research shows that high instructor presence and social support correlates with student persistence (Gering et al., 2018) and immediate, timely, and useful feedback has a high impact on improvement in student achievement on assigned tasks (Zimbardi et al., 2017). Although these strategies are important regardless of modality, they become particularly critical in online learning environments where students may be less likely to persist (Lockman & Schirmer, 2020).

Teacher educators in a post-COVID learning environment will need to use a variety of technologies to build relationships with students and create a social presence. Using video technologies to create introductions and orientations to the course, offer welcomes and announcements, or meeting with students via videoconferencing can be important for students who cannot be physically present. Teacher educators should also check in regularly with students via options such as texting or email, and make sure students get frequent, quality feedback on their performance. Teacher educators will also want to strategically use social media such as Facebook and WhatsApp as tools for interaction to increase digital community-building and student support (Sobaih et al., 2020).

When teacher educators demonstrate genuine care through their actions and develop relationships with their students built on trust and respect, they began to impement a pedagogy of care. Although critically important during the pandem-

ic, teacher educators in a post-COVID learning environment will want to continue to teach and implement a pedagogy of care where all of the students they teach feel they are in a safe environment to learn. The first step may be to starting "caring about care" (Feldman, 2020, p. 16) and to intentionally adopt a student centered approach to learning that promotes collective success (Karakaya, 2020). Teacher educators can model an inclusive and culturally safe environment, create a shared sense of connection with their students and be authentic in their interactions, communicate respectfully and in a timely manner, encourage the type of dialogue that builds a sense of community and increases student participating and supporting students as they themselves learn to care for others (Burke & Larmar, 2020). Although more difficult to measure, building relationships and providing a pedagogy of care are critical emotional supports that enable teacher educators to be flexible and adaptable and to intentionally use technological innovations and instructional supports to help students academically succeed, particularly in a digitally infused environment with challenging academic demands.

Implications of Transcending Modalities for Digitally Infused Education

As the lines between online and face-to-face modalities become increasingly blurred and teacher educators enter a post-COVID digitally infused learning environment, they will be challenged to make learning meaningful in new ways. By integrating lessons learned from the pandemic, they can maintain a sense of openness in experimenting with technologies that support student learning beyond the physical classroom space and allow students to engage and participate through multiple access formats. Teacher educators will be able to incorporate resources and strategies into lessons and assignments that build digital literacy skills so that students will know how to learn as well as what to learn, and by providing flexible deadlines, assignment options, and staying responsive to student needs, teacher educators will enable students to be more responsible for their own learning and build meaningful connections to the content. Since student learning will also be socially constructed, teacher educators will intentionally build relationships with their students by creating a social sense of presence, providing timely feedback, doing frequent check-ins, and communicating clear expectations. They will also model safe and inclusive environments, build a sense of community, and encourage students to care for one another. As teacher educators blend both academic and emotional supports into their teaching, they will be able to transcend modalities and teach effectively in a digitally infused educational environment and successfully prepare future teachers for the learning environments of tomorrow.

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Lessons Learned in Providing Field Experience Opportunities for Future Teachers of Emerging Bilinguals during the COVID-19 Pandemic

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Abstract: During the COVID-19 pandemic, many teacher education programs had to quickly find alternative ways to expose student teachers to the work of teaching English learners. Within this context, teacher educators should have learned that videos of practice could serve as powerful resources for noticing, reflecting, and investigating the qualities of particular teaching practices and skills. Second, situated scenarios either presented through videos or in writing should be accompanied with guiding observation forms or reflection activities. Also, virtual internships and simulated teacher learning environments provide affordances for teacher candidates to practice, rehearse or receive feedback on specific strategies of teaching emerging bilinguals. Further, teacher educators should have cautioned that the intersections between technology and teacher education practice might miss out on some critical aspects of teacher education for bilinguals such as co-teaching and connecting with families. Further work is needed to fully respond to the complexities arising from the intersection among technology, teacher education, and effective teacher education for bilingual children.

Lesson Learned: Teacher educators should have learned that the intersections between technology and teacher education practice might miss out on some critical aspects of teacher education for bilinguals such as co-teaching and connecting with families.

AN INTRODUCTION TO TRAINING TEACHERS FOR EMERGING BILINGUALS

During the COVID-19 pandemic, several educational realities surfaced. One directly concerned the field of linguistically and culturally responsive teaching and teacher education. Disparities surfaced in having access to Wi-Fi and devices not only among linguistically and culturally diverse student populations at K-12 settings (Robertson, 2020; Sugarman & Lazarin, 2020) but also college English as a second language (ESL) students beyond the K-12 level (Harston & McMurry, 2020). The transition to online teaching was challenging and students' language learning suffered (Hartston & McMurry, 2020). While some students had direct access to and familiarity with online learning, some English learner students and their families at K-12 and post-secondary levels either had digital connectivity issues or privacy concerns over online learning due to reasons such as legal immigration status (Robertson, 2020).

Within this larger context, pre-service teacher training practices, particularly field experiences came to a pause as well and many teacher education programs innovated strategies to maintain the fidelity and integrity of school-based field experiences through providing various virtual practicum experiences (Griffin et al., 2020). Undoubtedly, student teaching and field experiences constitute a significant part of preservice teacher preparation programs (Ronfeldt, Schwartz, & Jacob, 2014). During the COVID-19 pandemic, however, many teacher education programs had to quickly find alternative ways to expose student teachers to the work of teaching English learners (ELs)[1] in particular. This process was challenging even in states like Florida where it is routinely easy to place student teachers in diverse classrooms with emerging bilinguals (Monroe, Mendez, & Nutta, 2020). Within the context of inequalities that surfaced during the pandemic (Herrera, Porter, & Barko-Alva, 2020), it becomes imperative to retrospectively and introspectively examine what teacher educators learned and should have learned from 2020 with regard to enabling pre-service teachers to best serve emerging bilinguals. With that, this chapter focuses on two central topics of inquiry: 1) the extent to which teacher education programs were prepared to provide alternatives to field experiences for pre-service teachers to practice teaching emerging bilinguals in classrooms; 2) what lessons were drawn from the alternative methods that sought to provide alternatives to field experiences. This paper, therefore, explores and synthesizes lessons learned from alternative practices that were published in academic outlets with regard to the field experiences provided for future teachers of emerging bilinguals. The next section covers what we already know about teaching bilinguals, including several peer-reviewed works on what teacher education programs did to ensure that candidates had opportunities to practice teaching bilinguals during the pandemic (Borko-Alva, Porter, & Herrera, 2020; Grissom, 2020; Monroe, Mendez, & Nutta, 2020; Pelaez-Morales, 2020; Prado et al., 2020).

WHAT WE KNOW

Globally, not just limited to the US context, the presence of multilingual students who learn or use English as an additional language in mainstream classrooms has gained attention in relation to equitable education opportunities they received during the pandemic (Bayrakdar & Guveli, 2020). There are various reasons for this growing awareness. One obvious reason is that the number of these English learners and users as a second or third language is increasing. Taking the US as a case in example, ELs constitute a growing body of school-aged children. It is projected that one in every four students in the U.S. will speak English as a second language by 2025 (National Center for Education Statistics (NCES), 2011; National Clearing House for English Language Acquisition, 2007). These students are often characterized by their multilingual or bilingual backgrounds and in this paper, referred as emerging bilinguals from herein, instead of the term ELs.

In the US, emerging bilinguals' literacy and language development is multidimensional and their academic learning has been one of the major concerns for educators under regular and pre-pandemic times (Mancilla-Martinez et al, 2020; Mancilla-Martinez & Lesaux, 2017; Proctor, et al., 2005). With that, many teacher educators and researchers have long discussed how to educate future teachers to effectively serve emerging bilinguals (e.g., de Jong & Harper, 2005; Nutta, et al., 2014; Turkan et al., 2014). There are many critical skill areas to develop in future teachers during teacher education programs such as leading discussion through levelled questions (Nutta et al., 2018). Novice teachers start learning skills as such first during their teacher education programs, which play a significant role in the development of good practice with linguistically and culturally diverse students (Villegas & Lucas, 2002). However, in the absence of opportunities

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[1] While the term ELs is commonly used in many publications reviewed in this paper, the term 'emerging bilinguals' is used in this paper as it reflects a resource-based perspective to students who are learning English as an additional language.

to actually work directly with emerging bilinguals in real classrooms (Grissom, 2020), teacher education programs have had to not only maintain the integrity and effectiveness of the field experiences but also employ new or existing alternatives to provide future teachers with opportunities to practice teaching emerging bilinguals in lieu of field experiences.

Research has shown that field experiences with emerging bilinguals could shape pre-service teachers' attitudes towards teaching these students especially because their contact with bilinguals typically takes place within the mainstream classroom where they look up to classroom teachers' practices as models of interaction with the bilinguals (Sugimoto et al., 2017; Sugimoto et al., 2015). The use of simulated teacher learning environments (Straub et al., 2014; Straub et al., 2015) has definitely allowed a capacity for teacher education programs to provide alternatives to relying solely on classroom teachers for role models or on field experiences. Next, a brief review of previous work on using simulated teacher learning environments for teacher education of bilinguals is shared.

Use of Simulated Teacher Learning Environments with Bilingual Students

Simulated teacher learning environments have been heavily experimented for integration into the teacher education programs (Garland & Garland, 2020) mostly with general student populations in mind, not focused on the teaching of English learners. TeachLivE (https://www.ucf.edu/research/research-project/teachlive/), however, is one simulated classroom environment that has been used to educate teachers of emerging bilinguals. In fact, of the most commonly used simulated environments (e.g., TeachLivE, simSchool, and Second Life), TeachLivE appears to have the most empirical evidence to support its utility in helping PSTs teach emerging bilinguals of low, intermediate, and advanced English proficiency (Regalla et al., 2015; Regalla et al., 2014). In fact, Regalla et al. (2014) found that pre-service teachers who participated in a 5- to 10-minute TeachLivE experience with the three English learner (EL) avatars understood the need to use visuals, slow down their speech, and rephrase questions when teaching ELs. Further, applications of TeachLivE experience for student teachers to work with EL avatars have been promising in various areas such as training speech-language pathologists (Rosa-Lugo, Mihai, & Nutta, 2017), examining elementary level teacher candidates' classroom discussion skills with English learners (Turkan, 2020), teaching teacher candidates questioning strategies for English learners (Davies et al., 2020).

During the pandemic, the report by Monroe, Mendez, & Nutta (2020) reveals how TeachLivE was repurposed to enable student teachers to practice targeted bilingual teaching skills even if they were interacting with bilingual avatar students. The authors found in their study that 18 of the 20 internship students performed successful presentation of particular skills with bilingual and monolingual avatar students. The authors noted that these simulations are most effective when coupled with immediate or pursuant coaching sessions. If the teacher education program does not have access to simulated teacher learning environments, the authors recommend that student teachers are asked to perform micro teaching over skype, followed by coaching and evaluative feedback sessions with the teacher educators. The authors also discuss as a lesson learned that if funding for simulated environments is not available, traditional micro teaching could be adopted. This would involve training participants to act out bilingual-specific behaviours by using common phrases, responses, and mistakes that bilinguals would use at different proficiency levels. Apart from using simulated environments, teacher educators also used published videos to help candidates decompose and notice critical aspects involved in the work of teaching bilinguals. A brief review of the relevant reports is presented next.

Use of Videos for Decomposing Practice with Bilinguals

Grissom (2020) reports that the World Languages TESOL program at University of Central Florida devised an alternative plan to the usual process of placing the teacher candidates in K-12 schools. The plan involved compiling a set of videos of teachers teaching emerging bilinguals. Videos were selected from the *Colorín Colorado* website (https://www.colorincolorado.org/) according to the particular targeted skill areas named as theory-to-practice tools and techniques (TTT). These skill areas included teaching key vocabulary, interactive reading, using realia, answering guided questions, and teacher commentaries. Using an observation form that was aligned with the assigned textbook, the teacher candidates were guided to 'notice' the practices taken up by the teacher as well as the interaction between bilinguals and the classroom teacher. An important dimension to using videos of EL teaching is that resourcing them as representations of practice could be challenging at the unprecedented times. In fact, discontent with the poor examples of EL

teaching available on the internet, Pelaez-Morales's report (2020) shows how she capitalized on her own students' connections and landed on utilizing an online tutoring program's video resources made publicly available to train tutors of English language for Asian kids. Pelaez-Morales (2020) reports that the videos surprisingly served well as rich input for the teacher candidates to comment and write reports on. Pelaez-Morales even notes that student teachers' observations brought up pedagogical issues that would not have ordinarily come up under usual circumstances.

Virtual Internships and Other Practice

Virtual internships seemed to be another capability developed by teacher education programs. With specific relation to teaching emerging bilinguals though, Prado et al (2020)'s report stands out. The report indicates that virtual internships within the context of English as Second Language (ESL) teacher preparation programs could be successfully formed even when the internship task is to teach ESL academic writing which the candidates are used to offering in face-to-face settings. The report highlights the case of an international student (pseudonym Ling) who had not been prepared to offer virtual teaching within the program's methods courses and clinical experiences. The teacher educator in this case study reports that the student initially conceived of online instruction as just a switch to the *Zoom* class time. However, after conducting a needs assessment on the target ESL students at the beginning of the internship, gathering information about their needs, and ultimately forming a sense of community with them; Ling was ready to receive scaffolding from the teacher educator on how to build online teaching presence with her students. The case study with Ling followed a Cognitive Apprenticeship framework which allows for preparing the preservice teachers towards using specific skills within specific contexts.

Another critical area of student teacher practice concerned their preparedness to engage with families of emerging bilinguals. As the pandemic crisis unfolded, it was quickly recognized that both pre-service and in-service teachers were ill prepared to account for the digital inequalities existent across the families (Borko-Alva, Porter, & Herrera, 2020). It was unfortunate to note that most culturally and linguistically diverse students were unintentionally left to learning by memorization and low cognitive tasks. In other words, "monolingual learning packets widened the equity gap by creating new challenges" (Borko-Alva, Porter, & Herrera, 2020, p. 766). Especially multilingual pre-service teachers were invited to become "participatory agents in making content accessible to families" (Borko-Alva, Porter, & Herrera, 2020, p. 766). These candidates along with a faculty member invited the families to use tools already available at their homes when the learning package required them to use technology or manipulatives that were not available at home. The candidates mediated parents' understanding of the academic concepts or activities by asking parents to take pictures of pages from the learning packet that the parents did not understand. The study indicated the importance of identifying what technological tools are available for the families of bilinguals and what their digital literacy skills are. Authors of the study discussed that it can be possible to invoke pre-service teachers' own initiatives to move beyond the limitations that technology might have imposed on the level of diverse learners' learning and their families' engagement with schooling.

Next, lessons learned for research from the published work is organized and presented for discussion in this paper according to the three key pedagogies guided by the practice-based theories of teacher learning (Grossman et al., 2009; Lampert, 2010): 1) representations of practice, 2) decomposition of practice, and 3) approximations of practice. The practice-based lens is selected to synthesize the lessons learned in 2020 because the three key pedagogies serve as holistic categories to field the innovations and opportunities developed to maintain the integrity of candidates' field experiences with emerging bilinguals.

LESSONS LEARNED FOR RESEARCH

The literature presented above implicate specific areas of further research in relation to educating teachers to serve emerging bilinguals during unprecedented times. This section organizes the lessons learned for research in terms of what is still unknown that should be known, according to the above mentioned three key pedagogies. Some selected areas of further inquiry are listed here and then discussed in the subsequent sub-sections: 1) How could existing videos be made relevant for the purposes of helping candidates identify not only the linguistic demands of each content area but also effective ways of teaching the language demands of a particular content area for the bilinguals' understanding? 2) What criteria and selection protocol should be used when identifying the video practices from an existing online reserve and

selecting the ones relevant to the work of teaching emerging bilinguals? 3) What type of work needs to be done on virtual teacher learning environments and virtual internships to most authentically represent the heterogeneous levels of English proficiency among emerging bilinguals? 4) What constitutes 'teaching context' for training future teachers of bilinguals? 5) In order to build rapport with the families of bilinguals, what kinds of partnerships work best?

Relevance of Videos to Teaching Content to Bilinguals and Selection Criteria

One of the ways in which pre-service teachers learn to make connections between the theories in teaching emerging bilinguals and actual classroom teaching of bilinguals is through viewing other teachers' representations of practice and having the opportunity to 'notice' (Sherin & Van Es, 2005) what the other (seasoned or novice) teachers are doing and critique how these teachers go about particular instructional strategies, practices, and moves. In the absence of actually conducting classroom observations due to the COVID-19 pandemic, Grissom's report on the use of videos as representation of practice brought up questions for further investigation regarding teaching content (e.g., math, science) to bilinguals and selection criteria.

One question remains as to how the videos could be made relevant to the teaching of other content areas like teaching science, mathematics, history to emerging bilinguals. Many bilinguals are mainstreamed into classrooms where they may not be allowed to use their native languages to navigate the disciplinary language demands. Teacher candidates take a long time to learn how to identify the linguistic demands embedded in a content area (like mathematics) and model good instructional practices to engage the bilinguals in using the language of the particular content area(s). Hence, we should initially examine how existing videos could be made relevant for the purposes of helping candidates identify not only the linguistic demands of each content area but also effective ways of teaching the language demands of a particular content area for the bilinguals' understanding.

Regarding the use of videos, another question concerns what specific criteria and selection protocol should be employed when identifying the video practices from an existing online reserve and selecting the ones relevant to the work of teaching emerging bilinguals. The selection of the videos is extremely important to help candidates notice the targeted skills and help them decompose and learn about critical aspects of the skills. As part of the video selection criteria, the answers to what constitutes 'teaching context' for training future teachers of bilinguals need to be examined. This question needs exploring because contexts where emerging bilinguals are taught vary in composition of bilinguals, bilingual education policies, and bilingual education programs.

Accounting for Various English Proficiency Levels in TLEs and Virtual Internships

When using teacher learning environments (TLEs) and virtual internships for training teachers of emerging bilinguals, one main question remains unanswered: What type of work needs to be done on virtual teacher learning environments and virtual internships to most authentically represent the heterogeneous levels of English proficiency among emerging bilinguals? This question is pertinent because emerging bilinguals constitute a very heterogeneous population in terms of language proficiency levels and when simulated TLEs and virtual internships represent prototypical characteristics of emerging bilinguals, the nuanced linguistic and cultural characteristics of the sub-groups of bilinguals might be left out. Addressing this question would be conducive to understanding how best to improve the quality of candidates' practice teaching emerging bilinguals with diverse schooling and cultural backgrounds and with different levels of English proficiency within and across four skills (listening, reading, writing, speaking). This question should also be explored when developing virtual internship protocols in order to train candidates for various aspects of the work of teaching bilinguals. If the protocols are designed to serve as models for implementation in other pre-service ESL teacher preparation programs, then the protocols should account for the heterogeneous characteristics of bilinguals, and the various aspects of teaching this population including the work of engaging the parents of bilinguals in teacher-parent conferences.

Overlooked Aspects of Teacher Education for Bilinguals

It is important to examine what critical aspects of teacher education for bilinguals got compromised during the pandemic. Two aspects involved in the work of teaching bilinguals are critical: learning to 1) co-teach with mainstream or content teachers and 2) engage families of the bilinguals. Regarding co-teaching, one area of inquiry concerns examining the effectiveness of training future bilingual teachers how to co-teach with other teachers. It is known that co-teaching amongst two or more teachers delivering content to diverse students can be a common practice in the US (Dove & Honigsfeld, 2010). However, it is unclear as to what extent teacher education programs actually allocated time and space during COVID-19 for developing future teachers' co-teaching skills remotely. More importantly, the effectiveness of teaching candidates to co-teach remotely could be examined since it is one of the areas of teaching practice that candidates face when actually teaching or during field experiences. Goddard (2020)'s report, though focused on in-service teachers' remote co-teaching practices, calls for more research on developing a remote co-teaching model using *Google Classroom* (https://classroom.google.com/), *Seesaw* (https://web.seesaw.me/), *Schoology* (https://www.schoology.com/), and the like. Goddard also brings up another question, also relevant for pre-service teacher preparation, around the extent to which break-out room features on platforms like *Zoom* could best be utilized to provide student teachers with opportunities to practice different models of co-teaching.

Regarding the work of engaging families of bilinguals, we learned from Borko-Alva, Porter, & Herrera's study (2020) that it is extremely important to know how to relate to the families at technologically challenging times. However, we still do not know what remote practices are the most non-threatening to those families who may not want to officially engage with the candidates or teacher education programs. In order to build rapport with the families of bilinguals, what kinds of partnerships work best so they would cooperate with the teacher education programs for the purposes of training candidates on various tasks such as holding parent-teacher conferences, engaging families in bilinguals' academic performance and the like?

Lastly, the question of whether technological capabilities available to train future teachers of emerging bilinguals in one teacher education context while unavailable in another is an issue of equity should be brought up for discussion. To expand this question, what minimal opportunities to enact the practice of teaching special student populations like emerging bilinguals should be made available or be designed for student teachers in support or place of regular field teaching experiences?

As a closing remark, one can gather from questions shared in this section that the intersections between technology and teacher education practice might miss out on some critical aspects of teacher education for bilinguals such as co-teaching and connecting with families. Thus, further research and innovation is needed to identify how technology could be best utilized when virtually educating teachers of bilinguals around such critical aspects of the work.

LESSONS LEARNED FOR PRACTICE

The reviewed literature suggest three implications for teacher education practice: 1) videos of actual classroom practice could be used as representations of practice to guide candidates' learning to teach bilinguals; 2) situated scenarios either presented through videos or in writing should be authentic and accompanied with guiding observation forms or reflection activities targeted at specific skills of teaching bilinguals; 3) teacher educators could use simulated teacher learning environments and virtual internships as approximations of practice to emulate the field experiences for candidates with bilingual students.

1) Videos of practice accompanied with observation forms and classroom teacher commentaries serve as powerful resources for noticing, reflecting, and investigating the qualities of practices and skills specific to teaching emerging bilinguals.

The first implication for teacher education practice concerns the affordances of online video recordings and/or case study simulations for noticing and reflecting on key aspects of instructional practice in teaching bilinguals. Noticing is a big part of what teacher candidates do during field experiences (Sherin & van Es, 2005). In the absence of actual classroom observations of teachers or emerging bilinguals, the reviewed reports highlight how it could be possible to rely on existing online video resources or fictitious scenarios to elicit candidates' reflections and learning to teach bilinguals.

Given what worked effectively in 2020 (Grissom, 2020; Pelaez-Morales, 2020), guiding candidates' noticing and learning through classroom teachers' commentaries, observation forms, and follow-up reflections would be an effective take-away. Connections between theory and practice in teaching bilinguals could be effectively formed through using an observation form while the candidates watch and evaluate the video practice. Video commentaries from the classroom teachers could also be effective because they enable the teacher candidates to reinforce connections between theory and future practice. Furthermore, it is important to encourage post-viewing video reflections on the targeted skill areas and discussions between the course instructor and candidates.

Additionally, Pelaez-Morales' study helped bring awareness about the need to ensure the quality of video-based resources used to guide teacher candidates' reflections and learning. Specifically, it was important to be reminded that not all videos of ESL teaching on the internet could serve the purposes of training effective EL teachers. Teachers educators are encouraged to go the extra mile instead of replacing classroom observations in situations when the observations are not feasible or possible to conduct.

This implication is an important reminder because under regular or unprecedented times, it is convenient to fall back on lengthy theory-driven lectures or demonstrations of good practice without allowing the candidates to decompose critical aspects of an instructional segment or skill.

2) Situated scenarios should be authentic reflecting the heterogeneity of bilinguals and accompanied with guiding observation forms or reflection activities targeted at specific skills of teaching bilinguals.

Situated scenarios, or sometimes referred as case study simulations, serve well to invoke and elicit candidates' reflection and thinking about nuances of teaching. When learning to teach bilinguals, the utility of authenticated and valid scenarios is even more pronounced because there are various dimensions and aspects embedded in the work of learning to teach bilinguals that need to be accounted for. Here, it is recommended that teacher educators should consider accounting for the following two conditions: 1) authenticity and validity of the situated scenarios in terms of reflecting bilinguals' characteristics, 2) provision of observation forms and/or reflection activities.

One of the critical dimensions to consider when educating future teachers of bilinguals is the student characteristics. Bilinguals are a heterogeneous student population. The heterogeneity of bilinguals is rooted in their linguistic, educational, socioeconomic, and cultural diversity. When accounting for factors related to such dimensions of diversity, realistic scenarios should reflect some variables, including but not limited to: a) Varied proficiency levels within and across four language domains (listening, speaking, writing, and reading), b) multiple personal life experiences (e.g., migration, first-language influences, type of exposure to L2, interaction with monolingual or bilingual peers (Solano-Flores & Li, 2013), c) schooling histories (e.g., in bilingual or English-only programmes, length of schooling), d) age of arrival into the country of migration, e) previous literacy experiences, f) languages actively used daily outside school. Such variables profoundly influence how the work of teaching bilinguals is conducted vis a vis the linguistic and content demands of the material being taught to bilinguals. Especially when learning to teach bilinguals, candidates find it difficult to visualize what good teaching of bilinguals looks like in nuanced and flexible ways that account for the diversity of bilinguals' experiences in schooling. However, videos and/or situated scenarios provide the affordances for teacher educators to be able to reflect such diversity of bilinguals' experiences.

As discussed previously, second related implication is that videos should be presented along with observation forms and reflection activities. Reviewed literature showed that candidates' thinking and reasoning about specific aspects of teaching bilinguals would be best guided through reflections and noticing on what works and what does not work in a practice presented through videos or written scenarios. Protocols in particular allow the candidates to dissect and decipher components of specific teaching skills vis-à-vis bilingual student characteristics and needs. It is additionally useful to provide classroom teachers' commentaries on their own practice with bilinguals as it enables the candidates to see and hear through the lens of the in-service teacher what it feels like to enact the particular practice. The novelty in this implication is that the situated scenarios or case studies reflect heterogeneity of the bilinguals to the extent possible so the teacher educators could flex and guide candidates' thinking into considering a variety of instructional moves.

3) Virtual internships and simulated teacher learning environments provide affordances for teacher candidates to practice, rehearse and receive feedback on specific strategies of teaching emerging bilinguals.

Simulated virtual teacher learning environments hold great potential for enhancing practices of educating teachers of bilinguals in terms of providing candidates opportunities to try practicing a new skill, receive feedback, and retry the practice without doing any possible harm to real students. Also, the reviewed literature indicates capabilities that have been developed to even account for the English proficiency levels of bilinguals as well (Nutta et al., 2014; Regalla et al., 2015). However, when the teacher education programs do not have the means to use simulated virtual teacher learning environments, they could consider developing a repertoire of recorded bilingual student behaviours for future use. These recordings could then be employed to simulate a microteaching environment virtually over synchronous platforms like *Zoom*, *Skype*, or the like. This way, there would not be sole dependence and pressure on peers or others who need to accurately portray various diverse characteristics of the bilinguals. With the pre-recorded student portrayals, the peers could then serve as sounding boards during coaching or feedback sessions right after microteaching is completed. Also, the authenticity of the practice teaching experience during a regular internship or field placement might be maintained or simulated this way.

As for virtual internships, one of the main implications from the reviewed literature is that preservice ESL teacher education programs should involve virtual English teaching as part of their methods and clinical course work. The need for incorporating virtual English teaching as part of the program is not just applicable to unprecedented circumstances but also in general whenever there is any need to teach bilinguals virtually, which could be more commonplace than we think. Another related important implication is that incorporating online teaching into the scope of ESL teacher education programs could be applied to any instructional area including teaching writing which is often perceived to be most effective in face-to-face environments. Lastly, there is certainly a need for developing virtual internship protocols that could serve as models for implementation in other pre-service ESL teacher preparation programs. Teacher education programs could consider this gap if and when they implement virtual internships.

With any capability developed to provide opportunities for candidates to practice teaching bilinguals online or in actual field experiences, it is important to note that teacher educators should be clear and intentional on the specific constructs, skills, and instructional strategies targeted for teacher candidates' learning. Otherwise, any capability including VLEs or virtual internships would be futile unless teacher candidates are working on clear and motivating tasks and activities targeted specifically for learning to teach emerging bilinguals.

WHAT YOU SHOULD READ

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2.   Nutta, J. W., Mokhtari, K., & Strebel, C. (Eds.). (2020). *Preparing every teacher to reach English learners: A practical guide for teacher educators*. Harvard Education Press.

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3.   Sugimoto, A. T., Carter, K., & Stoehr, K. J. (2017). Teaching "in their best interest": Preservice teachers' narratives regarding English Learners. *Teaching and Teacher Education*, *67*, 179-188.

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We Need to Help Teachers Withstand Public Criticism as They Learn to Teach Online

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Abstract: Learning to teach with online technologies, delivery systems, and modalities presents new demands as well as opportunities. For most teachers, adopting these new ways of planning, teaching, and assessing takes time and will not be smooth. Such was the case before the COVID-19 pandemic. The urgency with which schools migrated to emergency remote learning to conduct education over the internet demanded that teachers make these shifts suddenly and under the national and international gaze. In this chapter, we discuss the need for professional learning experiences that prepare practicing teachers for criticism of online learning generally as well as criticism of their specific online teaching practice. Using stories from the popular press and research conducted during the school building closures of 2020, we establish that many parents were critical of the education children were receiving online during the pandemic. Then, we review previous research about parent critiques of teaching, including online teaching and the need to communicate and build relationships with parents. We use those understandings to draw implications for professional learning that sustains practicing teachers by girding them against negative public comments.

Lesson Learned: Teacher educators should have learned that teachers need specific support for enduring and addressing possible criticisms that emerge as they learn to teach online.

INTRODUCTION

Coming into the COVID-19 pandemic and its subsequent large-scale school building closures, most teachers had not received any preparation to teach online (Archambault, et. al., 2016; Kennedy & Archambault, 2012; Rice & Deschaine, 2020; Starkey, 2020). The urgency with which schools migrated to emergency remote learning that was largely delivered online demanded that teachers shift suddenly under the national and international gaze. This gaze had the potential to expose teachers to increased public critique. Communities realized that when children did not go to school buildings, adult economic activity was dramatically disrupted, even beyond the disruption from the pandemic generally (McKibbin, & Fernando, 2020). More parents were using computers to do their work, educate their children, and maintain contact with family, neighbors, and friends. In doing more activity online and less offline, parents might have had more chances to navigate to news stories about school building closures, seek support for doing school at home, and/or comment on social media sites about how their children were navigating remote learning (Asbury & Kim, 2020).

Some scholars attempted to frame the shift in modality due to the pandemic as emergency remote teaching (Hodges, et. al., 2020). Even so, the parents and teachers may not have been so concerned about the range of definitional nuances (Williamson, et., al., 2020). To these groups, education provided online, regardless of the reason, was online learning (Dong, et. al., 2020). Because learning to teach online is still relatively new to many teachers and because digital technologies that teachers use to teach online change and evolve so rapidly, teachers need time and support to incorporate these into their practices (DeCoito & Richardson, 2018; Tour, 2017). Along the way, teachers are likely to experience challenges in designing strong online pedagogies that leverage internet-ready devices, websites and digitized repositories, online programs and applications, and learning management systems (O'Neal, et. al., 2017; Rice, 2019a).

The isolating nature of the pandemic might have removed some teachers from their typical support systems. These systems might have included principals as well as instructional coaches and colleagues that could have helped teachers reflect on their online teaching practices (Price & Mooleanaar, 2015; Rice, 2019b). However, people in support positions were also underprepared and caught off guard (LaFrance & Beck, 2014; Rusdiana, et. al., 2020). Thus, the pandemic both exposed and exacerbated a pre-existing need to include support for teachers as they learn to teach online.

The purpose of this chapter is to argue the need to provide practicing teachers with professional learning experiences that respond to critiques of online teaching—whether that teaching is conducted under emergency conditions or not. Using information from the popular press and research conducted during the school building closures of 2020, we establish that many parents were critical of the education children were receiving online during the pandemic (Asbury & Kim, 2020; Garbe, et. al., 2020). Then, we review previous research about parent critiques of teaching, including online teaching and the need to communicate and build relationships with parents. We use those understandings to draw implications for research and professional learning during that sustains practicing teachers while girding them against negative public comments.

WHAT WE KNOW ABOUT PREPARING TEACHERS FOR POSSIBLE CRITICISM OF THEIR ONLINE TEACHING PRACTICES

School teaching has an essential public nature (Miron, 2008; Waller, 1932). Children go to school and then come home and tell parents what teachers did. As they become older, they might tell some stories about some teachers for many years to many different audiences. Of course, these stories can narrate the teaching in a positive or negative light. Videos of teachers that are made by teachers to teach or that have been taken of teachers by students are also becoming more common (Lo & Hew, 2017; Suzuka & Yakel, 2020). Sometimes these videos are publicly posted. Teaching is also public because much of what goes on in schools is financed through public funding and information about how those funds are used, particularly as they pertain to accountability measures is part of public discourse (Counts, 1925).

Because of the essential publicness of teaching, judgments, even negative ones, are bound to emerge (Hansen, 2009). Enduring negative judgments from dissatisfied parents and community members is a regular part of teacher work, and has been for many years, even before teachers started to learn to teach online (Berliner, 2000; Dunn & Downey, 2018; Kelchtermans, 2017; Waller, 1932). However, preparation to expect this criticism and make sense of it seems to be missing from teacher education about online learning. As teacher education proceeds in these new post-pandemic circumstances, it seems vital to include preparation to respond to criticism about online learning in general and for specific practices in a teacher's district, school, or classroom.

Criticism of Online Teaching

Teaching online requires teachers to learn or revise many complex pedagogical skills (Archambault & Crippen, 2009; Crouse et. al., 2018; Cutri & Mena, 2020). The public nature of teaching often results in public discourse about teachers in the popular media (Hansen, 2009). When the COVID-19 pandemic closed schools, even the world, some public expressions of admiration for teachers emerged (Asbury & Kim, 2020). Articles and editorials extolling the heroic nature of teachers as they moved to online programming were widespread. Such headlines included *Letters to the Editor: Add teachers to the list of coronavirus outbreak heroes* (Letters to the Editor, 2020), *Teachers Are COVID Heroes. It's time we listened to them* (Collier & Burke, 2021), and *Teachers' Day 2020: Celebrating the unsung heroes of Covid-19* (Yeo, 2020). Such accolades and positive social recognition were likely appreciated by teachers and certainly had the potential of encouraging them to continue to work hard to meet the programmatic challenges of emergency remote teaching online. However, not all public comment about online learning was positive, especially as fall 2021 approached and not all schools had returned to in-person learning (Cotton, 2021; Goldstein & Shapiro, 2020; Lowry, 2020; Richardson, 2020).

Alongside the pressure to place children back in physical buildings, strong critiques of online learning emerged while praise came for teachers who taught in person. For example, the Utah state legislature passed a bill offering a special bonus payment to teachers who were teaching in-person and denied the extra remuneration to teachers in districts who were providing remote instruction online (Schott, 2020). Such a gesture could be interpreted as a devaluation of online teaching as real work—a finding noted by Kennedy and Archambault (2012) when they surveyed teacher education programs about why they were not preparing teachers to teach online. Although many adults would probably not agree the work they were doing from home during the pandemic was a vacation, some might have had the sense that teachers who were working from home were not working as hard. Perhaps this perception emerged because parents thought they were doing the teaching (Grabe, et. al., 2020).

While some criticism in the popular press was focused on negative opinions of online learning in general, other criticisms focused on specific teachers' practices. For example, Gould (2020) penned an article for *The Atlantic* where she specifically indicated that her child's teacher could not use video conferencing well. Henderson (2020) also wrote an editorial blasting virtual learning because of the large amount of time spent video conferencing, lack of access to hands-on materials, lack of motivation from her children, and her belief in the impossibility of virtual learning to support group learning or even allow students to answer teachers' questions without glitches and delays. Both Gould (2020) and Henderson (2020) added a disclaimer along the lines that "teachers were doing their best," but their critiques were leveled at how instruction was designed and delivered … by teachers.

Research conducted during the pandemic supports the view that parental critique of online teaching and learning was not present in the popular press alone. For example, Dong, et. al., (2020) gathered parents' perceptions of remote online teaching and noted mainly negative opinions. Specifically, parents reported challenges with helping their children stay focused, managing technologies (especially in families with multiple children) and keeping up with the workload. While some parents commented that "*during the special* [pandemic] *situation, children can learn online*" (parent 1) most parents argued that "*although children can learn via online approaches, the learning quality is not good*" (parent 20), and "*the learning effect of online learning is bad*" (parent 2) (p. 6). In another study of parent experiences, Grabe, et. al., (2020) found that parents felt schools were not doing enough to help them balance responsibilities between schooling their children and their other work, supporting learner motivation, and providing accessible digital instructional materials. Most troubling, parents in this study felt they were investing considerable time and effort for minimal learning outcomes.

Many school districts were also surveying parents about their experiences with emergency remote teaching and some have made their findings public. In Parsippany-Troy Township Schools (2020), parents were asked to rate their experiences as well as provide qualitative feedback. Parents in this district were generally positive, but they also voiced concerns about motivating their children to do the online work. Also, some parents expressed that some teachers were using too many different websites and digital tools and parents could not keep track of all these; others indicated challenges with timing for video conferences with multiple children. Some feedback centered on difficulties parents had in helping their children keep pace with what some perceived as a higher workload than before the pandemic. These findings align with formal research studies and many of the critiques in the popular press.

Parent Relationships that Allay Critiques of Teaching

Teachers' experiences with criticism are often linked to feedback from parents in their communities and the perception of teaching as a profession. Previously, Tye and O'Brien (2002) found that teachers often left the profession due to criticism from parents of the children they taught. Farber (1982) also recognized that when parents withheld or withdrew support and were vocal about it, teacher burnout increased. Hughes (2012) found "[t]eachers who were more satisfied with the levels of parental and student participation and cooperation were 1.6 times more likely to remain in teaching," (p. 254). Thus, parent-teacher relationships are sustained when critique is low.

Where there is a perception of low parent support, such feelings might stem from teachers' attempts to maintain separate spaces for working with children—spaces into which parents were not always invited (Shearer, 2006). Long ago, Waller (1932) noted that schools were autocratic and tended towards isolation because they were under constant criticism, but they were also under constant criticism because they are autocratic. The negative cycle is disrupted when teachers improve communication with parents (Epstein & Dauber, 1991; Miretzky, 2004; Vincent, 2013).

Parental critique has also been documented in previous research in online learning. For example, Rice (2016/2021) described rural teachers' experiences with learning to conduct some teaching activities online before the pandemic. Teachers in Rice's (2016) study described how parents had given more criticism than praise for their efforts. For example, one participant noted that parents had been worried about screen time for their children and so when the school sent home one-to-one devices for some online assignments, some parents wanted detailed information about how the activities students were supposed to be doing were related to specific learning objectives. The teacher in the study was willing to provide such information and increase communication to negotiate shared goals, but she noted that some of her colleagues were not. Another participant wanted students to respond to the literature on social media and a handful of parents complained because they had concerns about social media's influence on their children. The teacher believed the assignment was strong pedagogy, but offered an offline alternative to assuage parents, rather than have what might have been an initially uncomfortable, but perhaps ultimately fruitful, conversation with those upset parents first and eventually with all of them. In such cases, Rice (2021) recommended that professional learning on topics of online learning and technology should be centered in the multiple simultaneous complexities and demands teachers face.

Prior research also documented parent concerns about children using technologies, such as online games and smartphone devices to do some assignments online at school (Hadad, et. al., 2020; Okan, 2003). Under such circumstances, teachers' have allowed parents to opt-out of the online part of the assignment. Opting in or out can be done informally, but it has also been increasingly common to use formal consent procedures to ensure that parents are provided detailed information about what tasks children will do online and for what purposes (Shaw, et. al., 2015). During the pandemic, schools may have used formal consent processes to convey that education would be provided online, or they may have assumed that when families took possession of devices or logged on to their video conference class, they were automatically consenting to do so.

When teachers and parents inhabited separate spheres of school and home there might have been an imagined sense of *detente* ("you stay on your side and I will stay on mine"). But during the pandemic children were sitting at home instead of school while a parent was physically present instead of a teacher. Some parents had the opportunity to gain a new, more expansive view of what the teachers were doing (Asbury & Kim, 2020). Other parents who were unable to sit next to their children because they were essential workers or for other reasons may have felt even more anxiety about their children's learning than before (Dong, et. al., 2020). The overall result could have been substantial frustration about relationships with teachers that may not have ever felt mutually supportive.

Further, while it may be tempting to say that teaching online should have facilitated improved communication with parents through online means (e.g., emails, travel-free video conferences), there is, at present, no empirical evidence that such increased communication has been a widely occurring phenomenon during the pandemic. Nor is there hard evidence that all parents in particular communities and teachers were able to reach agreements about what strong communication looked like in terms of content, manner, or pattern during this time. Strong communication with parents about online learning using digital tools was not easy to achieve and maintain before the pandemic (Borup, et. al., 2019). Given what has been typical in the past, it seems reasonable to assume great disparities in communication experiences, which predicts criticism (Epstein & Dauber, 1991).

LESSONS LEARNED FOR RESEARCH

As schools transition back to in-person learning in school buildings, teaching online or simply using more digital technologies could become more common. Where that is the case, it seems that more research will be needed to address the tensions that might have erupted during the pandemic due to parents' and teachers' misaligned visions of what online learning was and how it should operate alongside the general chaos of the emergency. Future research should focus on how teacher educators support practicing teachers in (1) identifying, classifying, and addressing the content of critiques about online teaching and learning, (2) advocating for online learning as an instructional modality and for themselves as online teachers, and (3) using communication strategies that support positive relationships with parents about instruction provided online.

We Need Research about Identifying, Classifying, and Addressing Critiques of Online Teaching and Learning

We need more research about how teacher educators support teachers in understanding and responding to critiques of online learning (Dong, et. al., 2020; Grabe, et al., 2020; Rice, 2016). For example, we need to know how teacher educators learn about teachers' experiences with general criticism of online learning versus specific critiques of online teaching (Asbury & Kim, 2020; Hadad, et. al., 2020). What critiques do teachers report to teacher educators? How do teacher educators shape the learning experiences to respond to these reports? Also, interesting is whether and how teacher educators become aware of critiques of online teaching in the popular press and use that information to plan learning for teachers (Hansen, 2009). What types of support do teacher educators provide in these instances (e.g., emotional, intellectual)? Finally, how do teachers respond to teacher educators' support efforts?

We Need Research about Preparing Teachers to Advocate for Online Learning

We need research that explores how teacher educators support teachers in advocating for online learning and themselves as online teachers (Archambault & Crippen, 2009; Crouse, et. al., 2018; Rice, 2019b; Rice & Deschaine, 2020). Such support might include strategies for helping teachers respond to critiques in productive ways. For example, encouraging teachers to avoid popular press sources that often critique teachers might be a salient strategy (Berliner, 2000). Teacher educators might also want to help teachers respond to critique by writing their perspectives and sharing experiences with the popular press. Researchers should design studies that evaluate the usefulness of these strategies for their effects on teacher's willingness to continue to learn to teach online.

More research is also needed to determine how teacher educators can help practicing teachers reconceptualize some critique as an opportunity to improve online teaching (Miretky, 2004; DeCoito & Richardson, 2018). Studies should focus on what happens when teacher educators encourage teachers to bring their real dilemmas into professional learning spaces (Rice, 2019b; Rice, 2021). These studies can also explore how teachers and teacher educators work together to determine ways to address those dilemmas. Problem-based professional development is perceived as being personalized to teachers (Arnesen, et. al., 2019; Rice, 2021). But we need to know more about how to design learning experiences for teachers that focus on online instructional improvement *and* addressing the critiques of online learning.

We Need Research about Supporting Communication About Online Teaching with Families

According to previous research, frequent, specific, positive, communication with parents is the key to decreasing criticism of teacher work. (Epstein & Dauber, 1991; Miretzky, 2004; Vincent, 2013). When the pandemic shuttered school buildings, teachers and parents might have had assumptions about what one another was capable of doing to support children that were incorrect and resulted in criticism (Asbury & Kim, 2020; Dong, et. al., Garbe, et. a., 2020). Future research could help identify strong communication applications and programs, strategies, and routines for teacher educators to share with teachers. Moreover, research should describe and evaluate how teachers are prepared to convey information about what learning is happening, with what tools (including consent forms as well as other means), and why specific strategies are being used.

Communication practices in teacher education might be facilitated by frameworks, such as the Academic Communities of Engagement Framework (Borup, et. al., 2020). In this framework, learners are supported within their personal learning environment, their communities of support, and by the teachers from the school. Instead of thinking of students as learning in one environment, they are actually operating in (at least) three. The question for research is, how can teacher educators make the presence of these multiple environments of online learning known to teachers? Also, how can teacher educators prepare teachers to orchestrate success in within and across these environments?

LESSONS LEARNED FOR PRACTICE

Teacher educators need to prepare teachers to teach online (Archambault & Kennedy, 2016; Kennedy & Archambault, 2012; Rice & Deschaine, 2020). As part of that work with practicing teachers, teacher educators also need to prepare teachers for criticism of online learning in general and critique of their specific online teaching practices. Teacher educators can provide this by (1) providing information to teachers that prepares them to advocate for online learning and (2) including parent communication and relationship building as an important aspect of professional learning about teaching online.

We Need Practices that Prepare Teachers to Advocate for Online Learning

When practicing teachers enter professional learning spaces to learn to teach online, they need to learn to advocate for online learning and themselves as online teachers (Kennedy & Archambault, 2012; Rice & Deschaine, 2020). One immediate need for teacher educators is to support advocacy by providing information to practicing teachers about the various types of online learning, including those that are driven by necessity, such as emergency remote teaching, and those that are not (Hodges, et. al., 2020; Williamson, 2020).

Support might be provided that is personalized to specific critiques that teachers report (Arnesen, et. al., 2019). Within teachers' professional learning experiences, teacher advocacy can be supported as teacher educators provide timely and accurate information about the demands of online learning (Crouse, et. al., 2018). For example, teachers are often unaware of the high reading demands in online textual materials (Rice & Greer, 2014). Providing teachers information about this research, including strategies for testing the reading level and assessing the text complexity of the online texts they plan to use will support online learners. Another belief about online learning is that because it is any time, any place learning, one does not have to plan it into their schedule—that online learning will just magically happen when the computer is on (Franklin, et., al., 2015). To support advocacy that addresses this belief, teacher educators need to provide specific content about helping families schedule online learning. Parents noticed that scheduling was a problem, particularly when there were multiple children in the home (Dong, et. al., 2020; Grabe, et al., 2020; Parsippany-Troy Township Schools, 2020). When teacher educators provide professional learning experiences about online teaching, they should include information about the challenges families face in scheduling (e.g., devices, WiFi bandwidth, noise, motivational flows) and help teachers conceptualize support they could give and ways to share that support with families.

Another important way to support teacher advocacy is to allow teachers to learn from other teachers (Rosaen, et. al., 2013; Van Acker, et. al., 2014). During the pandemic, teachers devised and shared some clever strategies for enhancing student engagement, such as putting stickers on their faces to acknowledge student participation (Kindelan, 2020). To make their material more visible, some teachers were sharing how to use a cell phone as a document camera (Vincent, 2020). These are interesting innovations that teachers can share during professional learning opportunities. Teacher educators should show teachers how to access these networks through nings, listservs, social media, or other tools. Teacher educators should also help teachers evaluate these networks for quality since not all online sources host quality information. For example, some materials on teacher-sharing sites have been found to host large amounts of racist materials (Shelton, et. al., 2020). Finally, teacher educators could support teachers in making videos of themselves teaching and then reflect together (Suzuka & Yakel, 2020).

We Need Practices that Include Parent Communication and Relationship Building for Online Teaching

Communicating with parents is a salient strategy for reducing criticisms, whether teaching is on or offline (Epstein & Dauber, 1991; Flynn, 2007; Tonks, et., al., 2020; Vincent 2013; Westergård, 2013). Professional learning experiences should prepare teachers for the range of interactions they will have with parents. Teacher educators should directly address communication with parents by providing examples of strong communication practices. Such practices might include using digital applications with reminder features, making digital spaces, such as wikis, for parents and teachers to exchange information that does not violate student privacy, and evaluating the limitations and affordances of certain methods of communication (phone, video conference, email, text, application) (Borup, et. al., 2019). Some communication techniques require teachers and parents to exchange information at the same time (synchronous) and some allow for communication at different times (asynchronous). Teacher professional learning should support teachers in considering these issues and making plans for future practice (Rice, 2021).

Teacher educators should provide examples of common documents for online teaching. These might include accessible 'Welcome to Class' emails, tips for trouble-shooting with technologies, and short videos teachers could make for parents to walk them through common technology problems or share strategies for helping children learn to navigate learning management systems, use new digital programs, and tools, or support children's self-regulation skills (Borup, et. al., 2019). Parents have expressed confusion about what work is supposed to look like or be formatted when it is online (Rice, et. al., 2018). Professional learning could be an opportunity for teachers to identify common concerns of parents about what work should look like and what learning should look like and then address these collaboratively.

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Online Teaching and Learning for Teacher Education

Reexamining Digital Citizenship:
Pandemic Lessons to Prepare Teachers and Students for Digital Learning Environments

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Abstract: The COVID-19 pandemic presented an unprecedented challenge to K-12 school systems to maintain continuity of education during a period of prolonged remote instruction. During this transition, emerging issues in digital health and wellness, digital security and privacy, digital equity, and digital fluency demonstrate the compelling need to reexamine the role of digital citizenship in schools and teacher education programs. Reflecting on common issues in digital citizenship curricula and instruction as well as emerging issues in digital citizenship during the pandemic, this chapter presents suggestions for teacher education practices and research to help preservice and in-service teachers develop digital citizenship competencies so that they would help prepare their students to become digital and ethical citizens in digital learning environments.

Lesson Learned: Teacher educators should have learned the critical importance of preparing teacher candidates to model and instruct digital citizenship in their future classrooms.

AN INTRODUCTION TO THE CHALLENGE AND THE SIGNIFICANCE OF TRAINING TEACHER CANDIDATES ON DIGITAL CITIZENSHIP COMPETENCIES IN TEACHER EDUCATION PROGRAMS

The year 2020, due to the COVID-19 pandemic, witnessed a growing concern on students' digital behaviors and mental health. The mass school shutdowns forced many schools or districts to hastily convert traditional classroom-based lessons to online instructional modules. This switch to emergency remote teaching (Hodges et al, 2020) exacerbated many existing issues such as lack of technology oversight in students' homes or lack of internet access, and new frustrations and behavioral issues arose. Educators have observed more inappropriate digital behaviors among the students in their virtual classrooms, and school administrators have received more reports of students' digital misconducts (Alba & Lorenz, 2020). Preparing the students to be digital citizens is becoming a pressing task for educators and school administrators. As a result, teacher education programs are facing an unprecedented challenge of preparing teacher candidates to handle students' digital misconducts and model proper digital citizenship in the virtual learning environments.

Prior to the pandemic, researchers had expressed concerns that preservice teachers were not adequately trained to teach all aspects of digital citizenship curriculum (e.g., Karal & Bakir, 2016; Pusey & Sadera, 2012), and were not prepared to exemplify appropriate digital citizenship to the students (Sincar, 2013) in their future classrooms. As digital natives, preservice teachers may be knowledgeable in the areas of digital communication and digital literature (Sincar, 2011), but they are lacking in the areas of digital ethics (Karal & Bakir, 2016; Sincar, 2013) and digital safety (Pusey & Sadera, 2012). The pandemic has made those issues more prominent and more urgent as the remote learning continues to be the mode of instruction during the new 2020-2021 school year. In addition, emerging issues on digital citizenship such as Internet safety and digital health have become serious concerns among all stakeholders including parents, teachers, and school administrators. Some school-aged children developed mental health issues due to social isolation after months of virtual learning (Pincus et al, 2020). A recent ransomware attack on metropolitan school systems (Barr, 2021; Marks, 2020) is an alarming example that both the students and teachers need to be prepared to manage learning and instruction should they encounter issues related to digital security.

Exposure to digital citizenship curriculum can help prepare teacher candidates to model appropriate digital behaviors and instruct digital citizenship topics in their future classrooms (Karal & Bakir, 2016; Sincar, 2013). The emerging issues related to students' digital behaviors call for a closer examination of the existing digital citizenship curriculum in teacher education programs. The purpose of the chapter is to revisit the topic of digital citizenship and propose an update on the digital citizenship curriculum to help prepare both preservice and in-service teachers to better understand digital citizenship so that they would be able to prepare their students to be digital citizens.

WHAT WE KNOW

Digital Citizenship, an umbrella term that covers instruction in and the practice of safe, responsible, and ethical online interactions (Ribble & Park, 2019), includes online behavior as one of its central tenants. Mike Ribble's Nine Elements of Digital Citizenship acts as a roadmap for digital citizenship instruction by laying down its essential elements and placing the theoretical foundations for ideal online interactions (Mattson, 2017). Using Ribble's Nine Elements as a framework, Common Sense Education (2020) has developed a curriculum on digital citizenship that is aligned with the Common Core, International Society for Technology in Education (ISTE), and American Association of School Librarians (AASL) standards. This curriculum covers six topics: Privacy & security, Media balance & well-being, Digital footprint & identity, Relationships & communication, Cyberbullying, digital drama, & hate speech, News & media literacy) in 73 total lessons (Common Sense Education, 2020).

Issues related to digital citizenship are not new. Research has identified various student digital behaviors that are problematic such as cyberbullying (Jones & Mitchell, 2016; Gleason & von Gillern, 2018) and general technology misuse (Conn, 2010; Ribble & Miller, 2013). Using Ribble's framework and Common Sense Education's curriculum as references, the following sections present literature on common issues related to digital citizenship in both pre-pandemic and during the pandemic times. Additionally, the challenge for teacher education programs to train teacher candidates on digital citizenship competencies is presented and discussed.

Common Issues related to Digital Citizenship in Pre-Pandemic Literature

There were three categories of commonly seen issues related to digital citizenship identified in the pre-pandemic literature: cyberbullying, technology misuse, and inappropriate language or content (e.g., explicit photos). Cyberbullying, defined as "any behavior performed through electronic or digital media by individuals or groups that repeatedly communicates hostile or aggressive messages intended to inflict harm or discomfort on others" (Tokunaga, 2010, p. 278), in its many forms was the most commonly cited student digital behavior issue in pre-pandemic literature (Jones & Mitchell, 2016; Gleason & von Gillern, 2018; Tanrikulu, 2018; Martin et al., 2019; Finkelhor et al., 2020), and was a prevalent and global issue (Tanrikulu, 2018). Cyberbullying may appear in many forms, including flaming, trolling, threats, and acting as a bystander.

Flaming and trolling are related forms of harassment that use written language (message board posts, comments on social media) to degrade, publicly abuse, or intentionally humiliate someone (Tokunaga, 2010). It is worth noting that although flaming is a behavior present in all age ranges, the majority of research on the topic focuses on children under the age of 18 (Tokunaga, 2010). While students may not be directly involved in bullying others, they might commit cyberbullying as cyber-bystanders if they witness cyberbullying behaviors but do not intervene, or if they record or document the cyberbullying incident (Machackova, 2020).

The second category of commonly seen issue on digital citizenship present in the pre-pandemic literature is general technology misuse (Conn, 2010; Ribble & Miller, 2013), which can be divided into two sub-categories: social media and inappropriate use of non-academic websites during non-instructional time connected to school (Conn, 2010). The social-media sub-category involves both students and teachers: students using social media, and teachers not understanding or having any training on appropriate use and etiquette for social media use (Ribble & Miller, 2013). The inappropriate use of non-academic websites during non-instructional time connected to school sub-category involves students using websites like YouTube or blogging sites to post insulting or offensive content that can violate school policy on harassment or violate the need for schools to have a supportive and safe environment for both staff and students (Conn, 2010).

The final category is inappropriate language or content (Finkelhor et al., 2020; Jones & Mitchell, 2016). Covering a broad spectrum of behaviors, inappropriate language or content refers to written or verbal inflammatory, racist, or derogatory language, videos, or pictures intended to cause disruption in the classroom or harm others (Barr, 2021). Sexually explicit content including text messages, videos, or pictures (commonly called sexts) that involve at least one minor have legal consequences resulting in prosecution for the distribution of child pornography at a state or federal level (Jones & Mitchell, 2016). Participation in sexting can have serious implications for a student's current and future reputation as digital content can be easily distributed (Finkelhor et al., 2020).

Emerging Issues on Students' Digital Behaviors during the Pandemic

During the pandemic, when the class instruction was delivered online using synchronous (e.g., Zoom, Google Meet) and asynchronous technologies (e.g., Schoology, itsLearning, Canvas, Blackboard, and Google Classroom), new issues related to digital citizenship are emerging, including digital health and wellbeing, digital privacy and security, digital equity, and digital fluency.

As students were adapting to prolonged remote instruction, the ongoing effects of social isolation and daily routine disruption resulted in a public health concern for the mental and physical health of children (Pincus et al, 2020). Disruption of student day-to-day home and school routines, sleep patterns, reduced physical activity, increased screen time, and dietary changes have negatively affected the physical and mental health of children as a result of extended home confinement and social isolation (Coyne et al, 2020). Pediatric screen time boundaries became no longer practical as schools were required to balance the negative physical effects of increased screen time with the achievement of educational outcomes as devices mandates were adopted for curriculum delivery (Nagata et al., 2020). Despite access to the school community through devices, social isolation and routine disruption served to both exacerbate existing and create new mental health issues in children and adolescents without adequate support services (Phelps & Sperry, 2020; Usher et al., 2020).

Digital privacy and security has emerged as a critical issue during shift to remote teaching as cyberattacks on school systems have disrupted operations affecting both individual classes and school systems (Barr 2021; Marks 2020). Ransomware attacks targeting servers, data, and instructional applications were a direct assault on school systems' digital

security and safety, shutting down instruction due to system inaccessibly in several major metropolitan areas, like Baltimore, Toledo, and Miami (Barr, 2021; Marks, 2020). Individual classrooms also faced disruptions as teachers experienced the new phenomenon called Zoombombing, the latest disruptive trend in online education where uninvited persons enter an online classroom and post or broadcast inflammatory or inappropriate content with the aim to disrupt instruction, or simply cause chaos (Barr, 2021). Teachers reported that while the majority of students did not participate in Zoombombing, a few students shared Zoom class links with friends, allowing outsiders the chance to quickly disrupt a class (Zimmerman & Amin, 2020).

Limited access to the Internet and technology by students in lower-income schools or districts during the pandemic widened the existing first-level digital divide (access to technology) (Scheerder et al., 2017), highlighting the inequality between lower- and higher-income districts (Goldstein, Popescu, & Hannah-Jones, 2020). This inequality in digital access has become clearer as the large majority of schools migrated to digital instruction during the COVID-19 pandemic and gained more attention when online instruction continued in the 2020-2021 academic year with the unsolved issue of absenteeism of a disproportionally larger number of low-income students (Goldstein et al., 2020). In an attempt to alleviate this inequality, school systems that did not have 1:1 device programs before the pandemic are making efforts to distribute devices and cell phones that act as WiFi hotspots to students without home access (Goldstein et al., 2020). However, this push to get reliable devices and internet access to students has not always been successful (Goldstein et al., 2020). For example, in New York City alone, thousands of students still lack reliable internet access and devices (Nierenberg & Pasick, 2021).

In an era of hyper-connected social media, misinformation can quickly spread and go viral very easily (Ressa et al., 2020). In the midst of a global pandemic, digital fluency, or the ability to discern real information from "fake news" (wrong, misleading, or inaccurate) can be a matter of life and death, with fake news items spreading and promoting fake health information or cures that have a very real potential for harm (Buchholz et al., 2020; Ressa et al., 2020; Young, 2020). The COVID-19 pandemic stands out as a "digital infodemic" (Banerjee & Sathyanarayana Rao, 2020), which highlights the essential nature of digital fluency and the practice of ethical citizenship. Students need to be digitally fluent so that they would be able to judge information sources as biased or inaccurate, rather than expecting an expert to assign credibility to a claim (Buchholz et al., 2020).

Teacher Education Programs' Challenge to Train Teacher Candidates on Digital Citizenship

Teachers are essential in helping students develop digital citizenship skills as they model and teach digital citizenship in their classrooms (Reilly, 2020). Issues related to student's digital behaviors can be solved by implementing an appropriate digital citizenship curriculum, which many teachers believe to be effective in helping students make safe, smart, and ethical decisions online (Vega & Robb, 2019). The question, often a challenge, is how to prepare teachers to teach digital citizenship curriculum. Digital citizenship, one element of digital competencies, is often an integrated component in the technology integration curriculum in teacher education programs. Concerns over the experience of students navigating online learning environments has prompted calls for teacher education programs to emphasize the teaching of digital citizenship to preservice teachers (Walters et al., 2019) in order to prepare them to support the development of critical thinking skills to evaluate information in varied online spaces, compassionate behaviors in their online interactions with peers, and healthy habits in their digital life (Reilly, 2020; Wilkey Oh, 2020).

Gaps exist in both research literature and practicing teachers' classroom instruction regarding digital citizenship. Research on digital citizenship in teacher education programs is limited, and only a few studies have attempted to address the development of the digital citizenship curriculum (Walters et al., 2019). The existing research indicated that preservice teachers were not well prepared at all aspects of digital citizenship competencies. They are often found to have adequate behaviors or knowledge about digital literacy, digital communication (Pusey & Sadera, 2012; Sincar, 2011), but lack knowledge or preparedness in areas such as digital law, digital rights and responsibilities, digital safety and security (Pusey & Sadera, 2012), and digital ethics (Karal & Bakir, 2016; Sincar, 2013). As a result, researchers issued a call for teacher education programs to develop a curriculum to better prepare teacher candidates for digital citizenship competencies (Walters et al., 2019). The emerging issues with students' digital misconducts during the virtual learning under pandemic make it more imperative for teacher education programs to tackle the challenge of training teacher candidates on digital citizenship competencies.

LESSONS LEARNED FOR RESEARCH

Pandemic experiences have highlighted the critical imperative of digital citizenship curriculum as students, teachers, parents, and school administrators have grappled with personal and organizational challenges adapting to a period of prolonged remote instruction. Emerging trends in digital health and wellness, security and privacy, equity, and fluency highlight the need for a comprehensive digital citizenship research agenda that focuses on the design and development of the digital citizenship curriculum. Research methodologies such as design-based research and mixed methods are useful approaches. The development of a national clearing house for students' digital misconducts can be another area of research in the field of teacher education.

It is imperative that teacher education programs keep their digital citizenship curricula updated to prepare pre- and in-service teachers to contend with emerging digital citizenship issues. The design and development of a curriculum require iterative process with rounds of revisions. A design-based approach that involves various stakeholders including teacher educators, teacher candidates, practicing teachers, and students would help generate a comprehensive coverage of the topics that are prevalent and critical for educating and preparing K-12 students for the digital world. Design-based research is not only an iterative, collaborative, and solution-based research method (Wang & Hannafin, 2005), but can also be used as a professional development strategy (St. Hilaire & Gallagher, 2020). In addition, the university-school partnership in the design process could help develop innovative ways of teaching the digital citizenship curriculum, which in turn may help create the most up-to-date curriculum for its students to begin their digital citizenship pedagogical practice with the use of realistic simulations, cases, and teaching methods that work for today's students (Instefjord, 2015).

A comprehensive research agenda for digital citizenship must address the effectiveness of digital citizenship curriculum, implementation, and training programs adapting to the fluid technology environment present in K-12 schools. This often requires expertise and experiences of various stakeholders. A mixed method approach (Johnson & Onwuegbuzie, 2004) that combines quantitative data from surveys (e.g., collecting data on the existence and frequency of students' digital behaviors) and qualitative data from interviews or observations (e.g., collecting data on students' live experiences in the digital citizenship instruction) could help gain a comprehensive perspective on the design and implementation of the digital citizenship curriculum. (Teddlie & Tashakkori, 2008).

The emerging issues in digital citizenship during the pandemic, coupled with firsthand accounts of the experiences of teachers, students, and administrators, suggest a more nuanced understanding of the real-world experiences of digital citizenship issues in and around the schoolhouse. Researchers and practitioners become aware of students' digital misconducts through anecdotal research findings or reports. It would be helpful to develop a national clearinghouse on students' digital behaviors that provides an opportunity for school communities to report on emerging experiences with digital citizenship. In higher education, EDUCAUSE leveraged quick polls to collect and report on higher education experiences as institutions grappled with the transition to remote and low-density instruction (EDUCAUSE, 2020). This provides a model for the organizations of educators to collect, monitor, and communicate emerging trends of digital citizenship post-pandemic.

LESSONS LEARNED FOR PRACTICE

To help prepare the students to be digital citizens, the teachers need to have digital citizenship competencies. As Ribble and Miller noted, "How are educational leaders to prepare their students for a digital future when they do not yet fully understand these technologies?" (2013, p. 136). We may ask a similar question: how are teachers to teach their students about digital citizenship when they have not learned about digital citizenship in their teacher education program or what they have learned is not adequate or current? The emerging issues on digital citizenship have some important implications for teacher education practices. There are four things we recommend: 1) updates on the digital citizenship curriculum, 2) holistic approach to develop the digital citizenship curriculum, 3) innovative strategies to prepare teacher candidates to teach and advocate for digital citizenship to their students; and 4) micro-credentials on digital citizenship competencies for pre- and in-service teachers.

Updates on the Digital Citizenship Curriculum

The topic of digital citizenship is usually integrated in the technology integration course in teacher education programs. Teacher education programs could draw from existing resources on digital citizenship curriculum such as Ribble and Park's work that was published by the International Society for Technology in Education (2019). This book discusses the importance of infusing digital citizenship concepts into the DNA of an educator's practice, and the need for embedding digital citizenship instruction into existing curricula at both the vertical (or real-world) and horizontal (or classroom) levels. Thus, this book could be a starting point for teacher educator programs as they work on designing and updating their digital citizenship curriculum because the book gives insights into current digital citizenship practices for teacher education programs to prepare preservice teachers to teach today's students. Another useful resource for digital citizenship curriculum development is the Common Sense Education (2020), which provides a curriculum that is aligned with the Common Core, ISTE, and AASL (American Association of School Librarians) standards. This curriculum is used by 60% of U.S. schools and over 1,000,000 teachers worldwide (Common Sense Education, 2020). While this curriculum covers many aspects of digital citizenship with a total of 73 lessons, it does not equally address all related ISTE standards (Common Sense Education, 2020). Teacher education programs may not want to simply adopt this curriculum, but rather use it as a resource to develop their own curriculum that meets the needs of their instructional goals.

In addition to the essential elements from Ribble and Park's book (2019) and the Common Sense Education curriculum on digital citizenship curriculum, teacher education programs need to consider updating issues related to digital citizenship that emerged during the pandemic. For example, in the midst of K-12 students returning to the schoolhouse during the pandemic, schools are facing unprecedented levels of mental health issues from the students and will continue to face the possibility of long-term effects (Pincus et al, 2020). Preservice and in-service teachers need to be educated as to what it means to be trauma-informed, and how to respond to student trauma due to social isolation and adverse childhood events (Pincus et al, 2020). Other updates worth noting are issues related to digital safety and security such as Zoombombing and cyberattacks (Barr, 2021; Marks, 2020; Zimmerman & Amin, 2020), digital health and wellness issues (Goldstein et al., 2020; Nierenberg & Pasick, 2021), and the digital fluency issues caused by the rapid and sometimes dangerous spread of misinformation (Banerjee & Sathyanarayana Rao, 2020; Buchholz et al., 2020; Ressa et al., 2020). Given the recent ransomware attacks on school districts, preservice and in-service teachers need to be better educated about digital safety and security. The "digital infodemic" (Banerjee & Sathyanarayana Rao, 2020) phenomena needs to be discussed as part of the digital citizenship curriculum to help preservice and in-service teachers to develop or strengthen their digital fluency.

With the updated curriculum on digital citizenship developed, teacher education programs may consider integrating the digital citizenship instruction or discussions into methods courses. As the traditional approach to preparing preservice teachers, standalone educational technology courses are still common in teacher preparation programs (Nelson et al., 2019; Parrish & Sadera, 2019). However, it has been shown that the isolated approach to teaching technology skills does not adequately improve preservice teachers' technology integration skills (Nelson et al., 2019; Parrish & Sadera, 2019). Instead, teacher educators should use a more comprehensive approach to train preservice teachers in technology integration (Nelson et al., 2019). Teaching with technology is a complicated and multi-faceted process that takes time to master (Foulger et al., 2017). Thus, it must be interwoven throughout the entire teacher education program (Foulger et al., 2017). As part of the overall technology competencies, digital citizenship instruction may follow a similar integrated approach where the instruction or discussions of digital citizenship skills should be integrated throughout the undergraduate program for preservice teachers and the graduate programs for in-service teachers as teacher candidates learn best in an environment where technology use is infused into the curriculum and modeled by their instructors (Nelson, 2017; Nelson et al., 2019).

Assessment of digital citizenship competencies needs to be part of the digital citizenship curriculum. There have been research efforts that attempted to develop assessment tools for teachers' technology competencies (e.g., Elmendorf & Song, 2015; Parrish & Sadera, 2019). As part of technology competencies, digital citizenship competencies should be assessed for both in-service teachers and preservice teachers. Since the digital citizenship curriculum is usually embedded within the instructional technology curriculum, the assessment of digital citizenship may be part of the overall assessment of technology competencies for preservice and in-service teachers in teacher education programs. Using Delphi research method (Linstone & Turloff, 1975) to seek expert's input may be a helpful approach to develop the assessment items for digital citizenship. In fact, the Delphi research method has been widely used to develop technology competencies assessment (e.g., Elmendorf & Song, 2015, Foulger et al., 2017; Parrish & Sadera, 2019). Teacher education programs may adopt this approach to develop an assessment tool for digital citizenship competencies.

Holistic Approach to Develop the Digital Citizenship Curriculum

While there is a need to better prepare teachers to integrate digital citizenship in their daily teaching practices, the responsibility for digital citizenship education involves the entire school community. The pandemic is recognized as an opportunity to consider the "end goal" of education and focus on authentic learning experiences (Trombly, 2020). Moving away from compartmentalized instruction on digital citizenship (Breakstone et al., 2018) to an integrated model requires a holistic approach supported by the entire school community. As school nurses, school counselors, and other school roles are reconceptualized for the return to in-person teaching, it is an opportunity to consider the role of school-university partnerships in order to support the needs of schools and the digital health and wellbeing of students. The Council for the Accreditation of Educator Preparation (2020) accreditation standards mandate that teacher education programs develop mutually beneficial partnerships with P-12 schools to advance teacher preparation. These partnerships ensure that teacher education programs prepare their students to adapt to and reflect on real-world teaching challenges (Ellis et al., 2020). University-School partnerships and field placements are shown to provide authentic experiences to students, better preparing them to transition into teaching in the communities they serve (Burroughs et al, 2020; Ellis et al., 2020) and collaboratively implement meaningful and sustainable changes in community schools (Burgard & Jozwiak, 2020).

The holistic approach can be effective in preparing digital citizens when it involves all stakeholders such as teachers and teacher educators (Pussey & Sadera, 2012) or a combination of university's instructional technology department, schoolteachers, and parents (Rice et al., 2015). Teachers and preservice teachers need to be trained on instructional technology skills in order to model and instruct proper use of technology to their students (Kara & Bakir, 2016). They typically learn those skills either in teacher education programs as part of their undergraduate or graduate degree program, or through the professional development offered in their school districts. As previously discussed, teacher education programs play an important role in training teachers and preservice teachers on those skills; therefore, an up-to-date curriculum on digital citizenship is critical. Additionally, teacher educators need to be fluent in digital citizenship skills so that they would model and teach them to the preservice teachers in the teacher education programs. Recent scholarship in the field of instructional technology has recognized the importance of preparing teacher educators for technology competencies in general. For example, Foulger et al. (2017) developed a list of teacher educator technology competencies, one of which addresses the legal, ethical, and socially responsible use of technologies. Implementing teacher educator technology competencies that incudes digital citizenship skills in teacher education programs could be a starting point for this holistic university-school partnership, which may take place simultaneously with the curriculum development and updates on digital citizenship for preservice teachers.

Approaches to Prepare Teacher Candidates to Teach and Advocate for Digital Citizenship

To achieve successful digital citizenship instruction, innovative instructional strategies need to be adopted. One strategy can be teacher modeling. Modeling has been identified as an effective instructional strategy in both K-12 learning environments (e.g., Haston, 2007) and in teacher education programs (e.g., Hogg & Yates, 2013). Researchers have promoted a teaching environment that is infused with modeling of technology and digital citizenship skills (Nelson, 2017; Nelson et al., 2019; Parrish & Sadera, 2019). This infusion will allow teacher educators to prepare preservice teachers in an environment where instructors model technology infusion and emphasize the importance of technology and its usefulness in their professional practice (Nelson, 2017).Whether in teacher education programs or in K-12 classrooms, when teaching the students about digital citizenship, teachers or teacher educators should model appropriate digital behaviors to help enhance the students' understanding and acceptance of the concept. For example, teacher educators could model the legal and ethical use of technology resources by including proper citations and uses of copyright protected resources in their instructional materials. Teacher educators or teachers may also facilitate discussions on current news related to the proper use of technologies. Recent Zoombombing and cyberattacks (Barr, 2021; Marks, 2020; Zimmerman & Amin, 2020), or the Texas lawyer with the cat filter by accident during a Zoom meeting (Victor, 2021) could become opportunities for lessons learned regarding the use of digital technologies.

Another pedagogical approach is through fieldwork. When preservice teachers are provided with the opportunity to practice what they have learned, they would likely to become advocates for what they teach (Delacruz & Jackson, 2019). Field work such as internship or service learning in schools (Song, 2018) are great opportunities for preservice teach-

ers to engage in observation of and conversations with the K-12 students regarding digital citizenship. While it might be challenging to place preservice teachers for their internship in virtual classrooms, there have been some successful adaptive and alternative approaches to fieldwork during the pandemic such as simulated teaching presentations (Monroe et al., 2020) and using social media to sponsor student interns digitally (Pike et al., 2020). As virtual learning continues to be part of K-12 school practices due to the pandemic, teacher education programs may consider placing student interns in the virtual classrooms with mentor teachers so that they will have authentic understanding of what virtual learning is like and first-hand observations of K-12 students' behaviors in virtual classrooms.

When preservice teachers are not participating in internship, they could engage in self-reflections or collaborative reflections through self-studies (Pinnegar & Hamilton, 2009) to examine their own digital behaviors in order to better understand themselves from a student's perspective. This self-reflection could be part of the preservice teachers' experience in their instructional technology course. For example, preservice teachers could be asked to present and share their experiences or observations of technology misuse by accidents and discuss strategies to address or avoid such behaviors in the future. Understanding issues with technology use from a learner's perspective may help them engage in meaningful discussions with the K-12 students in their future classrooms regarding digital citizenship.

Micro-Credentials on Digital Citizenship Competencies for Pre- and In-service Teachers

Based on the concept of "digital badges", microcredentials are a portable certification that demonstrates the achievement of skill-based competencies in a flexible online format that can be customized and combined to fit the needs of schools and teachers (Center for Great Teachers and Leaders [GTLC], 2021; Berry, Airhart, & Byrd, 2016; Will, 2017). In recent years, the use of microcredentials has grown in state teacher professional development as some states have expanded their recognition of professional development beyond for-credit university coursework and have started providing a district or state approved catalog of providers or offerings for teacher professional development (Acree, 2017; DeMonte 2017; Povich, 2017).

As a series of skill-based competencies, digital citizenship as defined by Ribble and Park (2019) presents an opportunity for teacher education programs to explore the development of microcredentials or "micromasters" programs to support preservice and in-service teachers (Collins, 2020). While critics of microcredentials claim that university initiatives are a 'reductivist' economic venture that devalues the benefit of traditional higher education (Ralston, 2021), this creates an opportunity to extend university-school partnerships by providing more flexible options for teachers to complete licensure requirements or required professional development for career advancement. The inconsistency of state implementations and support of microcredentialing presents a transformative opportunity for teacher education programs to shape how this form of competency-based education is reflected in licensure and professional development. Leveraging existing university-school partnerships and coordination with education leaders provides an opportunity to demonstrate how for-credit courses and non-credit professional development can equate in teacher training.

Currently, edX and Coursera are popular university partners in the development of microcredentials or "micromasters" programs because of their ability to host, promote, and help operationalize the instruction and student assessment while offloading the economic and technology challenges of large-scale course (Leighton, 2020; Voigt, Buliga & Michl, 2016). As a non-profit, edX (n.d.) offers a range of organizational partnerships ranging from universities, university systems and other non-profits. Teacher education programs may consider using such platform to launch their microcredential program on digital citizenship through university-school partnership and/or university-university partnership within the same university system. These programs provide the opportunity for the university students (e.g., preservice and in-service teachers) as well as practicing teachers in school districts to earn credit either towards their existing university's degree program or their professional development requirement.

Pandemic experiences have demonstrated how changing environments and technology adoption approaches have had a significant impact on the lives of students, preservice and in-service teachers, parents, administrators, and teacher education programs. The emerging issues related to digital citizenship call for an urgent need to prepare K-12 students for a digital learning environment. In order to prepare the students to become digital and ethical citizens, teacher education programs need to partner with school districts to develop an updated digital citizenship curriculum to help teachers (preservice and in-service) to develop digital citizenship competencies so that they would be able to teach and model digital citizenship to their students.

WHAT YOU SHOULD READ

We recommend the following readings for people who are interested in learning more about digital citizenship, strategies for promoting digital literacies in general, current status of digital citizenship instruction in schools, and recent news on digital citizenship:

1. Walters, M.G., Gee, D., & Mohammed, S. (2019). A literature review: Digital citizenship and the elementary educator. *International Journal of Technology in Education (IJTE), 2*(1), 1-21. https://tinyurl.com/esvtj0jo

2. Reisoglu, I., & Çebi, A. (2020). How can the digital competences of pre-service teachers be developed? Examining a case study through the lens of DigComp and DigCompEdu. *Computer Education, 156*, 103940. https://tinyurl.com/282t5pgg

3. Vega, V., & Robb, M. B. (2019). *The Common Sense census: Inside the 21st-century classroom*. Common Sense Media. https://tinyurl.com/3o8uf4y7

4. Vattikonda, N. (2020, September 9). Zoombombing at Cedar Ridge High raises cybersecurity concerns in area schools. *The Daily Tar Heel*. https://tinyurl.com/oyrr8sjz

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Teacher Educators and Teaching Presence in the Asynchronous Learning Environment: Emerging Issues and Future Priorities

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Abstract: At present, teacher educators (TEs) in many countries face significant changes in how their work is conceptualised and enacted. The unexpected digital pivot, due to the COVID-19 pandemic, requires TEs to reconceptualise their discipline-specific knowledge base and pedagogical skill set for the online learning environment. While this digital transition has placed TEs' digital capabilities, literacies, and competence in the spotlight, many aspects of online teacher education remain unexplored and poorly understood. More specifically, there is a dearth of literature which explores how TEs understand, craft, and enact pedagogies for the asynchronous learning environment (i.e., facilitate teaching presence). This chapter begins by exploring the unexpected pivot to teaching online, paying particular attention to the multifaceted role of the TE in this evolving process. The ideal knowledge base of the online educator is then defined, and its development and conceptualisation explored. TE professional development (PD) needs are also explored with particular reference to teaching presence in an asynchronous learning environment. The chapter concludes with a discussion highlighting key teaching presence instructional strategies which address identified TE PD needs. Directions for further research are also outlined.

Lesson Learned: Teacher educators should have learned how to re-envision the planning process to foster student engagement and interaction in the asynchronous learning environment.

AN INTRODUCTION TO THE MULTIFACETED ROLE OF THE ONLINE TEACHER EDUCATOR

Acknowledgement of the role of the teacher educator (TE) as being at the core of good teacher education has resulted in increased interest in this professional group (Swennen & White, 2021). However, scholars (e.g., O' Dwyer & Alti, 2015; Smith, 2011, Swennen & White, 2021) contend that in some education fora, such as policy and research, TEs have been overlooked and are not recognised as a distinct professional group. The resultant neglect of their induction and professional development (PD) needs is paradoxical given their role (Seifert & Bar-Tal, 2021). As the COVID-19 pandemic has forced all Teacher Education Institutions (TEIs) to transfer teaching to online platforms, concerns in relation to the quality of online instruction have been brought into sharper focus. This transition underscores a need for increased attention to TE readiness to teach online (Dyment & Downing, 2020; Ferdig et al., 2020; International Association of Universities, 2020; Moorhouse, 2020, Ó Ceallaigh, 2020). While many international and national policy initiatives have supported TEIs pre COVID-19 with digital transformation (e.g., European Commission, 2018; Redecker, 2017), a much sharper focus is needed for a much-changed context. With blended offerings set to become the new norm and 70% of all programmes forecast to adopt a blended design by 2030 (Bates, 2020), TEIs have been prompted to prioritise PD endeavours in the area of digital teaching and learning for TEs.

TEs are now tasked with facilitating learning environments for students who inhabit a dual role as both learner and facilitator of learning, a responsibility which demands a unique knowledge base and pedagogical skill set. Enabling TEs to constructively but rapidly adopt innovative design, delivery and facilitation skills for the asynchronous learning environment, a concept known as teaching presence, has become a pressing and challenging issue for all TEIs. Teaching presence entails the "methods that instructors use to create the quality online instructional experiences that support and sustain productive communities of inquiry" (Bangert, 2008, p.40). The achievement of student learning outcomes and student satisfaction are shaped by TEs' teaching presence (Dereshiwsky, 2013). Previous research on TEs' teaching presence in an asynchronous learning environment has focused on student perceptions (e.g., Davies & Meissel, 2018; Han & Ellis, 2018; Saint-Jacques, 2013; Sheridan et al., 2013; Zhao & Sullivan, 2017). Some scholars (e.g., Arinto, 2013; Baran et al., 2013; Feng et al., 2017) have also identified specific TEs' teaching presence behaviours. However, TEs' perceptions of, and preparations for, teaching presence in asynchronous learning environments is under-researched. Capturing an understanding of TEs' perceived teaching presence and its associated behaviours is essential if we are to respond appropriately to their discipline-specific needs and professional growth and thus enhance the user experience (UX). This chapter begins by examining the ideal knowledge base of the online educator. The development and conceptualisation of this unique knowledge base is then explored and TEs' PD needs as they relate to teaching presence are highlighted. The chapter concludes with a discussion on specific implications for teacher education practice and research with specific emphasis on TEs.

WHAT WE KNOW

The knowledge and pedagogies needed for online teaching are unique and complex. Teaching online requires a specific knowledge base and pedagogical skill set different to that required for face-to-face teaching (Dereshiwsky, 2013, Elliot et al., 2015; Ní Shé et al., 2019; Sadera et al., 2014). Online teaching not only requires sophisticated levels of digital competence (Redecker, 2017), it also demands a clear understanding of educational theories, instructional design, digital pedagogies, facilitation, learning management systems, student-centred activities, innovative assessment methods and an expertise in how students learn online (Bigatel et al., 2012; Grabowski et al., 2016; Shea et al., 2005). Scholars also argue that teaching online is often a more pedagogically challenging experience (Allen & Seamen, 2013; Costello et al., 2014; Swan et al., 2008). In reality, online educators require specific domains of knowledge which interconnect and influence each other in dynamic and complex ways. Baran et al. (2011) suggest that online educators undertake a range of disparate roles which demand pedagogical, facilitator, instructional designer (ID), managerial, social, and technical expertise. An emphasis on developing and fostering the bespoke knowledge base and diverse roles for online teaching is therefore fundamental in any PD initiatives.

Presence in an asynchronous learning environment: A theoretical framework

Garrison et al. (2000) provide a useful theoretical framework which helps us to understand the intertwined and holistic nature of these diverse roles. Community of Inquiry (CoI) framework (Garrison et al., 2000) is made up of three interdependent constructs (teaching presence, social presence, and cognitive presence) which contribute to the creation of a meaningful and collaborative learning environment and thus UX for students. The depth of knowledge construction and UX are shaped by how these three constructs interrelate. CoI is underpinned by a social constructivist philosophy where "a community of inquiry is made up of teachers and students work together for an educational purpose" (Swan et al., 2009, p.199).

These constructs, social presence, teaching presence and cognitive presence, will now be discussed in greater detail with a particular emphasis on teaching presence, the focus of this chapter. Teaching presence entails the "methods that instructors use to create the quality online instructional experiences that support and sustain productive communities of inquiry" (Bangert, 2008, p.40). This construct is made up of three categories which describe the roles an online educator needs to undertake to effectively foster a CoI. These include planning and organisation, direct instruction, and the facilitation of discourse (Anderson et al., 2001). The task of creating and sustaining teaching presence in an asynchronous learning environment "is most directly under the control of teachers" (Anderson et al., 2001, p.3). Educators are therefore responsible for designing, directing, and facilitating learning in the asynchronous environment. Teaching presence commences well in advance of asynchronous delivery, as the educator, acting as instructional designer, plans and prepares the course (e.g., planning for constructive alignment, informing learners of learning outcomes, stimulating prior learning, designing bite-size videos of appropriate quality, providing scaffolds and guidance for students, etc.). It continues during the course as the instructor facilitates deep learning conversations and provides direct instruction as required.

The second construct, social presence, is defined as "the ability of participants in the community of inquiry to project their personal characteristics into the community, thereby presenting themselves as *real people*'" (Garrison et al., 2000, p. 89). This construct consists of three intersecting categories – open communication, affective communication, and cohesive responses (Rourke et al., 1999). Some key elements which support social presence include open communication, welcome messages, student profiles, learning interactions which accommodate students' feelings and personal experiences (Richardson et al., 2017). Garrison et al. (2000) define cognitive presence as "the extent to which the participants in any particular configuration of a community of inquiry are able to construct meaning through sustained communication" (p.89). Cognitive presence stimulates critical thinking, critical discourse, reflection, and higher-order learning (Garrison et al., 2001). Associated behaviours include problem identification, exploration, integration, and resolution. The role of the instructor therefore is to engage and cognitively challenge students, to elicit performance, to provide meaningful feedback.

Transitioning to teaching online is a complex and multifaceted enterprise. Appropriate theoretical perspectives, like CoI, which help us examine this multifaceted and complex venture are useful. Used as an analytical lens, CoI not only enables us to identify obstacles in online teaching and learning but enables educators who transition to online teaching to reflect on, assess and reconfigure their knowledge base and pedagogical skill set for the online environment. Studies detailing this digital trajectory are limited, yet research does signal that educators require significant support as they transition (Gurley, 2018). Research in this area is therefore timely and critical.

Teaching presence in an asynchronous learning environment: Evidence-based instructional strategies

Fiock (2020) reviews CoI framework and provides a comprehensive list of evidence-based instructional strategies aligned with each presence in a design document in an effort to support educators as they build an online CoI. As teaching presence is the focus of this chapter, an overview of key teaching presence strategies as identified by Fliock (2020) is presented in Table 1 below.

Table 1
Key Teaching Presence Instructional Strategies: An overview
(adapted from Fiock, 2020)

Teaching Presence Instructional Strategy	Associated reference
Clear programme schedules outlining relevant submission deadlines	Richardson et al, 2009
Differentiated, weekly, graded tasks	Richardson et al, 2009
Student engagement in collaborative group discussions, activities, and projects	Lowenthal & Parscal, 2008; Richardson et al, 2009
Clear learning outcomes, guidelines, and scaffolds for students	Richardson et al, 2009
Clear instructional expectations	Richardson et al, 2009
Participation as a graded component of the programme	Rovai, 2000
Continuous, authentic assessment strategies	Lowenthal & Parscal, 2008
Engagement of students in problem solving activities	Dunlap & Lowenthal, 2018
Facilitation of online discussions	Richardson et al., 2009; Watson et al., 2017
Clarity and consistency in communication and approach	Richardson et al., 2009
Clear guidance to students regarding online navigation	Lowenthal & Dunlap, 2018; Richardson et al., 2009
Meaningful and timely feedback on students' posts	Lowenthal & Parscal, 2008
Incorporation of universal design for learning (UDL) principles in all crafted materials	Dunlap & Lowenthal, 2018
Differentiation and personalisation	Dunlap & Lowenthal, 2018; Stephens & Roberts, 2017

Teaching presence in an asynchronous learning environment: Online educators' professional development needs

While many scholars have identified evidence-based instructional strategies for the online environment, a significant and growing body of literature has reported that educators who teach online require considerable PD to do so effectively. They need support with the development of digital skills and literacies like selecting, creating, using, and managing digital tools and resources (Baran et al., 2013; Berry, 2018; Chen et al., 2017; McGee et al., 2017; Pagliari et al., 2009; Wingo et al., 2017). Scholars also report that online educators require specific PD in the area of e-content development to be able to address constructive alignment, content creation, authoring and distribution, and planning for online instruction (Arinto, 2013; Barran & Correia, 2014; Baran et al., 2013; Berry, 2018; Gurley, 2018). Online educators also grapple with instructional design (ID) challenges and dilemmas (e.g., operating a learning management system; LMS), designing and structuring an online course (Baran et al., 2013; Chapman, 2011; Chen et al., 2017; McGee et al., 2017; Pagliari et al., 2009; Wickersham & McElhany, 2010). They struggle to master learning experience design (LXD) like student-centred activities, differentiation and personalisation, and teacher presence (Arinto, 2013; Barran & Correia, 2014; Bolliger & Wasilik, 2009; Baran et al., 2013; Chen et al., 2017; Gurley, 2018; McGee et al., 2017; Mohr & Shelton, 2017; Pagliari et al., 2009; Wingo et al., 2017). Studies also report that online educators require tailored and bespoke supports to craft and enact evidence-based digital pedagogies. This includes the use of digital technologies to foster students' authentic engagement with subject matter, interactivity, and contextualised learning interactions (Arinto, 2013; Allen & Seaman, 2012; Berry, 2018; Bolliger & Wasilik, 2009; Ward et al., 2010). The design, development, implementation and evaluation of technology-enhanced assessment and feedback techniques also challenge online educators in conducting assessment strategies, analysing evidence, providing feedback, and planning (Allen & Seaman, 2015; Arinto, 2013; Barran & Correia, 2014).

A summary of these PD needs is presented in Table 2 below.

Table 2

Transitioning to an online environment: An overview of educators' professional development needs.

Identified category and associated examples	Identified studies
Digital skills and literacies	Baran et al., 2013; Berry, 2018; Chen et al., 2017; McGee et al., 2017; Pagliari et al., 2009; Wingo et al., 2017
E-content development	Arinto, 2013; Barran & Correia, 2014; Baran et al., 2013; Berry, 2018; Gurley, 2018
Instructional design (ID)	Baran et al., 2013; Chapman, 2011; Chen et al., 2017; McGee et al., 2017; Pagliari et al., 2009; Wickersham & McElhany, 2010
Learning experience design (LXD)	Arinto, 2013; Barran & Correia, 2014; Bolliger & Wasilik, 2009; Baran et al., 2013; Chen et al., 2017; Gurley, 2018; McGee et al., 2017; Pagliari et al., 2009; Wingo et al., 2017
Evidence-based digital pedagogies	Arinto, 2013; Allen & Seaman, 2012; Berry, 2018; Bolliger & Wasilik, 2009; Ward et al., 2010
Technology-enhanced assessment and feedback	Allen & Seaman, 2015; Arinto, 2013; Barran & Correia, 2014

Teaching presence in an asynchronous learning environment: Teacher educators' professional development needs

When it comes to teacher educators, their challenges in preparing teachers to teach within an online environment have been widely documented. Stott and Mozer (2016) report that TEs find the technical challenges in crafting and delivering online teacher education programmes "overwhelming and downright frustrating" (p.152), leading to concerns about the overall efficacy of online teaching (Gregory & Salmon, 2013; Zimmerman & Kulikowich, 2016). Significantly increased workload (Bolliger & Wasilik, 2009) and time needed to create and maintain effective online learning environments (Downing et al., 2019) are also highlighted as primary TE concerns. Many TEs struggle to maintain student engagement and report a strong sense of missing the face-to-face contact with their students (Downing et al., 2019). The complexities of effectively modelling *good teaching* within an online teaching environment calls for TEs to deconstruct and reconfigure their professional identities (Baran et al., 2013; Downing & Dyment, 2013; Mills et al., 2009; Smits & Voogt, 2017), a challenging, intricate process referred to as "learning as becoming" (Wenger, 1998).

In terms of TE teaching presence in the asynchronous learning environment, significant challenges in relation to designing and organising courses, facilitating learning, and providing direct instruction for students have been highlighted in the literature (Burke, 2020; Dyment & Downing, 2020; Ferdig et al., 2020; Ó Ceallaigh, 2020). Ó Ceallaigh (2020) explored the lived experiences of 123 TEs in Ireland as they transitioned to online teaching during the pandemic and identified diverse teaching presence PD needs from a TE-informed perspective. When referring to the planning process TEs described a sense of feeling lost, of confusion, of uncertainty. They were unsure of how to conceptualise the planning process due to a deficit in their knowledge base in terms of technical and ID skills (i.e., a deficit in TE technology competencies, TETC). TEs from disciplines that typically rely on experiential embodied pedagogies rooted in dialogic processes of experience expressed significant concerns. They struggled to re-purpose teaching content, to identify the most essential and critical content matter for the asynchronous environment and to address module learning outcomes with much shorter condensed asynchronous inputs. In relation to direct instruction, TEs noted their difficulty of stimulating meaningful, autonomous student engagement with content. They attributed this challenge to a lack of asynchronous pedagogical expertise and evidence-based practices and an inability to draw from a bank of subject-specific active learning pedagogies for the asynchronous environment. Other challenges as reported by Ó Ceallaigh (2020), include TEs inability to foster student-student interaction and build community in the asynchronous learning environment. Please see table 3 below for an overview of TE teaching presence PD needs as reported in Ó Ceallaigh (2020).

Table 3
Overview of teacher educator teaching presence professional development needs (Ó Ceallaigh, 2020)

Planning and organisation	Direct instruction	Facilitation of discourse
• re-envisioning the planning process • re-purposing teaching content to identify the most essential and critical content matter for the asynchronous environment • achieving module learning outcomes with much shorter condensed asynchronous inputs	• technological and pedagogical skills required to teach asynchronously • fostering students' authentic engagement with content • crafting discipline-specific pedagogies aligned with the contextual realities of teaching and learning in an asynchronous environment	• orchestrating purposeful practice to stimulate contextualised learning interactions and productive dialogue among students • generating a sense of community online • linking assessment to deep and challenging learning conversations in the asynchronous environment

LESSONS LEARNED FOR RESEARCH

Teachers shape the quality of learning in schools. However, while TEs play a central role in teachers' professional growth, their experience and the nature of their knowledge base are rarely if ever the focus of empirical studies. TEs represent an essential link in the chain of educational enhancement and thus cannot and should not be ignored by research. While scholars (e.g., Burke, 2020; Dyment & Downing, 2020; Ferdig et al., 2020; Ó Ceallaigh, 2020) have identified TEs PD needs, as discussed above, there is still much work to be done to understand better how TEs understand, develop, and enact teaching presence in the asynchronous learning environment. The field would benefit from additional ethnographical or reflexive research that facilitates the observation of the planning, instructional and facilitation processes of asynchronous teaching.

Future research could include regional and discipline-specific studies which focus on teaching presence in the asynchronous learning environment. Such studies have potential to identify shortcomings to be addressed in future PD initiatives. In addition, it would be valuable to collect more TE best practice case studies in assuring smooth transition to e-learning environments or improving quality and functionality of these environments for TEs. There is also a dearth of research on PD experiences which positively impact TEs' asynchronous practices (i.e., planning and organisation, direct instruction, facilitation of discourse) from a TE-informed perspective. Such studies have potential to reveal specific features of high impact PD experiences which drive TE teaching presence knowledge growth as it relates to the asynchronous learning environment and in turn enable and empower them to re-configure their professional identities for the online environment. Much research remains to be conducted to examine not only the nature of TEs' teaching presence knowledge and expertise, but also the impact of their practice on future generations of teachers.

LESSONS LEARNED FOR PRACTICE

TEs are role models for the next generation of teachers. It is therefore vital for them to be equipped with the digital competence all educators need to pass on their critical and creative use of digital technologies (Redecker, 2017). However, specific PD needs in relation to TEs' teaching presence have been reported (Ó Ceallaigh, 2020). These PD needs will now be considered with reference to planning and organisation, direct instruction, and facilitation of discourse in the asynchronous learning environment. Evidence-based instructional strategies will also be identified to address these TE teaching presence PD needs.

Planning and organising: Identified PD needs and related evidence-based instructional strategies

Re-envisioning the planning process. TEs struggled to conceptualise the planning process for the asynchronous learning environment (Ó Ceallaigh, 2020). Evidence-based instructional strategies which support TEs with planning and organising instruction for the asynchronous learning environment have been identified in many studies. Scholars have highlighted the relevance of informing students of intended learning outcomes as a prerequisite for meaningful engagement and learning, i.e., describing the required performance and the success criteria in detailed rubrics (Hope, 2020; Gagné et al., 1992; Lapitan et al., 2021; Martin et al., 2019). Lapitan et al. (2021) argue that by providing students with lecture notes, progress trackers, lecture videos, revised syllabus and links to additional resources, learning is enriched. Outlining weekly expectations and deadlines for submission of tasks are also perceived as useful strategies to support the learning process (Lapitan et al., 2021, Martin et al., 2019). Some scholars also note the importance of organising teaching in a way which provides a clear path for students to follow in a coherent, logical, easy-to-understand and consistent manner. Strategies for organising include providing a screencast of the course architecture and providing graphics to make visual associations (Anderson et al., 2001; Gagné, 1992; Martin et al., 2019; Watson et al., 2017). Arinto (2013) suggests that student engagement can be boosted by exploiting learning management system (LMS) functionalities to structure content effectively. Selecting learning resources to cater for differentiation and personalisation is also viewed as essential practice (Arinto, 2013, Martin et al., 2019). Watson et al. (2017) claim that navigational cues, supports, and guidance enable students to engage in authentic ways with the asynchronous learning experience. Anderson et al. (2001) point out that being clear to students regarding what is expected of them and the order in which to engage with materials and complete work is also fundamental to achieving success in the asynchronous learning environment (e.g., establish time parameters for discussion fora posts, quizzes, podcasts, etc.).

Re-purposing teaching content to identify the most essential and critical content matter for the asynchronous environment. TEs grappled to re-image and re-design content for the asynchronous learning environment (Ó Ceallaigh, 2020). Many scholars have identified evidence-based instructional strategies which support TEs craft content for the asynchronous learning environment. Martin et al. (2019) suggest that engaging in backward design (i.e., design the course with the end in mind) is key to ensuring instructional alignment and student success. More information on backward design is available at *Backward Design: Choosing Technology Tools for Teaching* (http://www.nwacco.org/card/choosetechnology/). Anderson et al. (2001) highlight the importance of injecting knowledge from diverse sources into content and the use of a variety of texts, graphics, figures, pictures, sounds, simulations etc. to stimulate learning and engagement. Connecting learning to real world activities and the contextual demands of the profession are also reported as core instructional strategies (Downing et al., 2019; Herrington et al., 2015). Martin et al. (2019) emphasise the importance of consistency in terms of design, layout and mode of communication and also advocate for the implementation of a periodic communication strategy.

Achieving module learning outcomes with much shorter, condensed asynchronous input. Ó Ceallaigh (2020) claims that TEs expressed concerns regarding their capacity to accomplish identified learning outcomes in the asynchronous learning environment. Scholars report that TEs can be supported to achieve module learning outcomes with shorter, condensed asynchronous input by utilising specific instructional strategies. Watson et al. (2017) stress the importance of lecturer availability and responsiveness to students. Lapitan et al. (2021) note the importance of connection with students and promote the use of a variety of teaching strategies to cater for diverse learning styles and to foster engagement and success (e.g., visual cues, verbal instruction, active learning, explanations, demonstrations, podcasts, videos, and collaborative work). Others argue that the incorporation of learning resources using diverse, multimodal formats is critical (Arinto, 2013; Gagné et al, 1992; Watson et al., 2017). Integrating problem-solving based self-assessment questions with pre-recorded narrated video presentations to promote student engagement, inquiry and personalisation of learning is also reported to have a positive effect on the learning process (Lapitan et al., 2021; Nerantzi, 2014). *Screencast-O-Matic* (https://screencast-o-matic.com/education), a video and screen-capture application with captioning capability is a useful tool for video creation. Martin et al. (2019) claim that re-imagining content through meaningful chunking (i.e., breaking content into similar size chunks of 5-7 minutes focussed on single idea or theme) is also an essential instructional strategy to support TEs to achieve learning outcomes with much shorter, condensed asynchronous input.

Direct instruction: Identified PD needs and related evidence-based instructional strategies

Technological and pedagogical skills required to teach asynchronously. TEs were unsure of how to conceptualise the planning, instructional and facilitative processes, due to a deficit in their knowledge base in terms of technical and ID skills. Various digital competence frameworks and tools support TEs develop digital competence (e.g., DigComp into Action - https://publications.jrc.ec.europa.eu/repository/bitstream/JRC110624/dc_guide_may18.pdf; DigCompEdu - https://ec.europa.eu/jrc/en/digcompedu). The DigComp framework (European Commission, 2016) acts as a common reference tool that can be used as a basis for an online self-assessment test, which allows individuals to measure their digital competence and identify gaps in their knowledge, skills, and attitudes in the five key areas – information and digital literacy, communication and collaboration, digital content creation, safety and problem solving. DigCompEdu, (European Commission, 2018) a European framework for digital competence for educators, is directed towards educators at all levels of education, from early childhood to higher and adult education. The framework is designed to promote educators' digital competence and boost innovation and distinguishes six different areas in which educators' digital competence is expressed with a total of 22 competences. Areas include professional engagement, digital resources, teaching and learning, assessment, empowering learners, facilitating learners' digital competence. While consulting with digital competence frameworks like, DigComp and DigCompEdu, enable TEs to become aware of the various digital competencies required for success in the workplace (European Union, 2018), it also enables TEs to reflect on their own digital competence skills and identify development goals (Valtins et al., 2020). TEs may also prepare and keep track of their digital competence learning and development by engaging with the Europass e-portfolio (https://europa.eu/europass/eportfolio/screen/cv-editor?lang=en; European Union, 2020). Reading, sharing, and critiquing relevant literature and professional learning experiences with colleagues is perceived as another means of developing professional knowledge and TE understanding in this area (Ó Ceallaigh, 2020). Ó Ceallaigh (2020) advocates shadowing and mentoring experiences, online team teaching and peer review initiatives to plan, conduct and evaluate identified PD learning outcomes as other PD routes for TEs' digital competence enhancement. Engaging in self-study courses and Massive Open Online Courses (MOOCs) (e.g., Teacher Educator Technology Competencies Course; http://tetcpd.thinkific.com/), and availing of structured opportunities in a collaborative environment that allow for intellectual exchange and shared experience (e.g., Communities of Practice) also lead to job satisfaction and TE personal and professional growth (Ó Ceallaigh, 2020).

Fostering students' authentic engagement with content. TEs were challenged to stimulate and sustain students' engagement with content. Several instructional strategies aimed at supporting TEs to foster students' authentic engagement with content have been identified in the literature. Lapitan et al. (2021) promote the use of infographic announcements to alert students to timeframes for activities (e.g., Canva - https://www.canva.com/create/infographics/; Infogram - https://infogram.com/education; Piktochart - https://piktochart.com/). The use of analogies to assist students' knowledge construction, the use of mnemonics to cue and prompt learning as well as the creation of authentic self-made multimedia presentations (e.g., pre-recorded videos) connect with students and drive motivation and engagement (Xu & Jaggars, 2014). The availability of recorded synchronous sessions in accessible ways not only provide a scaffold for learning, but students are also enabled to review and reflect on content and learn at their own pace (Lapitan et al., 2021). Ensuring audio and visual clarity of lecture videos to promote engagement and learning is also essential (Molnar, 2017; Lange & Costley, 2007). Watson et al. (2017) stress the importance of engaging and interacting with students in the asynchronous learning environment as a means to promote student engagement with content (e.g., discussion fora, announcements, email, thought-provoking questions, and intriguing problems). Lambie and Law (2020) encourage TEs to use class polling tools (e.g., Poll Everywhere - https://www.polleverywhere.com/) to boost interaction, engage interest and assess understanding. Engaging and interacting with students in the asynchronous learning environment also enables the TE to diagnose misconceptions and monitor progress (Anderson et al., 2001). Arinto (2013) identifies the inclusion of resources that students can adapt for their own context as another useful strategy to stimulate engagement with content. The importance of making resources accessible by incorporating universal design for learning (UDL) principles cannot be underestimated as a practice to enhance student learning, digital wellbeing, and success (Hope, 2020). More information on how to integrate UDL principles into online teaching and learning is available at UDL Framework (http://udloncampus.cast.org/home). Northern Illinois University Center for Innovative Teaching and Learning (2020) also recommends Hypothesis (https://web.hypothes.is/) as a tool for digital annotation of content. Hypothesis enables TEs to facilitate class discussions, to enable students generate collaborative texts together, to support students organize their research, and enable them to take personal notes on learning. OneNote Class Notebook (https://www.onenote.com/classnotebook), available on Office 365, allows the TE to cultivate collaboration and engage students with content by creating class notebooks,

adding students to individual notebooks, and designating private spaces within the class notebook for content-driven collaborative projects.

Crafting discipline-specific pedagogies aligned with the contextual realities of teaching and learning in an asynchronous environment. Ó Ceallaigh (2020) reports that TEs from disciplines that typically rely on experiential embodied pedagogies expressed significant concerns. Multiple evidence-based pedagogic possibilities which support TEs to craft discipline-specific pedagogies for the asynchronous learning environment have been identified in several studies. Van Rensburg (2018) advocates the use of multiple-choice questions and automated feedback as a skill enhancement device (e.g., *Poll Everywhere; Kahoot!* - https://kahoot.com/). Utilising a range of features, including two-way video, typed chat, a whiteboard function with permitted interactivity with the screen using drawing tools, and discussion fora for group work are also perceived as useful strategies to support TEs in particular discipline areas which historically rely more extensively on experiential embodied pedagogies and on physical and interpersonal interaction (Burke, 2020). Scholars also recommend the engagement of students in practical learning experiences creatively reinterpreted for the online context as a means of fostering learning and skill development in discipline-specific areas. Those areas include role-play, improvisation, simulations, case studies for real world application, and concept mapping for associations (Burke, 2020, Dyment et al., 2017; Gagné et al., 1992). The provision of digital content including multimodal modules (e.g., video, podcasts, blogs) that provide written content, embedded links to online sources, images, and streamed content to support and illustrate core concepts and skills are also identified in the literature as essential strategies to enhance discipline-specific learning (Burke, 2020; Herbert, 2007). Dyment et al. (2017) also note the importance of designing authentic assessment tasks that require students to engage in coherent, authentic, meaningful, and purposeful activities as a means to boost success in discipline-specific teaching and learning in the asynchronous learning environment.

Facilitation of discourse: Identified PD needs and related evidence-based instructional strategies

Orchestrating purposeful practice to stimulate contextualised learning interactions and productive dialogue among students. TEs struggle to envision how they could promote productive dialogue among students in the asynchronous learning environment. Ó Ceallaigh (2020) highlights the importance of a communication plan as a key strategy which may support TEs to promote productive dialogue among students. For instance, this might include establishing a clear plan on how and when you and your students will communicate throughout the year (e.g., announcements, discussion board or forum, email). Communicating expectations to students in relation to interaction is also critical in driving interaction (Gagné et al., 1992; Martin et al., 2019). Including student-student interaction as a key element in designing learning activities is also viewed as a necessary component of successful ID. Interaction might entail peer reviews, collaborative projects, discussion fora, collaborative wikis, and sways (Martin et al., 2019). *Flipgrid* (https://info.flipgrid. com/), *Padlet* (https://padlet.com/), and *Slack* (http://slack.com/) are useful platforms for disseminating content through video, text or voice recording and for stimulating and facilitating discussion in the asynchronous learning environment (Millar, 2019). Anderson et al. (2001) note that the role of the online educator is key in enabling students to connect and socialise with each other through moderated activities. Identifying areas of agree or disagreement in online discussions, seeking to reach consensus or understanding, encouraging, acknowledging, or reinforcing student contributions and prompting discussion are all viewed as important strategies which promote collaboration, support, and productive dialogue among students (Anderson et al., 2001).

Generating a sense of community online. Building community in the asynchronous learning environment was reported as a consistent TE struggle (Ó Ceallaigh, 2020). Many scholars recognise the potential of community in the asynchronous learning process as powerful in pushing students' knowledge creation, enhancing deep understandings, and stimulating collaboration and student success (Millar, 2019; Ó Ceallaigh, 2020; Van Rensburg, 2018). Asynchronous communication lacks verbal and non-verbal cues such as intonation, gestures, stance, and facial expressions that are a regular part of face-to-face communication. The absence of these cues can quickly lead to confusion, misunderstandings, and isolation in the asynchronous environment. Establishing netiquette, i.e., using courtesy and politeness when communicating with other students online, is essential to ensure that student interactions are respectful, professional, responsive, and inclusive (Anderson et al. 2001; Lewis, 2000). Van Rensburg (2018) highlights the importance of cultivating a sense of belonging in a non-threatening and user-friendly asynchronous learning environment. Berry (2017) too reminds us of the importance of creating a warm and welcoming tone. Effective netiquette is one means of cultivating a sense of belonging, tone, and community in the asynchronous learning environment. Other scholars advocate the importance of

fostering collaborative learning and problem-based collaborative learning experiences to build community (Arinto, 2013, Van Rensburg, 2018). Garrison et al. (2010) note the importance of modelling inclusivity in asynchronous discussions to encourage participation of all students (i.e., create an expectation that everyone will participate, regardless of age, gender, culture, language, ability, etc.). Modelling forms of discussion that are authentic and self-disclosing is also viewed as a catalyst for community development online (Rovai, 2007). Encouraging students to support the academic and social development of their peers through feedback, constructive criticism and reflective dialogue fosters belonging, participation and community online (Berry, 2017; Rovai, 2007). Berry (2017) notes the significance of crafting a personalised learning experience for all students. Personalized learning might include recorded messages, small group activities, and multi-modal activities designed to cater for diverse talents and ways of learning. All of these may serve as a means to cultivate community in the asynchronous learning environment.

Linking assessment to deep and challenging learning conversations in the asynchronous environment. TEs also struggled in their attempts to re-configure, adopt, and manage assessment and feedback techniques. Scholars advocate the use of detailed assessment rubrics with clear instructions, assessment criteria and deadlines as an essential support for students and educators alike in the online environment (Arinto, 2013; Watson et al., 2017). Lapitan et al. (2021) note the importance of providing self-assessment questions for each online discussion or learning conversation to enable students to apply knowledge and skills learned (Lapitan et al., 2021). Other scholars suggest that it is imperative to incorporate flexible formative and summative assessment methods and a variety of assessment techniques into the asynchronous learning and teaching enterprise. These include discussion fora and boards, quizzes (e.g., Kahoot!; Poll Everywhere; Top Hat - https://tophat.com/classroom/classroom-response-system/), e-portfolio, reflective blogs or podcasts, collaborative sways, creating digital content, gamification, digital storytelling (Arinto, 2013; Martin et al., 2019). Watson et al. (2017) also note the value of incorporating interaction between students in discussion fora in assignments. Student choice in assignments is also perceived as fundamental to successful student outcomes in the asynchronous learning environment (Hope, 2020; Watson et al., 2017). The provision of constructive feedback and grades on students' learning in a timely manner is also essential (Anderson, 2001; Watson et al., 2017).

An overview of TEs' teaching presence PD needs aligned with evidence-based instructional strategies is presented in Appendix 1.

WHAT YOU SHOULD READ

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APPENDIX 1

An overview of TEs' teaching presence PD needs aligned with evidence-based instructional strategies

Teaching Presence	Identified PD needs	Evidence-based instructional strategies
Planning and organising	re-envisioning the planning process	• present intended learning outcomes to students (Hope, 2020; Lapitan et al., 2021; Martin et al., 2019) • provide lecture notes, progress trackers, lecture videos, revised syllabus, and links to additional resources (Lapitan et al., 2021) • outline weekly expectations, deadlines for submission of tasks, reading lists and links to additional learning resources in revised syllabus (Lapitan et al., 2021, Martin et al., 2019) • organise teaching in a way which provide a clear path for students to follow in a coherent and consistent manner, this may include providing a screencast of the course architecture (Anderson et al., 2001; Martin et al., 2019; Watson et al., 2017) • exploit learning management system (LMS) functionalities to structure content effectively to promote engagement and interaction (Arinto, 2013) • select learning resources to cater for differentiation and personalisation (Arinto, 2013, Martin et al., 2019) • provide navigational cues, supports and guidance (Watson et al., 2017) • be clear to students regarding what is expected of them and the order in which to engage with materials and complete work; this includes establishing time parameters for discussion fora posts, quizzes, podcasts, etc. (Anderson et al., 2001)
	re-purposing teaching content to identify the most essential and critical content matter for the asynchronous environment	• engage in backward design (i.e., design the course with the end in mind) to ensure instructional alignment (Martin et al., 2019) • inject knowledge from diverse sources into content (Anderson et al., 2001) • connect learning to real world activities and the contextual demands of the profession (Downing et al., 2019; Herrington et al., 2015) • be consistent and systematic in terms of design, layout, and mode of communication (Martin et al., 2019) • implement a periodic communication strategy (Martin et al., 2019)
	achieving module learning outcomes with much shorter condensed asynchronous input	• incorporate learning resources using diverse, multimodal formats (Arinto, 2013; Watson et al., 2017) • be available and responsive to students (Watson et al., 2017) • integrate problem-solving based self-assessment questions with pre-recorded video presentations to promote student engagement, inquiry, and personalisation of learning (Lapitan et al., 2021; Nerantzi, 2014) • re-imagine content through meaningful chunking (e.g., break content into similar size chunks of 5-7 minutes focussed on single idea or theme) (Martin et al., 2019) • foster a connection with students by using a variety of teaching strategies (Lapitan et al, 2021)

Teaching Presence	Identified PD needs	Evidence-based instructional strategies
Direct instruction	technological and pedagogical skills required to teach asynchronously	• consult with digital competence frameworks (e.g., *DigComp into Action*, *DigCompEdu*) to become aware of the various digital competencies required for success in the workplace (European Union, 2018) • reflect on digital competence skills and identify goals by using a variety of relevant tools like *DigComp into Action*, *DigCompEdu*, (Valtins et al., 2020) • prepare and keep track of digital competence learning and development by engaging with the *Europass e-portfolio* (European Union, 2020) • read and share professional literature and critique professional learning experiences with colleagues (Ó Ceallaigh, 2020) • engage in shadowing, online team teaching and peer review initiatives to plan, conduct and evaluate identified PD learning outcomes (Ó Ceallaigh, 2020) • engage in self-study courses and Massive Open online courses (MOOCs) like the *Teacher Educator Technology Competencies Course* (Ó Ceallaigh, 2020) • avail of structured opportunities in a collaborative environment that allow for intellectual exchange and shared experience like *Communities of Practice* (Ó Ceallaigh, 2020)
	fostering students' authentic engagement with content	• provide infographic announcements for students to alert students to the timeframe for activities (Lapitan et al., 2021) • create your own multimedia presentations (e.g., pre-recorded videos) to connect with students and to drive motivation and engagement (Xu & Jaggars, 2014) • ensure synchronous sessions are recorded and made available to students in accessible ways (Lapitan et al., 2021) • ensure audio and visual clarity of lecture videos to promote engagement and learning (Molnar, 2017; Lange & Costley, 2007) • engage and interact with students in the asynchronous learning environment such as discussions fora, announcements, and email (Watson et al., 2017) • diagnose misconceptions through monitoring progress (Anderson et al., 2001) • include learning resources that students can adapt for their own context (Arinto, 2013) • make resources accessible by incorporating universal design for learning (UDL) principles (Hope, 2020) • utilise class polling to engage interest and assess understanding (Lambie & Law, 2020)
	crafting discipline-specific pedagogies aligned with the contextual realities of teaching and learning in an asynchronous environment	• provide students with the opportunity to practice and improve their skills with multiple-choice questions where they receive automated feedback (Van Rensburg, 2018) • utilise a range of features, including two-way video, typed chat, a whiteboard function with permitted interactivity with the screen using drawing tools, and discussion fora for group work (Burke, 2020) • engage students in practical learning experiences creatively reinterpreted for the online context like role-play, improvisation, simulations, case studies, and concept mapping (Burke, 2020, Dyment et al., 2017) • provide digital content included multimodal modules (e.g., video, podcasts, blogs), that provide written content, embedded throughout with links to online sources, images, and streamed content to support and illustrate core concepts and skills (Burke, 2020; Herbert, 2007) • design authentic assessment tasks that require students to engage in coherent, authentic, meaningful and purposeful activities (Dyment et al, 2017, Van Rensburg, 2018)

Teaching Presence	Identified PD needs	Evidence-based instructional strategies
Facilitation of discourse	orchestrating purposeful practice to stimulate contextualised learning interactions and productive dialogue among students	• illustrate a communication plan (e.g., establish a clear plan on how and when you and your students will communicate throughout the year) using tools like announcements, discussion board or forum, and email (Ó Ceallaigh, 2020) • communicate expectations to students in relation to interaction (Martin et al., 2019) • include student-student interaction as a key element in designing learning activities, e.g., peer reviews, collaborative projects, discussion for a (Martin et al., 2019) • identify areas of agree/disagreement and seek to reach consensus/understanding (Anderson et al., 2001) • encourage, acknowledge, or reinforce student contributions (Anderson et al., 2001) • prompt discussion (Anderson et al., 2001)
	generating a sense of community online	• recognise the potential of community in the learning process (Ó Ceallaigh, 2020) • cultivate a non-threatening and user-friendly learning environment (Van Rensburg, 2018) • establish netiquette (Anderson et al., 2001) • foster collaborative learning and problem-solving collaborative learning experiences (Arinto, 2013, Van Rensburg, 2018) • facilitate discussions to encourage participation of all students (Garrison et al., 2010) • model forms of discussion that are authentic and self-disclosing (Rovai, 2007) • encourage students to support the academic and social development of their peers through feedback, constructive criticism and reflective dialogue (Berry, 2017; Rovai, 2007) • create a warm and welcoming tone (Berry, 2017) • craft a personalised learning experience for all students, e.g., recorded messages, small group activities, (Berry, 2017)
	linking assessment to deep and challenging learning conversations in the asynchronous environment	• provide clear instructions for completing assignments (Watson et al., 2017) • provide self-assessment questions for each discussion (Lapitan et al., 2021) • specify assessment criteria to guide students (Arinto, 2013) • incorporate flexible formative and summative assessment and variety of assessment techniques using tools like discussion fora, quizzes, e-portfolio, reflective blog or podcast, collaborative sway, creating digital content, gamification, and digital storytelling (Arinto, 2013; Martin et al., 2019) • provide constructive feedback and grades on students' learning in a timely manner (Anderson, 2001; Watson et al., 2017) • incorporate interaction between students in discussion fora in assignments (Watson et al., 2017) • incorporate student choice in assignments (Hope, 2020; Watson et al., 2017)

The Digital Transformation Happened Overnight in K-12: Implications for Teacher Education

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Abstract: K-12 has undergone a digital transformation in response to the demands of teaching and learning in the COVID-19 era. The question explored in this chapter is whether teacher education will need to undergo a comparable transformation in order to prepare K-12 teachers to effectively teach in a digitally transformed school. In our exploration, we describe how our Center for Digital Curricula at the University of Michigan has supported, since September 2020, about 180 Michigan, K-5 teachers by providing them with deeply-digital, standards-aligned curricula for their classrooms and with professional learning opportunities on how to use those resources in their classrooms. Based on those experiences, we pose questions about what potential changes K-12 teacher education may need to undergo in the next few years. Such an exploration is urgent since more and more schools are going beyond using digitized curricula – paper-and-pencil curricula put onto a computer – and adopting deeply-digital curricula to more effectively address digital-savvy students now populating K-12 classrooms (i.e., the *Alpha Generation*). Those questions are also extremely important since teacher educators are the future leaders of public-school classrooms across the country.

Lesson Learned: Teacher educators should have learned that deeply-digital, OER curricula is a tested way to teach teachers how to reach the deeply-digital generation of children – whether at their school desks or at their kitchen tables.

INTRODUCTION

On March 13, 2020 in Michigan ("Gov. Whitmer: Michigan schools," 2020) and elsewhere in the U.S, governors closed PK-12 schools for in-classroom learning and called for remote learning to try to stem the spread of COVID-19. Many schools had copying machines working essentially 24/7. Teachers created packets of curricular materials and delivered the packets of paper to their students' homes with the *promise* of returning to pick up the completed worksheets and give the children feedback on their work.

Not all schools, however, went the paper-packet route to support remote learning (Batiwalla & Poon, 2021). In Michigan, several K-5 schools moved seamlessly from in-classroom learning to remote learning (Norris & Soloway, 2020). These schools had already been working since September 2019 to use deeply-digital, standards-aligned curricula provided by the University of Michigan's Center for Digital Curricula. According to Mrs. Wendy Skinner a 2nd grade teacher at Brandywine Elementary School, Niles, MI.: "We didn't miss a beat. . . and we had essentially 100% attendance during the COVID break!" (Personal Communication, August 28, 2020).

In this chapter, we first unpack the digital transformation that had occurred in those Michigan classrooms during the 2019-2020 school year. Several examples of successful deeply-digital curricula integration are shared for illustration. We then explore how the lessons learned from those experiences might impact teacher education. For example, moving forward, the field must move beyond simply providing teachers and students with digitized curricula—curricula made initially for pencil-and-paper but then transferred to the computer. Most importantly, we need to rethink how we are preparing teachers for the digitally transformed classroom. Indeed, will teacher education need to undergo a comparable transformation in order to prepare K-12 teachers to effectively teach in a digitally transformed school?

Underlying Rationale

K-12 schools started to go 1-to-1 and provide a computing device to each and every student when low-cost, handheld computers like the Palm Pilot and the PocketPC came onto the market (Norris & Soloway, 2004; Norris & Soloway, 2008). Developers worked to then accompany that hardware with educational software. For instance, we created the *Mobile Learning Environment* (MLE) for the Palm and PocketPC devices (Norris & Soloway, 2003). MLE provided teachers and learners with apps (e.g., a drawing and animation tool called *Sketchy*, a concept mapping tool called *MapIt)* (Curtis, et al., 2002). But MLE was *not* accompanied by curricula. Using the language of *Crossing the Chasm* (Moore 2013, p. 5), the classic book on high-tech marketing, that lack of curriculum didn't stop the *early-adopting* teachers from using the mobile devices with MLE since those teachers were comfortable creating their own curricula. However, MLE never "crossed the chasm" (Moore, 2013, p. 5); it was never was adopted by the *early majority* teachers who were expecting to be provided with curricula that integrated the mobile devices.

Based on the experiences with mobile computing devices, we observed that "schools don't want technology, schools want curricula" (Norris & Soloway, 1999, p. 2). Following that *mantra*, we then founded the Center for Digital Curricula at the University of Michigan's College of Engineering with the mission of providing K-12 teachers with high-quality, K-12 *curricula*, aligned to standards, that incorporated the use of computing devices. And, working with 7 Michigan K-5 schools (400+ students) in September 2019, the Center released deeply-digital, standards-aligned curricula for K-5 for the four core subjects: ELA, Math, Social Studies, and Science. The rollout was moving ahead smoothly until March 13th, 2020. Even with the pandemic interruption, the Center's pilot classrooms made a seamless transition from in-class to remote teaching and learning.

After improving curricular offerings based on the Center's experiences during the tumultuous 2019-2020 school year, at the start of the 2020-2021 school year when many schools were starting out using remote learning, seven public schools in Michigan adopted the Center's deeply-digital curricula for the four core subjects in K-5. One of schools, Remote2Learn Co-op with 1500 students, was a *remote only* school, where all the children were at their homes. In-class or hybrid learning was employed at several other schools (e.g., rural Sand Lake Elementary in Sand Lake, MI and urban Ralph J. Bunche Academy in Ecorse, MI). At the start in August, there were about 2500 K-5 students using the Center's deeply-digital curricula. Another 1500 students joined in January 2021 from the Detroit Public Schools. All the public schools were Title 1 schools with greater than 65% Free-and-Reduced Lunch programs.
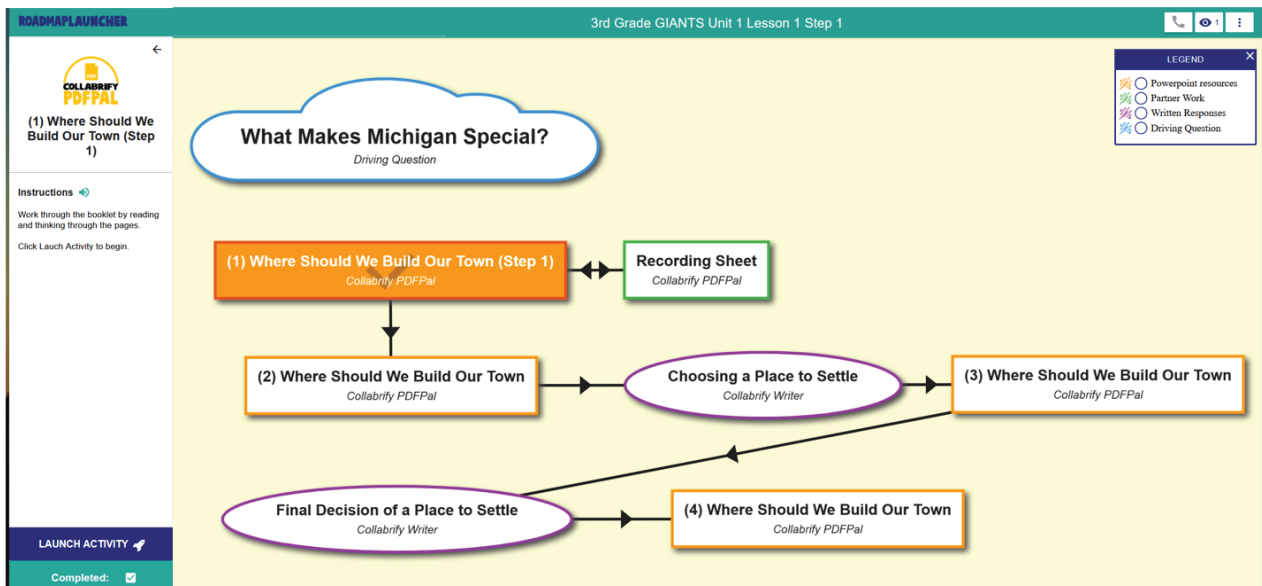
Figure 1. Example of a deeply-digital Roadmap for social studies for grade 3.

The Roadmap: Implementing Deeply-Digital Lessons

A *Roadmap* for a lesson in social studies for 3rd grade is depicted in Figure 1. A Roadmap is browser-based, computer-independent, visual implementation of a lesson. Students tap on a *node* in the Roadmap, the *drawer* opens on the left (left part of Figure 1), and the student is provided with instructions for what to do after launching the learning activity inside the node (e.g., 'Where Should We Build Our Town' (Step 1)).

The deeply digital Roadmaps (e.g., the example provided in Figure 1) that implement the standards-aligned, K-5 lessons, are supported by the *Collabrify Roadmap Platform*[1]. Collabrify is a browser-based, device-agnostic platform that supports the life cycle of a deeply digital lesson:

1. **Create** a Roadmap lesson or **Modify** a Roadmap lesson. It is easy for a teacher to tailor/personalize a digital lesson in order to better address the different needs of different learners.

2. **Distribute** a Roadmap lesson to a class. A teacher may well want to differentiate the Roadmap to better address her/his students' needs or localize the Roadmap to make it more appropriate geographically, for example. In distributing a Roadmap, a teacher can build collaborative groups that work together on a Roadmap.

3. **Monitor** the enactment of the lesson. Using Collabrify, a teacher can monitor, in real-time, what every student is doing. Using Twilio's VoIP service Collabrify provides a "phone" that enables a teacher to talk to a student or a collaborative group of students as the student or students work on their Roadmap lessons.

4. **Assess** student artifacts, post-enactment, including the use of learning analytics collected during enactment.

5. **Share** Roadmaps with other educators through Collabrify's Roadmap Repository.

In building a Roadmap, Collabrify provides a range of productivity tools that can be used to create learning activities that can then be included in a Roadmap lesson. All the Collabrify apps are *collabrified* and make student-student collaboration very easy to do.

Examples of productivity tools include:

- Collabrify Flipbook enables students to create drawings and animations.
- Collabrify Venn enables students to create Venn Diagrams.
- Collabrify Map enables students to create concept maps.
- Collabrify KWL enables students to create KWL charts.
- Collabrify Chart enables students to create simple spreadsheets.

Unlike much of the commercial digital curricula, Collabrify Roadmaps are open. That is, curricula developers (e.g., teachers) can include virtually any URL or any internet resource in a node in a Roadmap. Thus, students can access the wonderful *PhET Interactive Simulations for Science and Math* (https://phet.colorado.edu/) or *Khan Academy* (https://www.khanacademy.org/) videos, or any other open educational resource (OER) element. Collabrify enables teachers and students to use the *Google Apps for Education* (e.g., Docs, Sheets, etc.). And finally, Collabrify can be used in conjunction with *Google Classroom* or other *Learning Management System* such as *Schoology* or *Canvas*.

The Roadmap has several important features. For instance, clicking on the microphone icon (at the top of the drawer) will read the instructions to the student. If students are working together on the same Roadmap, they can use the phone icon (upper right of menu bar) to have a verbal conversation via Twilio's VoIP technology. They talk to each other *through the computer* with no cellphone required. A teacher can also use the phone to talk to a student or small groups of students. After completing the learning activity in that node, a student can tick the *completed* box (bottom left, drawer) and that puts a check mark into the Roadmap (see the orange-colored node).

This Roadmap has a number of learning activities that employ several of Collabrify's productivity tools. For instance, PDFpal (a simple-to-use PDF markup tool) enable teachers to re-use their existing printed documents (e.g., worksheets, maps) and make those static documents much more dynamic (e.g. a worksheet or map can now include voice notes made by teachers or by students; a worksheet could be *collabrified* and worked on by several students concurrently). *Collabrify Writer* is a multi-media editor, enabling students to use video and photos, in addition to text to express themselves. To give feedback to students on their work in Writer, a teacher can attach a short video to a student's work that contains the feedback. Roadmaps were built to serve as a *one-stop shop* in that a Roadmap has all the students work in one place for a lesson in one place.

Figure 2 shows a weekly schedule that has been encoded in a Roadmap that Mrs. Skinner sent to her 2nd grade students via the *Collabrify Roadmap Platform*. Mrs. Skinner reported that her 2nd graders had no trouble navigating the Roadmap schedule. And, in comparison to the LMS used by the school that sent out individual messages for each assignment, parents found the weekly schedule much more comprehensible. "Since all the assignments were in one place, parents found Roadmaps easy to understand and thus felt more comfortable about what schoolwork their children were doing at home at the kitchen table" (Personal Communication, August 28, 2020).

The deeply-digital curricula described in this chapter, as well as the Collabrify Roadmap Platform that supports its use, can be accessed by going to: https://roadmap.center/ and logging in with a Google email. (Shortly, the Center will be releasing a version that is accessible via Microsoft-backed email addresses.) There is no cost for exploring the resources. However, for use in a classroom there is a small, cost-recovery charge (see the discussion on OER, below). Please contact: digitalcurricula@umich.edu for more information.
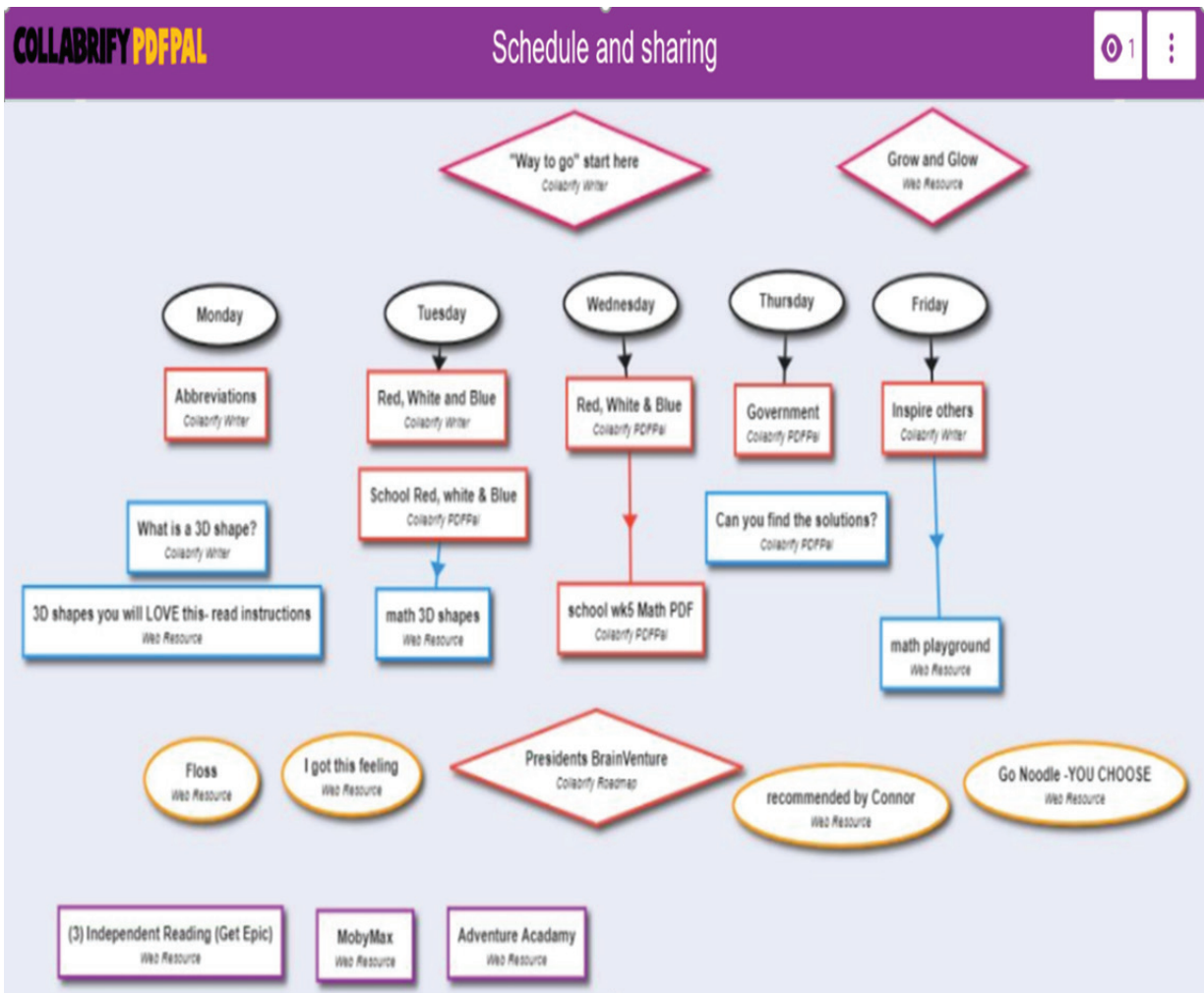
Figure 2. Weekly schedule during the remote learning period in Spring 2020 in Mrs. Skinner's 2nd grade class.

WHAT WE KNOW

The Collabrify Roadmap Platform is being presented in this chapter as an example of one way in which PreK-12 schools are moving to deeply-digital curricula. More importantly, the example highlights the ways in which teacher educators must respond in light of these changes. In this section, research is provided that sets the stage for the move to deeply digital curricula. Research data is also provided showing outcomes of its use.

Digital Technologies in K-12 Schools

K-12's move to remote learning in March 2020 was not without its challenges (Hobbs & Hawkins, 2020). Delivering paper-packets and collecting students' responses was not particularly effective nor sustainable (Dynarski, 2020; Gewertz, 2020). Thus, in preparation for the start of school in Fall 2020, districts purchased massive numbers of computing devices (e.g., Chromebooks). For example, Detroit Public Schools amassed $23 million in foundation support to buy every student her or his own laptop (Spruill, 2020). According to Julie Scott (Director of Curriculum in a rural district working with UMich.CDC) rural districts also moved to purchase computing devices for their students, partly due to the fact that delivering a packet of curricula material to a student's home could take upwards of 40 minutes, (Personal Communica-

tion, September 15, 2020). But rural communities in some areas found that Internet access was a challenge; for some homes out in the country, there simply was not a signal. Scott estimated "…that at least 10% of the students wouldn't be able to access the Internet from their homes" (Personal Communication, September 15, 2020).

Putting aside the challenges of providing Internet access to a segment of students, the infrastructure of K-12 in the Fall of 2020-21 was fundamentally different from the infrastructure of K-12 in the fall of 2019-20. The digital transformation of K-12's infrastructure (Hawkins, 2020; Norris & Soloway, 2018) had taken place virtually overnight. Now, 1-to-1 is the new normal in many school districts.

Schools decided to use those technologies in various ways. For instance, in Michigan, some K-5 schools used technology primarily for in-class learning. Teachers used various 'educational tools' (e.g., *Google Classroom*, *SeeSaw*, *Flip-Grid*) to manage the digital resources (e.g., distribute assignments, curricular resources like PDFs or videos, etc.) they had found on the Internet and had integrated into their curricula. Other schools used such devices for remote learning. The districts or schools often purchased self-contained online courses (e.g., from *Lincoln Learning, Edgenuity, Edmentum*), for those students who elected not to participate in in-class learning. Regardless of the ways in which the devices were used, K-12's report card is still a work in progress.

Regardless of the ups and downs that schools are going through now to address the immediate needs of the pandemic, it is important to observe one important outcome. Namely, once the immediate impact of the pandemic is over, it is not likely that schools will go back to where they were before the pandemic. That is, schools are likely to use the digital infrastructure that they had to put in place at significant expense, oftentimes quite hastily, to address the needs of remote learning. Paper-based curricula will certainly find its way back into the classroom, but as, Kiddom, a major purveyor of digital curricula observes: "Digital Curricula is Here to Stay" (Hyacinthe, 2020, p. 1).

Now more than ever, students and their instructors need a learning platform that will deliver deeply engaging, collaborative curricula. Digital competencies have changed. It is no longer acceptable to work with digitized worksheets, acquiring information online. A contemporary challenge within education is engaging students in sustained collaborative work with ideas toward enriching collective understanding in complex learning environments that blend digital learning and quality, deep learning (Goldman & Scardamalia, 2013). Consequently, computer-supported collaborative learning represents an increasingly important approach for advancing classroom practices (Chen & Hong, 2016; Yang, et al., 2011).

As students are at the core of education, it is appropriate to explore the question: who are the children coming to school these days? Are they different from the children that came to school 10 years ago or 20 years ago? How? Children born since 2010 are considered to be in the Alpha Generation (Vargason, 2017; Zmuda, Alcock & Fisher, 2017). "They are logged on and linked up … They are the most … technologically literate generation to ever grace the planet!" ("What is Generation Alpha?" 2020, p. 2). *TikTok*, where 15 second videos are the units of communication, is the choice of Alphas. While there is precious little scientific research on this topic, it is our conjecture that Alphas will not find that paper-packets are effective tools for learning.

What is Deeply Digital Curricula?

Paper-and-pencil technology, when used to create curricula for teaching and learning, affords learners the opportunity to primarily read and write text, and read and write drawings. For thousands of years such affordances have supported learners and teachers. But, as we now are immersed in the digital age, the digital platform affords new opportunities for teaching and learning – opportunities that paper-and-pencil technology cannot provide. Thus, by *deeply-digital*, we mean curricula that have the following characteristics:

- **Provide multiple media:** Students can express themselves using text, of course, but they can also express their evolving understanding using animations, drawings, photographs, voice recordings and video. We have found, for example, in the Roadmaps that explore socio-emotional learning (SEL), students might not communicate person-to-person. However, they did find recording a video of themselves to be fun and effective. The learning activities should employ a full range of media like text, video, animations, photographs, and sound.

- **Provide synchronous collaboration:** Support for synchronous collaboration needs to be a first-class service. The ability to *share* materials and the ability to *talk* with peers (student-student, teacher-teacher, teacher-student) needs to readily and easily accessible. For example, in Collabrify, the phone icon enables synchronous conversa-

tions. Research shows that student to student collaboration leads to more effective learning and problem solving (Akinyemi, et al., 2019; Laal & Ghodsi, 2012).

- **Provide visual – not just textual – representations:** Children in school today are from the Alpha and Z Generations (What is Generation Alpha? 2020) where visual representations are primary in their media use outside of school (Ferguson, 2020). Visual representations have been shown to lead to effective learning (Arcavi, 2003; Bobek & Tversky, 2016). As such, the visual modality for learning must also be primary. For example, in Roadmaps, students follow a visual Roadmap. Besides being a depiction they readily understand, the Roadmap is pedagogically valuable: students know where they are going and where they have come from.

- **Enable lessons to be highly malleable:** Teachers will always want to modify whatever curricula that is provided to them. The ability to easily make changes is critical. For example, the Collabrify interface makes Roadmaps malleable so that teachers can quickly create differentiated lessons to better meet the needs of their students. They can also quickly localize Roadmaps to highlight their regional or geographic elements (Mahan, 2020; van de Pol, Volman & Beishuizen, 2010).

- **Enable lessons to be highly interactive**: The pedagogical philosophy that underpins the use of technology in the classroom is social constructivist learning (Palincsar, 1998). In this mindset, deeply digital curricula must support student learning by building, by creating, and by working collaboratively.

One more distinction needs to be made: we distinguish between digitized curricula from deeply-digital curricula. By and large, digitized curricula are curricula that were first created for non-digital formats and then were put onto the computer. While videos may have been added, the materials and learning activities in digitized curricular are still driven by what was enabled by pencil-and-paper technology. In contrast, deeply-digital curricula take advantage of the affordances of being created for and living in a digital infrastructure. For example, student-student collaboration is easy to set up. Indeed, one student can be in-school while a collaborating student could be at her/his kitchen table. Not only can the students work together on the same document, but the students can also talk to each through the computer!

The Role of OER: Open Education Resources

UNESCO (n.d.) defined Open Education Resources (Ball & Saucedo, 2019; Beck, 2016) as follows: "Open Educational Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions (p. 1)."

Research has shown that high-quality educational materials can have a significant impact on student achievement (Boser, Chingos & Straus, 2015). So, having those high-quality resources freely available would be a major boon to PreK-20. But content is not curricula. Curricula are created by thoughtfully organizing content into coherent lessons that students will use to guide their learning by engaging in the learning activities specified in the lessons. While creating high-quality content is a challenge, creating high-quality curricula is a much greater challenge.

It is worth noting that there is a fly in the OER ointment: run-time support. Picture a student using a Chromebook to work through the Roadmap in Figure 1. When the student taps on node (1), the Chromebook opens the drawer on the left of the screen. The Chromebook displays the opened drawer, but the execution of the software is taking place in the cloud. Chromebooks are low-cost precisely because Chromebooks do not do the actual computation and Chromebooks have minimal storage capacity. Rather, Chromebooks rely on the cloud for the computation and storage, e.g., animate a drawer opening, support two students talking to each other through the phone.

The bottom line, so to speak, is that *someone* needs to pay for those cloud functions. Thus, educators need to be careful when claims are made for OER being *free*. Yes, a simulation, for example, might be made available by a developer as OER at no charge. However, in *using* that simulation on a Chromebook, charges are incurred that *someone* needs to cover.

**Putting It All Together: Roadmaps + Collabrify = Seamless Learning**

The deeply digital, K-5 curricula developed by the Center for Digital Curricula have been in use in several schools (approximately 180 teachers and approximately 4000 students) in Michigan during the 2020-2021 school year:

- Two elementary schools from two rural Michigan districts and one elementary school from an urban Michigan district are using the Roadmaps for *in-class only learning*. Some of the students, however, left school to be quarantined and then rejoined their classes after the quarantine.
- One school is an amalgam of remote-only students from 12 school districts.
- One elementary school from another rural district is using the Roadmaps for both in-class and remote learning (one teacher is simultaneously teaching students in-class while others are at home).

In late October/early November 2020, after working with the Roadmap curricula for only about 8-9 weeks, 80 teachers from these schools responded to a ten-question survey to explore the effectiveness of the Collabrify Roadmap Platform and deeply digital curricula in their classrooms. In what follows we compare two schools: the remote-only school with the in-classroom learning school. We hasten to point out that the number of teachers surveyed in each school (26) is relatively small so statistical analyses are not possible. In what follows, then, are brief analyses of key questions from the survey:

- Q1 - Two-thirds of the teachers have been making substantial use of the Roadmaps (25% to 99%; see Chart 1).

Chart 1
Roadmaps Use in Classrooms

Q1. Roadmaps make up what percentage (%) of your curriculum?
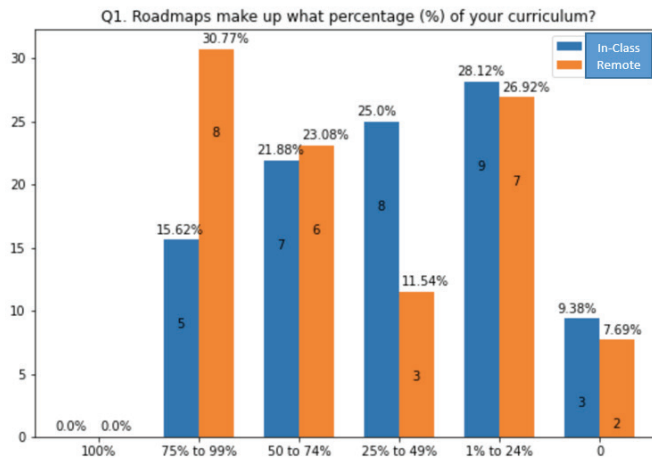
- Q2 - Two-thirds of the teachers of the teachers reported that 'things were going well' or 'extremely well' and the difference between the two schools was 16%. Interestingly, the in-class school contributed more to the 'slightly-well' and 'not well' categories (See Chart 2).

Chart 2
Teachers' Perceptions of Roadmaps
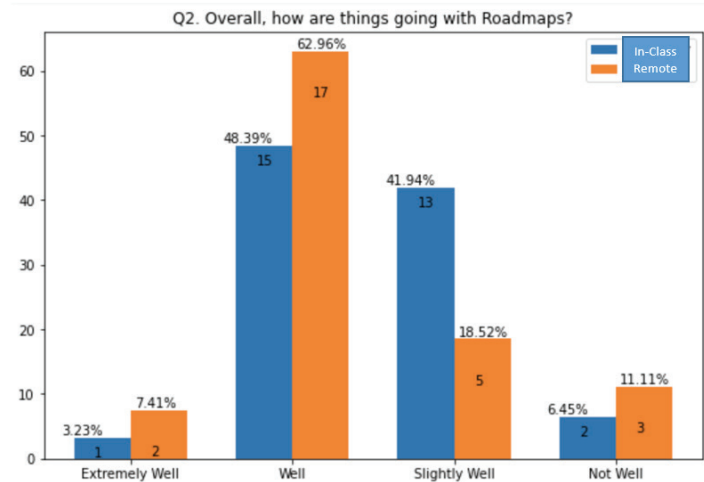
- Q6 - The remote-only school reported modifying the Roadmaps more often than did the in-class school. Inasmuch as the Roadmaps were developed for in-class teaching and learning, it is reasonable that the remote-only teachers needed to do more modifying. In a follow up survey, we need to determine the extent of those modifications (e.g., were the modifications merely cosmetic or were substantive changes needed – or something in between?; see Chart 3).

Chart 3
How Often Teachers are Modifying Roadmaps
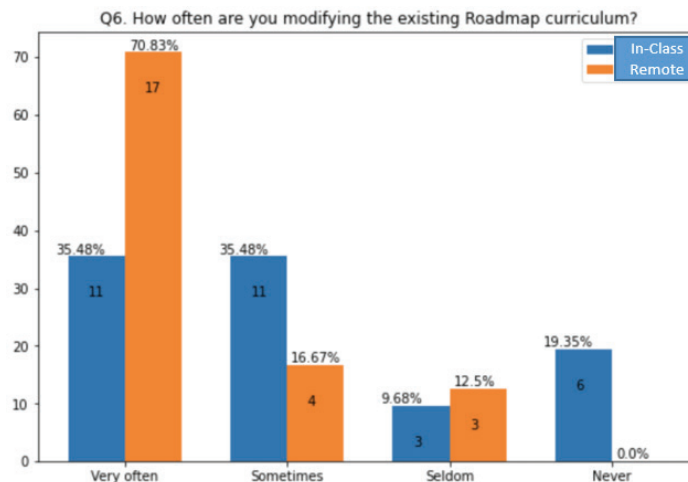
- Q9 -Only 5% of the teachers reported that their students were not engaged in the Roadmap curricula (see Chart 4).

Chart 4
Student Engagement

Q9. How engaged do you believe your students are when they are using Roadmap curriculum
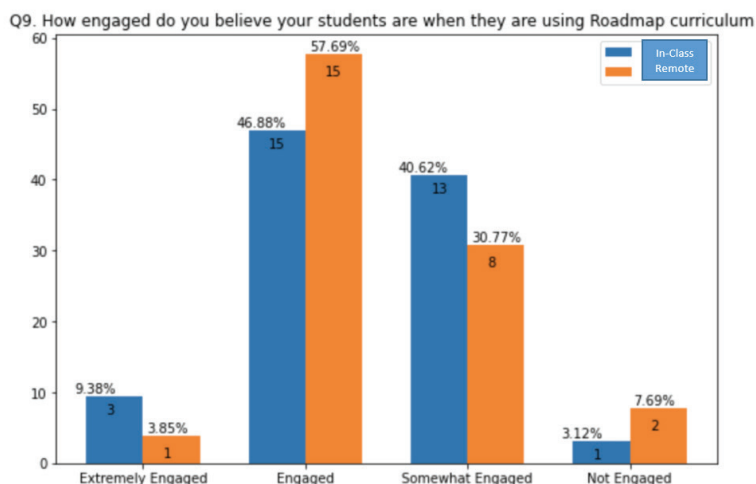
Whether the students were in remote-only or in-class, there is a consistency – albeit with some exceptions – in the reporting with respect to using the deeply-digital Roadmaps. While more data is needed, this initial study supports our claim that deeply digital curricula support seamless learning – the same curricula could be used for remote-only and for in-class teaching and learning.

LESSONS LEARNED FOR RESEARCH

These are early days in the creation and deployment of deeply-digital curricula in K-12. As such, it would be presumptuous to identify specific research activities that need to be explored. Rather, in this section we pose a range of questions that need to be openly discussed in the community. The outcome of those conversations can define a research agenda for the *new* teacher education, the education that addresses the teacher issues surrounding the creation and deployment of deeply-digital curricula.

As Reich (2018) argues, computing technology has not been entire successful in disrupting PreK-12 education; nor would we argue it has disrupted teacher education. Computing technology has been used primarily to supplement existing modes of instruction. Thus, we are only in the beginning phases of truly understanding how to create and employ deeply-digital curricula in the K-12 classroom. That is, we are just beginning to understand how to take advantage of the affordances of internet-connected computing infrastructure. While these are still early days for deeply-digital curricula, the lessons learned already make it clear that such curricula can provide learners with truly new opportunities for learning. This is particularly true when compared with the opportunities afforded by pencil-and-paper technology. Based on those new opportunities, a set of questions follow:

- How do teachers take advantage of deeply-digital curricula?
- What is the role of teacher education in helping K-12 teachers learn to be effective in deploying deeply-digital curricula in their classrooms?

First, it is our opinion that it is not too early to ask about changes needed in teacher education. We base that claim on seeing how fast the *digital transformation* has occurred in other areas of human endeavor (Norris & Soloway, 2018). For example, the music industry has gone through *multiple transformations* in the last 10 years. Records and CDs gave way to buying digital music on iTunes to listening to music that is streamed by companies such as *Spotify*.

We also need to ask how profound those changes might be to teacher education. Does teacher education transi-

tion to dealing with digitized curricula or does teacher education undergo a larger (and hoped for) transformation to engaging with deeply-digital curricula? In her classic book entitled *In the Age of the Smart Machine*, Harvard School of Business Professor Shoshana Zuboff (1988) distinguished between automating and *informating*. Automating is putting a pencil-and-paper process onto a computer. Gains in productivity might accompany this transition, but the real benefits of technology come with there is informating – when new processes, not before possible, are employed. While there are a range of ways to create deeply-digital curricula, the intent is for such curricula to be on the informating side of Zuboff's distinction.

We conclude this section as we started: asking questions. So, if deeply-digital curricula can be transformative, not just providing a transition to something a bit better, what must happen to teacher education? Must teacher education be transformed? Are schools of education ready for informating their teacher education courses in order to prepare teachers to use curricula that is also informating in the classroom?

LESSONS LEARNED FOR PRACTICE

At the outset of this chapter, we asked: does teacher education need to undergo a digital transformation that is comparable to the digital transformation that curricula and the K-12 classroom is undergoing? Towards answering that question, then, in this section, we abstract lessons for the practice of teacher education from three *experiences*. First, Tapp, Hansen and Kumar (2006) studied preservice teacher educators within science methods courses to learn about their classroom technology use. Second, we discuss what can be learned from our (AT) experience in restructuring our teacher education course at Saginaw Valley State University to explore the transformative potential of deeply-digital curricula with respect to educational practice. Finally, we discuss the lessons learned from the professional development created by the Center for Digital Curricula for in-service teachers to enable them to use the Center's deeply-digital curricula effectively.

We must ensure all preservice educators complete teacher preparation programs with a solid foundation of effective digital teaching and learning principles as well as a comfort level to teach with technology

Within undergraduate and graduate teacher education courses, it is essential for pre- and in-service teachers to learn about technology standards and the incorporation of meaningful technology into curricula within the context of their courses. Tapp, Hansen and Kumar (2006) studied preservice teacher educators within science methods courses to learn about their classroom technology use. Students were required to incorporate technology within their lesson plans. Groups of students from various universities were given field experience opportunities to teach their lessons in classrooms, and others were not. Those who taught their lesson plans increased their comfort level with technology and likelihood of use. Those who did not, had a lower comfort level with technology and likelihood of use. Later, a random sample of these students were rated by their school administrators, and the in-service teachers who had rated themselves as having a higher comfort level and likelihood of use were rated higher on the scale of technology knowledge, comfort with technology, and likelihood of use. "It was recommended that preservice teachers have additional opportunities to practice these skills within all methods courses including reading, social studies, and math to further strengthen their level of comfort and likelihood of use within these curricular areas" (p. 179).

Teacher education programs should require preservice teachers to design meaningful, standards-based lessons that incorporate technology within all content areas. Further, preservice teachers need opportunities to teach these lessons during their field and student teaching experiences and receive clinical supervisor and cooperating teacher feedback, support, and opportunities to improve. Following our last year, digital technology should be a requirement as well as the lessons learned from K-12.

Teacher educators should work towards digital transformation of their teacher education courses

Teacher educators should explore questions about the potential transformative nature of deeply-digital curricula in their teacher education courses. We attempted this in our own teacher education course, TE 587, Technology in Elementary Schools, in Spring 2019 and Spring 2020.

First, we integrated discussion and hands-on experience with deeply-digital curricula. A key in the conversations was using the following criteria (see WestEd, 2008) to analyze the Center's deeply-digital curricula and the Collabrify Roadmap Platform:

- *Collaboration* – What is the level of student/student, student/curriculum, student/teacher collaboration?
- *Engagement* – To what degree are students engaged? What student and parent data supports this?
- *Support Critical Thinking* – What impact does the program have on learner process skills such as critical and higher-order thinking?
- *Student Achievement* – What impact does the P-12 program have on student achievement?
- *Learner Outcomes* – Is the curriculum standards-based? How are learner satisfaction and motivation related to the outcomes?

Second, drawing on a social constructivist model of learning (Palincsar, 1998), the students in the class used the materials explored in TE 587 in their own classrooms and then reported their experiences back for discussion. TE 587, in effect, modeled what the teachers needed to do in their classrooms when using deeply-digital curricula. And based on interactions with the students in TE 587, we feel that this transformed version of TE 587 was an effective strategy. In other words, students in TE 587 uniformly reported positive experiences in their classrooms.

Teacher educators must work towards the digital transformation of professional development for in-service teachers

Typical professional development in K-12 involves a trainer coming into a school and talking at teachers for 1 day or 2 days (Davis, 2017). However, just as we adopted social constructivist learning in the K-12 classroom and in TE 587, we felt that our PD to prepare in-service teachers to use Roadmaps and Collabrify needed to reflect that pedagogical philosophy. In what follows, then, we describe how we conducted PD for teachers who were going to be using Roadmaps and Collabrify. After that description, we step back and draw lessons for teacher educators from that experience.

In late summer 2020, after school administrators had decided to adopt the Center's deeply-digital curricula and the Collabrify Roadmap Platform. However, we were challenged to consider how to bring teachers who were accustomed to traditional uses of computers in the classroom up to speed quickly in using the Center's deeply-digital curricula in their classrooms. We quickly created a program of professional learning that was comprised of various learning activities. Our core pedagogical philosophy for the PD was this: the PD experience should model how the teachers would use the Roadmaps in their classroom. For example:

- The K-5 teachers who had created the Center's curricula led a 90-minute, face-to-face webinar with a school's teachers. Driving the progress of the webinar was a Roadmap, thus using the deeply digital curricula the teachers would eventually be using. The school's teachers and the webinar leaders were all collaborators on the Roadmap.
- After the synchronous PD session, the teachers were provided with a sequence of four Roadmaps that teachers would work through on their own time.
- During the time the teachers were working on their PD Roadmaps, we held many open Q&A sessions. Teachers could drop into a zoom session and talk with the Center's teachers. The Q&A sessions were well attended and quite lively.
- We did not want the teachers to think that Roadmaps were to be used for asynchronous learning. That is, we did not want the teachers to think that all they needed to do was distribute Roadmaps to their students, and then the students would complete the Roadmaps by themselves. This was the opposite of what we intended. Deeply digital curricula were meant to be used for synchronous learning, whether the children were in-class or at home at their kitchen tables; in both instances, a teacher would be working with them.
- After the teachers had worked through the PD Roadmaps, we held a *Show & Tell Session* where the teachers showed each other the Roadmaps that they had modified and/or created.
- Teachers could ask questions via email. As several Center members monitored that email, teachers often would get answers in 10 minutes or less. Phone numbers were even exchanged as occasional one-to-one conversations were needed.

Not everything went well; creating PD for digitally transformed curricula was challenging. Here we point out two fundamental mistakes we made in the PD program. We identify them here in the hope that others can learn from our mistakes.

- **Focus primarily on *using the provided* curricular materials:** While our PD program showed teachers how they might change the deeply-digital curricula, we neglected to focus on simply using the curricula as is, without change. Given how different these digitally transformed curricula are from traditional paper-and-pencil curricula, changing those materials without first using them runs the risk of creating a "lethal mutation," in the classic words of Brown and Campione (1996, p. 291), and losing the coherence that was built-into the provided lessons.
- **Show teachers *how to use* the provided curricula materials:** Teachers need to see how other teachers are using the deeply-digital curricula. While the Center has video of teachers using the deeply-digital curricula in the classroom, we neglected to heed the wisdom of teacher educators who advocate for the use of just such video in teacher education programs (e.g., Marsh & Mitchell, 2014).

Survey data revealed that the participating teachers rated the PD relevant, high quality and effective in design and progression. Further, teachers stated they acquired the intended knowledge and skills of the PD to a high degree and they felt that the deeply digital curricula would be very useful to their students. While teacher comments were incredibly positive, this example is provided to continue to push teacher educators to reconsider traditional professional development. We need to continue to teach teachers using tools we want them to use with students.

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Transactional Limitations of Informal Assessment in Online Teacher Education Courses

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Abstract: The COVID-19 pandemic triggered a rapid transition to online instruction, both for universities and K12 schools. This transition exposed the limitations of teacher to student engagement using video conferencing technology for synchronous instruction. Effective use of formative assessment, including informal assessment, is beneficial for learners, both in K12 and postsecondary contexts, but requires adaptation for online instruction. This chapter illuminates the challenges of conducting informal assessment in synchronous online courses using Dewey and Bentley's (1949) conception of transaction, or communication as mutually constituted, goal-oriented action. It argues that instructors of pre-service teachers should reestablish as much transactional engagement as possible, while using the affordances of the video conferencing technology to supplement where necessary.

Lesson Learned: Teacher educators should have learned techniques to compensate for the transactional challenges of informal assessment during online instruction.

INTRODUCTION TO TRANSACTIONAL LIMITATIONS OF INFORMAL ASSESSMENT

Formative assessment measures student learning during the instructional process (e.g., in contrast to summative assessment, which occurs after instruction) with the goal of providing actionable feedback for both students and instructors (Council of Chief State School Officers, 2008; Heritage, 2007; Popham, 2008). As models of best teaching practice, instructors of pre-service teachers should both use formative assessment strategies (Klimenko & Sleptsova, 2015; Nilsson, 2013; Tinoca & Oliveira, 2013; Webb, 2010) and intentionally teach them in education courses (McMillan, 2018a; McMillan, 2018b; Popham 2008; Popham 2020; Schneider & Bodensohn, 2017). Robust forms of formative assessment, whether formal or informal, require dynamic engagement between instructor and student (López-Pastor & Sicilia-Camacho, 2017; Ruiz-Primo, 2011). This is especially true for informal assessment, which is based on teachers' direct engagement with students (McMillan, 2018a; Ruiz-Primo, 2011). Through informal assessment, instructors gauge students' responses to content in order to quickly modify instruction and are thus better able to meet students' needs.

The COVID-19 pandemic forced university courses online, causing drastic shifts in pedagogy. Instructors using a synchronous approach have frequently relied on video conferencing technology to deliver instruction. This chapter considers how the informal formative assessment process in teacher education has been impacted by the move to video conferencing for instruction in the wake of the COVID-19 pandemic. It provides both a review of the research on informal assessment, as well as a theoretical grounding in the educational philosopher John Dewey and sociologist Arthur Bentley's (1949) conception of transaction, which identifies human communication as a matter of mutually constitutive action. This chapter argues that Dewey and Bentley's conception of transaction illuminates the informal assessment process when considering engagement between instructors and their students.

Due to videoconferencing reducing the transactional engagement between students and instructors in a variety of ways, instructors should bolster elements of communication that can maximize robust engagement between classroom participants. Instructors of pre-service teachers must not only consider their roles as teachers but also as models of best practice. Both of these roles should be considered when making pedagogical adjustments, which is discussed in this chapter. Further research should examine the challenges of reduced transactional engagement and how it can be overcome within the parameters of learning through videoconferencing technology.

WHAT WE KNOW ABOUT TRANSACTIONAL LIMITATIONS OF INFORMAL ASSESSMENT

Theoretical Lens

Communication is often conceived as a channel or pipeline in which a communicator delivers a message to a recipient. A messenger might ask "did you get it?" making the process analogous to receiving a package through the mail. In this conception, a message is effectively communicated if the receiver feels like they understand the message.

Dewey's conception of communication, which he eventually labeled *trans*action (Dewey & Bentley, 1949), challenges the sender-receiver model of communication. It is based upon an anticipatory structure which requires action by all involved parties, making a proper analogy closer to a dance than a parcel delivery. Dewey (1958) states,

> The characteristic thing about B's understanding of A's movement and sounds is that he responds to the thing from the standpoint of A. He perceives the thing as it may function in A's experience, instead of just ego-centrically...To understand is to anticipate together, it is to make a cross-reference which, when acted upon, brings about a partaking in a common, inclusive, undertaking. (p. 178-179)

Dewey settled on transaction because he felt the term interaction conveyed a back and forth which did not fully capture the dynamism involved in the communicative process. While one person may initiate a transaction, it requires action by both parties to reach understanding. In such a process, each person uses all of their senses; not only explicit words but intonation, pitch, body language, and other situational and environmental cues. While the concept of transaction may not be well known to practicing teachers, it captures the continuous dynamic engagement between instructors and students that makes effective informal assessment possible, as will be discussed ahead.

Background and Literature Review

Informal Formative Assessment as a Transactional Process. Dewey's conception of transactional processes is not only relevant during instruction, but also assessment. This is particularly true within formative assessment, which inherently relies on a transactional relationship between instructor and student. The Council of Chief State Officers (2008) defined formative assessment as "a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes" (p. 3). This definition emphasizes the importance of formative assessment as a bidirectional engagement between teacher and student. Formative assessment allows teachers to adjust instruction based on students' feedback. As such, students must be active participants in the formative assessment process (López-Pastor & Sicilia-Camacho, 2017; McMillan, 2018a; McMillian, 2018b; Nicol & Macfarlane-Dick, 2006; Popham, 2008; Ruiz-Primo, 2006). Transaction identifies the mutual constitution of this process and recognizes that students are not merely acted upon; they are also agents within the formative assessment process.

Research in both teacher education and K12 contexts indicates that use of formative assessment enhances student learning. Within K12 contexts, the effective use of formative assessment is linked to gains in student achievement (Black & Wiliam, 1998; Graham et al., 2015; Herman et al., 2014; Ozan & Kincal, 2018; William et al., 2004). The emphasis on student involvement in the formative assessment process also promotes valuable academic skills and dispositions such as self-regulation (Clark 2012; Heritage, 2007; McMillian 2018a; McMillian 2018b). Research in higher education has found similar impacts on student achievement (Baliram & Youde, 2018; Hudesman et al., 2013; López-Pastor, 2011) and academic skills (Kincal & Ozan, 2018; Nicol, 2009). The positive impact on students is enhanced further when they are actively involved in the assessment process (López-Pastor & Sicilia-Camacho, 2017; Nicol & Macfarlane-Dick, 2006). Thus, the effective use of formative assessment in teacher education courses, particularly when students are involved in an active, transactional process as articulated by Dewey and Bentley (1949), benefits student learning while demonstrating best practices for teaching in a K12 classroom.

Formative assessment includes both formal and informal practices (Bell & Cowie, 2001; McMillan, 2018a; Schildkamp, 2019). While formal assessment is based on planned, systematic collection of student data (McMillian, 2018b; Popham, 2008; Popham, 2020; Schildkamp, 2019), informal assessment relies on less structured, but continuous, engagement with students (McMillan, 2018a; Ruiz-Primo & Furtak, 2006; Schildkamp, 2019). Formal assessment requires review of assessment data in order to make planned changes before more instruction occurs. Informal assessment, sometimes referred to as embedded assessment (McMillan, 2018a), including observation of students' facial expressions, body language, and verbal reactions to instruction and responses to teachers' questioning (Jiang, 2014; Lekwa et al., 2020; McMillan, 2018a; Ruiz-Primo & Furtak, 2006; Ruiz-Primo, 2011), allows instructors to make in the moment adjustments during instruction based on their own judgment. For example, an instructor who notices confused reactions to a question would restate the question for clarity. Or an instructor seeing students nodding would conclude that students are understanding the instruction and continue teaching. Due to the relative efficiency, teachers rely on the transactional engagement of informal assessment more frequently than formal assessment (Howley et al., 2013; Young & Jackman, 2014).

Unfortunately, due to the unstructured nature and its reliance on instructors' intuition and judgment, informal assessment can often be invalid (McMillian, 2018a) and biased (Scott et al., 2019; Quinn, 2020; Watson, 1999). Instructors can misinterpret or overlook student responses, causing them to make inaccurate inferences. Student factors, such as self-efficacy and cultural differences also affect their participation in informal assessment, further limiting its validity. In general, students with higher self-efficacy tend to participate more in class (e.g., asking and answering questions, displaying clear reactions to instruction, etc.), giving them a greater influence in instructors' informative assessment. Minority students, low SES students, and first generation students, who often experience low self-efficacy already, also tend to participate less frequently and more passively during class (Devlin & McKay, 2019; Soria & Stebleton, 2012; Thiele et al., 2017), also reducing their participation in informal assessment. Further, cultural norms can affect the frequency and manner in which students participate. In Dewey and Bentley's (1949) terms, these factors inhibit transactional engagement, and teachers are charged with finding ways of overcoming these challenges and pulling all students into the process.

Video Conferencing Limits the Transactional Process of Informal Assessment. Many instructors continuing to teach synchronously during 2020 utilized a variety of video conferencing software options to deliver instruction. The promise of video conferencing was that it would bring the co-presence of the classroom into online learning environments. It achieves this to some extent, but viewed through Dewey and Bentley's (1949) transactional conception of communication, it becomes apparent that using video conferencing technology to deliver instruction further compounded

these limitations of informal assessment by reducing the transactional engagement between students and the instructor, exacerbating already existing concerns about the validity of informal assessment. Depending on the technology used, the instructor may only be able to view a portion of the students while teaching, reducing their ability to gauge student reactions or read body language that signifies interest or understanding. Further, student responses such as facial expressions can be more difficult to interpret compared to in-person formats or may be delayed enough to disrupt the transactional flow that is the norm for experienced teacher educators. These challenges are further complicated when students choose not to participate using video during class. The inability of software to capture audio from more than one speaker at a time creates reduced and unnatural engagement between students and with the instructor. The result is an artificial environment in which much of the fluid, natural transactional engagement among and between students as well as between students and the instructor is disrupted in ways that must be identified and considered when creating modifications for synchronous online learning.

In addition, video conferencing also worsens biases within the informal assessment process. As with in-person classes, students with high self-efficacy are more likely to participate with both video and audio during video conferencing. Yet in online environments, instructors can no longer use their own proximity and non-verbal cues to give subtle checks to less engaged students. In video conferencing, facial looks can not clearly be directed at individuals without other supporting information, further disrupting transactional engagement between instructor and students and students with each other. In some cases, students may not be able to use video and/or audio during class, perhaps due to inadequate technology or poor internet. Students with technology issues tend to already be disadvantaged by the informal assessment process, particularly low SES, rural, and first generation college students (Buzzetto-Hollywood et al., 2018; Goode, 2010; Koricich et al, 2020). Some students may also choose not to participate using video or audio due to their home environment such as lack of private space or embarrassment at the perceived quality of their surroundings.

LESSONS LEARNED FOR RESEARCH

In general, more research on the use and efficacy of informal assessment, both in K12 and higher education, is needed. Though informal assessment is often used more frequently than formal assessment (Lucariello et al., 2014), it is susceptible to bias (Scott et al., 2019; Quinn, 2020; Watson, 1999). Further research is needed to understand both trends, specifically the impact on instructors of pre-service teachers. Instructors' heavy reliance on informal assessment may be indicative of low self-efficacy related to formal assessment techniques, particularly in online formats (Horst & Prendergast, 2020; Massey et al., 2020). The quick shift to online instruction in 2020 forced instructors, many of whom rarely or never teach online, to change their pedagogical techniques, frequently with minimal training (Grenon et al., 2019; Gyampoh et al., 2020; Sharadgah, & Sa'di, 2020). The efficacy of assessment training for online teacher education should also be examined. The impact of instructors' perceptions of students on evaluation can inform research on bias within informal assessment. Fortunately, research in bias reduction training for instructors is promising (Harrison-Bernard et al., 2020; Hudson, 2020; O'Leary et al., 2020). The impact of such training on informal assessment, with attention to online instruction, is also necessary.

Dewey and Bentley's (1949) conception of transaction can also serve as a guide for further research, which could illuminate how the move to video conference instruction has affected the ability of instructors to informally assess students during the learning process. A more robust understanding of the particular roles played by non-verbal cues such as head nods, eye contact, and forward body posture would help teachers to modify their instruction in more responsive ways.

Engagement in online courses can be particularly problematic for students that lack adequate access to technology or technological skills, especially low SES, racial minority, or first generation college students (Buzzetto-Hollywood et al., 2018; Goode, 2010; Koricich et al, 2020). Synchronous online instruction using video conferencing software requires sufficient internet connectivity as well as a device with both audio and video capabilities. The specific impact of these issues on teacher education during 2020 is yet unknown. There may be further issues related to student characteristics or their home situations that inhibit their ability to fully participate in online instruction, which requires further investigation.

As online instruction in higher education becomes more prevalent, even beyond the COVID-19 pandemic, instructors must adapt to meet the challenges of teaching with technology such as video conferencing. This includes modifying both instructional and assessment practices. This is especially important for instructors of teacher education, who also serve as models of best practices for pre-service teachers. Due to the recency of the large-scale shift to online learning in 2020 and the general need for research for more on informal assessment in higher education, few solutions have been adequately researched. However, suggestions driven by Dewey and Bentley's (1949) conception of transaction, utilized by the authors, can help teacher educators consider how to best modify instruction for maximum effectiveness.

Engaging Pre-Service Teachers in Discussion about Transactional Limitations

Instructors of pre-service teachers have the challenge of not only creating effective learning experiences for their students but also modeling best practice for pre-service teachers (Moore & Bell, 2019). K12 education experienced a shift to online instruction along with higher education in 2020. As instructors consider the impact of the change to online instruction on their practices, they should also take into account their role as models for pre-service teachers. The limitations on transactional processes in instruction are also present in K12 education, causing similar challenges for informal assessment. Like college students, K12 students may also be unable or hesitant to use video or audio during instruction.

In a review of literature on modeling by teacher educators, Moore and Bell (2019) identified four types of modeling in teacher education, including explicit modeling with reflection and connection to theory. In these cases, instructors of pre-service teachers used best practice grounded in educational theory within their own courses and engaged students in reflection about the efficacy of these strategies with respect to the theories. Instructors of pre-service teachers should consider discussing with their students the use of informal assessment, both in K12 education and in their own teaching. Instructors should consider being transparent about the teaching challenges presented by video conferencing software. Teachers could engage students in discussions about the challenges of transactional engagement during online classes, asking students to think critically about how participation affects the efficacy of instruction. Instructors may benefit from explaining to students that they are now less able to gauge their understanding and be responsive to their engagement with the material, and therefore more overt and explicit communication is necessary. These discussions can clarify both the instructors' intent and also trigger students to reflect on their own engagement in online learning as it impacts transactions with other students and with the instructor.

However, instructors should also be attentive to the hesitancy or inability of certain students to participate in transactional processes during online instruction. Students such as those from low SES backgrounds, rural communities, or first generation college students may struggle to engage fully during online learning due to personal or technological reasons (Buzzetto-Hollywood et al., 2018; Goode, 2010; Koricich et al, 2020). Similar groups are impacted in K12 settings as well. As such, instructors should discuss the impacts of online instruction on these students. Pre-service teachers, who are increasingly likely to be asked to teach online themselves, should critically reflect on the challenges for participating for some students. In addition to these conversations bringing awareness to students, it may also create a more inviting environment for students who themselves were hesitant to participate. In these cases, instructors may find it beneficial to hold individual meetings with students so their concerns can be voiced without the judgments of their peers. Following reflective conversation about transactional processes in theory and practice, instructors should be intentional about explicitly modeling informal assessment and accommodating for the transactional challenges.

Explicit Modeling of Transactional Processes

Given the limitations of video conferencing on the transactions between instructor and students, instructors must make a greater effort to engage students, particularly when conducting informal assessment (López-Pastor & Sicilia-Camacho, 2017; Ruiz-Primo, 2011). Instructors should be particularly aware of and accommodate for the limited input from students' body language, facial expressions, and verbal reactions to content. Instructors could ask students to position cameras and adjust lighting for the clearest presentation possible; thereby maximizing potential to reclaim the transactional engagement of facial expressions and body language of the upper body. Such instructions could be verbally explained in the first day of courses, and a document explaining camera and lighting positioning may be useful for students.

Instructors can also request that students participate more consistently, using both video and audio. In addition, instructors may explain to students that more overt responses are needed, possibly implementing a system of responses (e.g., thumbs up for understanding). Instructors could also require students to keep audio on at all times, so more verbal information is available. Setting these expectations early in the course can help the practices become the norm for students.

Instructors can utilize other methods of encouraging student to student engagement. The breakout room feature on Zoom, and similar features on other software options, can help to replicate the paired and small group discussions of the physical classroom. If groups are limited to two or three students, more of the body language cues can become interpretable by students when engaging with one another. Although, this presents another challenge to informal assessment in that instructors can only visit one room at a time. However, the informal assessment information gathered within each breakout room could potentially be more meaningful, as fewer participants will allow the instructor to better interpret verbal responses and non-verbal cues with fewer participants.

Instructors should also consider other forms of engagement for students. For example, many video conferencing platforms include chat or voting features. In cases where students may not be able to or comfortable with participating using video or audio, these can be helpful alternatives. When asking for feedback from students, instructors may need to rely on more direct methods to compensate for reduced input from students. For example, rather than relying on open questions (e.g., "are there any questions?"), instructors should rely on more targeted questions (e.g., "what is an example of this in practice?") (Green & Johnson, 2010; Jiang, 2014; McMillian, 2018a). Also, it may be fruitful for instructors to directly call on students for responses. Further, given the challenges of video conferencing, instructors should provide adequate wait time to allow students to respond.

Shifting from Informal to Formal Assessment

Synchronous online instruction may also require a shift toward more formal methods of assessment. Unlike informal assessment, formal formative assessment tends to be more valid, reliable, and fair (Lucariello et al., 2014), especially in online teacher education courses (McLaughlin & Yan, 2017; Tinoca, 2012; Webb, 2010). Thus, they are also less likely to be influenced by the limitations of video conferencing. Though more planned and systematic, formal formative assessments can still be useful for responsive adjustments to instruction. Quick, formal checks of understanding can be implemented quickly throughout instruction and used for adjustments within the class or for future classes. Formal assessment can be implemented using features built into video conferencing software (e.g., polling, chat, etc.) or using pre-existing online tools (Chen & Chen, 2009; Hatzipanagos & Warburton, 2009; Robertson et al., 2019). Students who are unable or hesitant to engage using video and audio are still able to engage with these features and tools. Beyond gauging understanding, formal formative assessment can also be used to address student attitudes, perceptions, and opinions about content. Unlike informal assessment, formal assessment requires review of student data, but efficiently implemented formal formative assessment is a powerful tool for enhancing the efficacy of instruction.

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It's Virtually Possible: Rethinking Preservice Teachers' Field Experiences in the Age of COVID-19 and Beyond

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Abstract: Mid-semester Spring 2020, most universities and K-12 schools in the US transitioned into fully online teaching and learning as a result of the COVID-19 pandemic. This required K-12 teachers with no prior training or experience to teach online. With online learning likely to have a lasting presence in K-12 education, preservice teachers (PSTs) must be prepared to deliver virtual instruction. This chapter offers lessons learned by teacher educators who guided PSTs in the modification of hands-on engineering lessons for virtual implementation during the Spring 2020 semester as part of an NSF-funded project. PSTs delivered engineering lessons both synchronously and asynchronously to elementary school students and reported positive learning opportunities, gaining confidence and competence from their experiences. The authors assert that if online teaching experiences can be crafted carefully and intentionally for PSTs, rather than adapted on the spot in response to a sudden shift to virtual learning, there may be even greater potential for learning and confidence building. Successful strategies for both asynchronous and synchronous instructional field experiences are shared and implications for both teacher educator practice and research are made.

Lesson Learned: Preservice teachers benefit significantly from virtual field experiences with K-12 students; teacher educators can, and should, provide these opportunities to prepare teachers for a post-COVID-19 world.

AN INTRODUCTION TO ONLINE ENGINEERING EDUCATION FIELD EXPERIENCES FOR PRESERVICE TEACHERS

After K-12 schools in the US transitioned fully online due to COVID-19, studies that explore the impact of the pandemic on teaching emerged (Nuere & de Miguel, 2020; Romero-Rodriguez et al., 2020). However, most of this early research addressed teaching and learning in higher education rather than K-12. Researchers have just begun to examine the rapid shift from in-person to online teaching and learning, capturing teacher educators' field stories and innovative approaches to using technologies to provide meaningful learning for PSTs during a pandemic (Ferdig et al., 2020; Hodges et al., 2020). Many teacher preparation programs have only begun to partner with K-12 virtual schools to prepare PSTs to teach online in the K-12 environment (Archambault et al., 2016). Hence, there is limited literature that examines field experiences where PSTs directly interact with and prepare to teach K-12 students in online environments. Nevertheless, the experience of a team of educators in Spring 2020 strongly suggests that PSTs can benefit significantly from K-12 virtual field experiences.

In Spring 2020, Ed+gineering, an NSF-funded project, partnered undergraduate engineering students (UESs) and preservice teachers (PSTs) together to learn from and with each other as they planned and delivered engineering lessons to elementary students. The extensive project involved three collaborations between the two groups of college students (Figure 1). While each collaboration was planned to occur face-to-face and result in in-person lessons with children, a modified plan was enacted mid-semester to shift the lessons for online delivery. This chapter highlights lessons learned by Ed+gineering's teacher educators following the modification of their engineering lesson project for the virtual learning context. It reveals how virtual teaching opportunities with K-12 students provided critical learning experiences for PSTs. Holistically, these collaborations have broad implications to the larger teacher educator community, demonstrating how PSTs can be prepared to teach online through asynchronous and synchronous virtual field experiences.
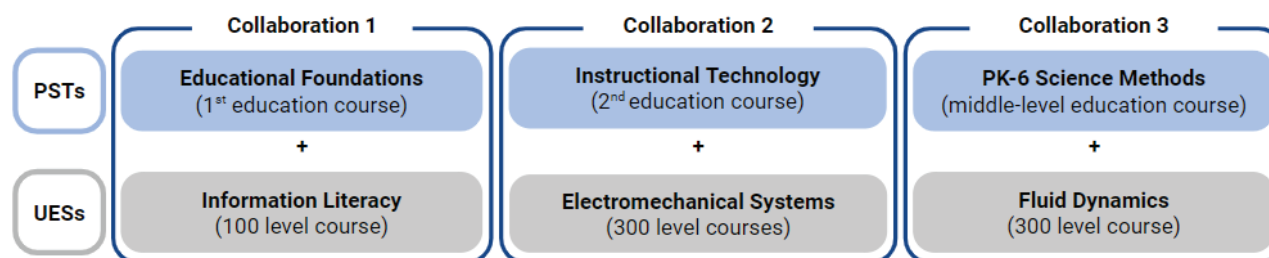

Figure 1. Three Collaborations of the Ed+gineering Project.

WHAT WE KNOW

PSTs' Field Experiences in Online Settings

According to Tobin (1993), teachers learn best when they have direct experience with their students. Such direct experience is valuable because it provides PSTs with the most compelling source of teaching efficacy, student performance (Liaw, 2009). Considering that practical experience with students has an impact on PSTs' teaching efficacy, which in turn affects students' achievement (Riggs & Enochs, 1990), it is critical for PSTs to experience teaching K-12 students in authentic contexts before entering their own classrooms (Hunter & Botchwey, 2017).

Field experience is an essential component of teacher preparation where PSTs contextualize knowledge and theories (Darling-Hammond, 2014). Researchers have consistently expressed the need to prepare PSTs to teach online to prepare teachers for the 21st century (Ferdig & Kennedy, 2014; Irvine et al., 2003); however, little has changed in the past ten years to provide such preparation (Kennedy & Ferdig, 2018). A national survey conducted in 2010 by Kennedy and Archambault (2012) found that only seven programs nationally, or 1.3% of US teacher education programs, offered virtual field experiences to PSTs. After four years, the authors (2016) replicated the study and found only a small increase to 15 programs, representing only 4.1% of teacher education programs across the US. Thus, there is a significant gap between the growing need for online education and teachers' preparation (Larson & Archambault, 2019; NFES, 2015). Consequently, at the time of school closures in Spring 2020, only a small portion of teachers and teacher educators had been trained to teach online (Larson & Archambault, 2019). It is not surprising then that the shift to emergency remote instruc-

tion took many educators in both K-12 and higher education by surprise; hence, they were unprepared to teach in online settings when COVID-19 forced schools to close in 2020.

In order to provide meaningful online field experiences for PSTs, teacher educators need to be prepared. However, teacher educators were found to have limited knowledge about K-12 online learning, with some believing that simply having PSTs take an online course would be adequate preparation for teaching one (Kennedy & Archambault, 2012). Guiding PSTs to teach online goes beyond introducing technology skills and requires a different skill set (e.g., content delivery, classroom management) from traditional face-to-face teaching (Kennedy & Archambault, 2012; Larson & Archambault, 2019). Virtual field experiences situate PSTs to develop the skills and knowledge needed to effectively teach in an online environment. For example, PSTs who were exposed to virtual school environments gained a better understanding of the responsibility and skills of a virtual teacher, overcame concerns and misconceptions about K-12 online learning (e.g., thinking it would involve less teacher-to-student and student-to-student interaction than face-to-face settings) (Compton et al., 2009), and developed a positive perception toward K-12 online teaching (Luo et al., 2017).

Nationwide, as PSTs were unable to complete their face-to-face field experiences due to school closures in Spring 2020, teacher educators had to explore unique ways to make field experiences meaningful for PSTs. For example, Kier and Clark (2020) implemented a Virtual Tutoring Program, where PSTs would meet weekly, one-on-one, with 3-5 elementary students by phone or in virtual meetings in order to both address issues of equity in online teaching and provide tutoring services to identify problems and potential solutions. Koch and Vu (2020) arranged Zoom-based field experiences for their special education PSTs, in which they met with K-12 students with disabilities, as well as the students' parents and teachers, in order to provide a realistic replication of a face-to-face meeting where the stakeholders discussed the child's home and school experiences with regard to their identified disability and accommodations. Moreover, teacher educators incorporated innovative ways to provide virtual substitutes for the face-to-face field experiences that PSTs missed as a result of school closures, such as technology-based simulated professional development environments (Sasaki et al., 2020), virtual reality simulations (Monroe et al., 2020), and video-based case studies (Kerkhoff, 2020). These alternative field experiences for PSTs were found to be viable options for substituting traditional face-to-face field experiences from both the instructors' and students' perspectives.

Asynchronous and Synchronous Learning for Teachers and Students

There is ongoing debate on the benefits and challenges associated with the two main types of online learning: asynchronous and synchronous. While asynchronous learning allows time for learners to process information (Robert & Dennis, 2005), students can feel isolated and have fewer opportunities to process information with others (Haythornthwaite & Kazmer, 2002). Synchronous sessions, especially those with video interaction, often provide space for richer verbal communication, allowing students to clarify problems quickly and easily, feel less isolated, and perceive greater social presence (Lowenthal et al., 2017). Burgoon et al. (2010) observed that synchronous sessions resulted in higher levels of engagement than asynchronous, promoting a stronger sense of connection, presence, and social awareness in the conversation.

It is not surprising then, that despite the convenience of asynchronous learning, many students and teachers choose synchronous learning over asynchronous as it is perceived to be more social given the opportunity to simultaneously ask and answer questions (Hrastinski, 2008). However, synchronous learning is not without concern as it can easily turn into long one-sided lectures, which makes it difficult to participate and leaves people fatigued (Schulman, 2020). While both modalities have limitations, research suggests online learning has some benefits over face-to-face environments. For example, researchers (e.g., Borup & Stevens, 2016; Graham, 2006) found that online communication allowed more personalized communication than face-to-face learning environments because teachers can work with individuals more easily. Given the pros and cons of both models, it has been suggested that teacher educators prepare PSTs to utilize both, depending on the complexity of the teaching activity and the need for social interaction.

Teachers' Need for Autonomy

Littlewood (1996) defined autonomy as one's ability and willingness to make choices independently. When autonomy is viewed from a teacher's perspective, the ability to control content and environment is a key (Pearson & Hall,

1993). In an online setting, teachers were satisfied when they had flexibility in when and how they taught and had time to interact individually with students (Borup & Stevens, 2016). Moreover, Ketelaar and colleagues (2014) reported that teachers need to sense ownership in order to implement educational innovation. Thus, in order for teachers to implement new pedagogies or educational technologies, they need to first build a sense of ownership. Few studies have investigated factors that foster teacher autonomy. Factors that hamper teacher autonomy are more commonly reported. For example, Xu (2015) identified overdependence on peer support and oppressive circumstances at institutions as obstructing factors. More research is needed to understand how to support teacher autonomy in both pre-service and in-service contexts.

PST Participation in Virtual Field Experiences in Spring 2020

Following the shift to online instruction in Spring 2020, the teams of education and engineering students participating in the three Ed+gineering collaborations were asked to revise their engineering lessons for elementary students to a virtual version, rather than face-to-face delivery. The lesson redesign for Collaboration 1 (C1) and Collaboration 3 (C3) was similar—each team created an interactive multimedia Google Slides presentation (see sample presentations in "Implementations" at https://www.oduedgineering.com/) to interact asynchronously with partnering elementary students. In Collaboration 2 (C2), teams redesigned lessons planned for elementary students in an after-school club for synchronous delivery via Zoom (Figure 2). This chapter will leverage the experiences of the PSTs as they redesigned their engineering lessons for virtual delivery to illuminate the potential advantages and challenges of virtual field experiences.
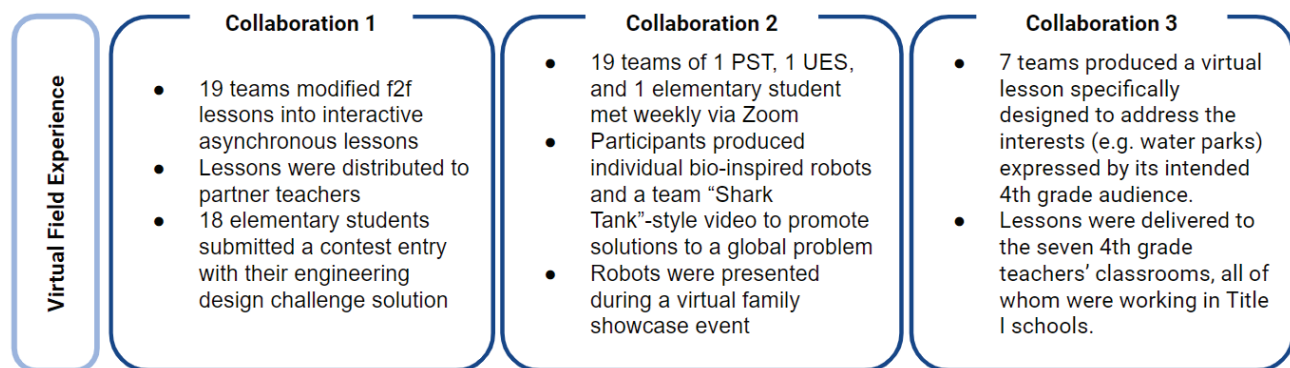

Virtual Field Experience

Collaboration 1
- 19 teams modified f2f lessons into interactive asynchronous lessons
- Lessons were distributed to partner teachers
- 18 elementary students submitted a contest entry with their engineering design challenge solution

Collaboration 2
- 19 teams of 1 PST, 1 UES, and 1 elementary student met weekly via Zoom
- Participants produced individual bio-inspired robots and a team "Shark Tank"-style video to promote solutions to a global problem
- Robots were presented during a virtual family showcase event

Collaboration 3
- 7 teams produced a virtual lesson specifically designed to address the interests (e.g. water parks) expressed by its intended 4th grade audience.
- Lessons were delivered to the seven 4th grade teachers' classrooms, all of whom were working in Title I schools.

Figure 2. Virtual Field Experience for PSTs.

The following sections draw from PSTs' written reflections and focus groups to provide evidence of the struggles and benefits PSTs reported from preparing to teaching virtual lessons. They highlight lessons learned by the teacher educators as they redesigned the field experiences for virtual implementation. The experience of PSTs who participated in an asynchronous instructional model are described first, followed by a description of the experiences of PSTs participating in a synchronous field experience.

PST Field Experience through an Asynchronous Instructional Model

PSTs Shift their Lesson Design from Face-to-Face to Asynchronous Online. Prior to school closures, teams of 4-6 UESs and PSTs were preparing to deliver hands-on engineering lessons during *Engineering Day*, a field trip for elementary students to visit the university. Mid-semester, teams were tasked with converting their lesson to an asynchronous online format.

What we learned from this shift is that even with additional stressors imposed by COVID-19 and the university's transition to online learning, PSTs noted learning from the preparation of asynchronous instructional material. A C3 PST acknowledged that even though she did not get to teach the lesson face-to-face, she "learned how to do an interactive presentation, which [she'd] never really done with audio or video." PSTs also learned online pedagogical strategies in resource development:

We also tried to keep the presentation interactive, even though it was a virtual presentation, by adding videos of us also doing the project and adding audio recordings, where we thought the students would need more explanation. We also tried to keep the videos on the presentation short so we would not lose the students' attention.
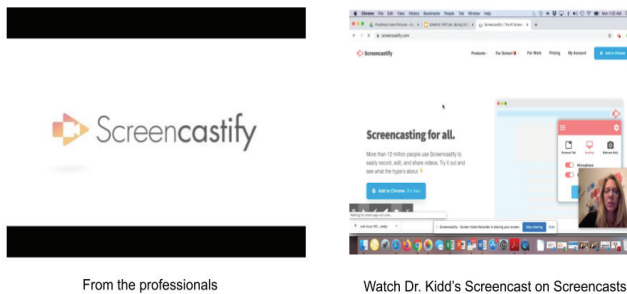
These were not the original objectives for PSTs in Spring 2020; however, these are essential skills to help prepare PSTs for teaching virtually. As inservice elementary teachers have been asked to utilize similar skills in the 2020-21 academic year (Korkmaz & Toraman, 2020), these skills will be beneficial for PSTs moving forward, even post COVID-19.

PSTs' Interactions with Elementary Students. PSTs expressed disappointment at not being able to interact and gauge the elementary students' responses in real-time. One C1 PST "lost a lot of [her] motivation to continue since [she] would not be able to actually interact with the students in-person or even see them complete the project," while another C3 PST was "all kind of bummed that we had to have a virtual interaction." The distribution of the Google Slideshows to the elementary students was inconsistent, reflective of inadequate infrastructure for K-12 virtual instruction nationwide (Korkmaz & Toraman, 2020). Furthermore, K-12 teachers and students were often not familiar with the technology tools used in the presentations or lacked access to necessary resources (see "Resources" below). Thus, some students were not availed access to the presentations, and interactive elements (e.g., Padlet, Kahoot) were not always used by the intended elementary audiences. This was exacerbated by mandates from school divisions to only provide students with district-prepared classwork packets. As a result, few teams received evidence of elementary student interaction with their lessons. This created a very one-sided asynchronous experience with minimal opportunity for back and forth interaction between the elementary students who were to complete the lessons and the college students who prepared them.

What we learned was that PSTs considered the lack of interaction with elementary students a missed learning opportunity, especially since they were originally slated to work with students in a face-to-face lesson. They were disappointed that they did not receive feedback on their work from their intended audience. They could not fully ascertain if their lessons were responsive to students' knowledge, interests, or cultures. Considering that students perceive feedback as a powerful source for learning (Ferguson, 2011), lack of feedback from elementary students impaired their ability to learn from this experience. Our project team asserts that the asynchronous lesson design (and, by extension, asynchronous teaching experiences generally) were not inherently flawed, but rather were hampered by the lack of expertise and infrastructure for online learning in K-12 schools that existed in April 2020 when the lessons were delivered. Inservice K-12 teachers have since increased their comfortability interacting with students online, and future distribution of asynchronous lessons would likely be more successful than it was during the emergency remote instruction transition.

Modeling Virtual Instruction. To help ensure a high-quality product, the project team created and distributed a highly interactive, exemplar Google Slideshow that included student-friendly images, personal video and audio clips, and tools to promote elementary student interaction (e.g., Google Forms, comments in Google Slides). The team also created a presentation that explained how to create and embed interactive elements (Figure 3), as well as providing a Google Slides template as a starting block for their asynchronous lessons.

Figure 3. Slides Explaining How to Create and Embed Interactive Content.

What we learned was that PSTs, especially those earlier in their program (C1), valued the digital resource models. One C1 PST explained that "the slideshow templates allowed us to follow step by step on what information we need and what content needed to be put in our slides for our project. These resources allowed us to effectively complete our les-

son…" However, some PSTs, especially those further along in their education program (C3), found that the prescriptive nature of the exemplar slideshow minimized their autonomy, their creative ability, and pedagogical flexibility:

> I feel like [the slideshow] should've been more creatively done by us [rather] than a prompt for us to fill out. Because, okay. We did all this work just to fill out this prompt, and it doesn't really match idealistically what I would do….

This aligns with the literature that identified ownership as a critical factor for teacher motivation (Borup & Stevens, 2016; Ketelaar et al., 2014).

Providing Resources for Virtual Learning. Prior to the transition, both university teams and elementary students would have been provided with all physical materials (e.g., styrofoam, tubing) necessary to carry out the engineering lessons. Following the transition, teams had to consider what resources would be available to them in their own homes, as well as to Title I elementary school students, as they (re)designed their engineering lessons.

What we learned was that PSTs benefitted from the real-world opportunity to reflect on resource equity. Most of the participating elementary students are considered 'high-need' and attend schools that receive Title I funding. Thus, PSTs had to consider whether or not elementary students would have access to the 'basic' household supplies they planned to ask them to provide. A PST in C1 explained, "we had to be mindful of the supplies they might have at home. We just had to definitely rethink. I don't think it was difficult, we just kind of had to restructure our project." Hartshorne and Baumgartner (2020) suggested that "educators and teacher educators must inform solutions to resolving equity, accessibility, and other disparities in teaching and learning, as well as provide preservice and in-service teachers with opportunities to understand and address these issues" (p. 603). As PSTs were preparing asynchronous engineering design challenge lessons for elementary students, they were situated in an environment where they had to address equity and accessibility.

Faculty and Peer Support for PSTs. PSTs were supported through this project by their course instructor, their undergraduate engineering student (UES) partners, and the corresponding engineering instructor. Faculty met with teams as needed to provide feedback and direction. PSTs also relied on their teammates. One PST described the transition to learning and teaching online as "surprising, confusing, and challenging" but found their team members and faculty "readily available for any challenges that may arise." PSTs often relied on their engineering partners to provide expertise on engineering or scientific concepts. A C1 PST elaborated on the importance of his UESs partners:

> The engineering students are very creative and can think on their feet. Without them, it would have been harder to transition from in-person to online. They had ideas ready on how to revise our lesson and activity to work with what the students might already have at home.

What we learned was that many PSTs developed autonomy following the transition. The transition created challenges, especially in team communication, and PSTs had to overcome these by demonstrating initiative and innovation. For example, many teams collaborated less effectively after classes moved online. This often resulted from technical challenges, a reduction in team member input, or teams not communicating as frequently or as richly post-transition. Some PSTs noted that the virtual collaboration environment forced them to act independently and as such, helped them to develop professional skills. For example, a PST in C3 impacted by a reduction in her team members' productivity, reported that her leadership skills improved as she became "more active and express[ed] where the project should go." She added that this was the first group project in which she "felt comfortable enough to communicate well, and often, about expectations and work quality." She went on to say that she "can now start to take more leader roles in group projects and work well with others without fearing judgment." Xu (2015) found that there is a delicate balance, or synergy, necessary when novice teachers work in teams, too much reliance on team members may reduce one's autonomy. Similar to Xu's findings, our team found that a balance of autonomy and support from faculty and UES allowed the PSTs to grow their knowledge and confidence for engineering content and pedagogy, even in a virtual teaching and learning environment.

PST Field Experience through a Synchronous Instructional Model

PSTs Shift their Lesson Delivery from In-person to Zoom. Before the COVID pandemic, C2 teams were planning a robotics project for 5th graders participating in an after-school technology club. The project was the club's culminating design challenge: design, build, and code a bio-inspired robot to address a global challenge. When schools transitioned online, the after-school club did also. Each team of one PST, one UES, and one 5th grader met via Zoom to complete their robotics project.

Shifting to a virtual context meant that the teams needed to re-envision their multi-week robotics lessons for online delivery. PSTs used a variety of instructional technologies to facilitate this. As one PST reported, "Teaching through Zoom required me to find more technology-based activities to encourage participation." Another explained, "I used PowerPoints, videos, and Kahoot to make the learning process more engaging and fun." Many of the adaptations were difficult to plan for ahead of time, however, as they involved addressing emergent student needs (e.g., waning attention, trouble connecting parts) and troubleshooting technical issues (e.g., servo motor not spinning, code not uploading correctly). PSTs had to demonstrate perseverance in order to successfully achieve their lesson objectives. Many issues were only resolved after multiple back and forth screen shares and holding up hardware to the camera (e.g., "put your motor like this….") (Figure 4).

Figure 4. A Team Working on Motor Placement During a C2 Synchronous Lesson.
Note. Undergraduate engineering student (left) and preservice teacher (middle) communicating with 5th grade partner (right) by holding up hardware to the camera.

What we learned was that teaching hands-on robotics online was challenging, but feasible. As one PST put it, "Not sharing the same space was HARD! I could not directly show Rachel how to plug in her wires or save her code to her robot." The myriad of challenges that arose from teaching robotics online forced PSTs to innovate and adapt and they developed confidence from doing so. A PST explained it this way:

> ...getting the chance to teach this, like, crazy, complicated concept over Zoom, kind of makes me like, "Okay, if I can teach this stuff over Zoom, I can teach, like, reading and addition and, like, the more classic elementary concepts."

In addition to gaining technical expertise and confidence, PSTs appreciated the opportunity to teach online. As one PST explained, "I believe teaching through Zoom provided me with the experience in case classes get moved online in the future! Some teachers right now have never had anything like this happen and have struggled trying to teach online." We also learned that many PSTs appreciated and benefitted from the increased autonomy and responsibility they were granted when the club went virtual. As one PST noted:

> Virtual WoW Club gave me more autonomy than in-person WoW Club. I was able to decide what I wanted my student to achieve, the methods of instruction, what topics I wanted them to explore, and how much time I wanted them to work on it.

PSTs seemed to be motivated by additional responsibility, and this, coupled with their interest in assisting their 5th grader, often drove them to invest more time and energy into lesson preparation.

PSTs' Interactions with Elementary Students. C2 PSTs worked one-on-one with a 5th grader during 4 or 5, two-hour Zoom sessions. This extended interaction allowed them to develop a relationship with their student, understand and anticipate their needs, and structure their sessions accordingly. The instructors and teaching assistants would occasionally drop into Zoom sessions for a few minutes, but the PSTs bore the primary responsibility for executing the lesson and meeting its goals. The PSTs were encouraged to learn with, and even from, their 5th grader partners: in some cases, the elementary students had more prior experience with coding or robotics than their partner PSTs.

What we learned was that PSTs learned from their elementary students and enjoyed interacting with them but faced many challenges. Most of the challenges were technical (e.g., unreliable internet, difficulty seeing/hearing students), but many PSTs also discussed difficulty maintaining student engagement, especially given home distractions (e.g., pets, family members). As one PST articulated: "two hours is a really long platform for a fifth-grader on a Zoom call." PSTs noted that the online nature of the robotics project taught their 5th grade partners to be independent. As one PST pointed out, she could not manipulate the hardware or software *for* the students, and her 5th grader "built her robot completely on her own." Another PST noticed that her student "had to be a little more self-motivated, especially when he became frustrated." Yet another recounted having her father, who was listening to her Zoom lesson, laugh when her 5th grader partner

said to her "Well, why don't you just try to do it this way? *Duh*." Instead of being intimidated or insulted by the student's remark, the PST was empowered, responding:

> ...it was the truth. He was able to come up with his own ideas in problem-solving. And I was like, 'Well, we're both good then if we both can just come up with ideas and figure it out and learn as we go.'

The PST's developing confidence and positive relationship with her 5th grade partner helped her see the benefit in learning from an elementary student.

Providing Resources for Virtual Learning. Prior to the transition, the plan was for each team to design and build a single robot. When the meetings went online, this was no longer feasible. Without being in the same geographic location, the teams could not work collaboratively on a single artifact unless they were only to guide the 5th grade students in their production. It was determined that all participants would benefit from designing and building their own robots, but to do so based on a communally decided theme. So, each team determined a global challenge that their robot would address and a bio-inspired solution to address it; for example, one team designed seal-inspired robots that could collect trash in the ocean and attract other seals to study migration patterns (Figure 5). Each team member was encouraged, but not required, to build their own robot accordingly. Robotics kits were offered to all participants. This new task of independently building a robot was in addition to the challenge of reconfiguring their lessons for online delivery, adding stress for some PSTs. A few of the PSTs opted not to build their own robot, but the great majority did.

Figure 5. Seal-inspired Robots.

What we learned was that PSTs valued access to the robotics kits and they learned and gained confidence from building their own robots. As one PST explained:

> I think a benefit to moving online was we got our robotics kits mailed to us and so we ended up with a lot more time … to mess with [it] on our own … I was able to code and play with things before the meeting when I had time ... I wouldn't have had access to [it] if it were just the normal in-class meetings.

PSTs reported that building their own robots helped them teach their elementary partners by preparing them for what to expect and by producing models to share with their students. One PST explained that she was able to "try to build the project before our lesson giving me a better idea what problems we may run into and allowing me to create solutions before they arise." They added that the kits also enhanced the PSTs' ability to learn alongside students, "By everyone attempting to create the same thing at the same time we were able to problem solve together, everyone bringing different solutions." Another PST expressed pride in her accomplishment of building a robot: "I can't wait to take my experiences and share with my future students and tell them I was an engineer!"

Faculty and Peer Support for PSTs. The shift to a virtual context meant that the C2 teams had to implement their lessons in physical isolation from their instructors and classmates. This generally resulted in less overall guidance for the PSTs and more reliance on their assigned engineering partner.

What we learned was that some UESs provided excellent support to the PSTs, while a few engineering students struggled with the project due to outside conflicts that were sometimes COVID-related. PSTs partnered with underperforming UESs were challenged to assume additional responsibilities and guide their 5th grader to completion independently. Those who managed successfully often gained confidence. One PST explained:

> After realizing I was not going to have the engineering partner with me in-person to help with the coding, I was definitely not confident that I would be able to accomplish much with this project. But once I started working on my own, I realized it wasn't so bad and gained confidence after learning to do it on my own.

Another PST, however, required intervention from a faculty member to assist her 5th grade partner when her UES was unresponsive. In general, PSTs responded well to support from faculty. This was especially true when encouragement was provided in the context of autonomy. One PST explained that her instructor "really encouraged us that it was okay to learn with our students. That we weren't expected to know everything. And I think that that gave me some confidence to be willing to try out some new things technology-wise." This supports Kaplan-Rakowski's (2020) assertion that emotional support should be prioritized over efficiency of learning especially when the world is rapidly shifting to online learning during a global pandemic. The need for additional emotional support during this time is attributed to the impact that the pandemic had in exacerbating mental health conditions, such as depression and anxiety, in both adults and children alike (Rajkumar, 2020). Another PST explained how the limited guidance from faculty inspired her to exert more effort in her preparation:

> We only got a certain amount of instruction. So, I feel like a lot of this project was, kinda, up to the students to, kinda, figure out. So... I was googling, like, making sure I had the right definitions, and everything made sense because I didn't wanna go and teach my students something that was incorrect.

LESSONS LEARNED FOR RESEARCH

Much of the research in online education has focused on developing and evaluating technologies to enhance online learning. However, our experience with PSTs in 2020 suggests that teacher educators need to focus on developing and evaluating opportunities for online teaching. More specifically, research is needed to identify successful strategies for PSTs to interact virtually with K-12 students, both synchronously and asynchronously, and to evaluate the impact of those interactions on PSTs' learning. If teacher educators rely exclusively on formal field placements to provide these opportunities, there is little chance that PSTs will have the experience they need for a post-COVID-19 educational reality. A research agenda calling for innovative approaches to providing virtual teaching experiences is imperative.

To this end, we propose research into PST participation in the creation of asynchronous instructional materials, such as virtual field trips, simulations, and other media-rich presentations; PST interaction with K-12 students via asynchronous tools (e.g., Seesaw, Flipgrid, Quizizz); and PST participation in synchronous instructional exchanges, especially lessons delivered with web-based meetings tools (e.g., Zoom) and instructor-paced presentation tools (e.g., PearDeck). In methods classes and instructional technology courses, PSTs are often asked to create lesson resources that are never leveraged with K-12 students. The PSTs' experiences in our Spring 2020 implementation are a reminder of the motivational and learning benefits of PSTs' direct interaction with K-12 students. We call upon teacher educators to organize class-based virtual field experiences that provide an authentic K-12 audience for PSTs' learning artifacts. Such experiences can occur both during and after school and in both formal and informal contexts and can serve a dual purpose: to provide personalized virtual interaction for K-12 students and to provide PSTs with meaningful online teaching experience.

Finally, as a follow up to the PSTs' reflections shared here, we suggest that more research is needed to understand how to structure PSTs' online teaching experiences in order to provide a continuum of autonomy that PSTs can access based on their confidence level. While all students are likely to benefit from some degree of autonomy, students with more confidence may be better positioned to benefit from greater freedom in their design of online interactions with K-12 students, whereas less confident PSTs may benefit from greater structure. Research is needed in order to understand how to appropriately scaffold PSTs' virtual field experiences.

LESSONS LEARNED FOR PRACTICE

Many teacher educators advocate for preparing PSTs for online teaching; however, a large number of teacher educators continue to promote face-to-face rather than online experiences (Kennedy & Archambault, 2012). However, the findings

from our project as well as those documented by other researchers (Kier & Clark, 2020; Koch & Vu, 2020) assert that teacher educators can, and should, provide meaningful opportunities for PSTs to interact virtually with K-12 students, even post-COVID-19. By ignoring this often untapped, rich resource, teacher educators preclude worthwhile field experiences. Mishra and Koehler (2006) defined the technological pedagogical content knowledge (TPACK) teachers require to effectively utilize educational technology, but recent research suggests PSTs lack sufficient TPACK (Wang et al., 2018). It is the responsibility of teacher educators to organize and establish effective virtual field experiences to cultivate this knowledge in PSTs.

The intention of this chapter is to shed light on the benefits and challenges of synchronous and asynchronous field experiences, to add to the literature about PSTs' experiences with these methods, and to offer suggestions on how teacher educators can structure them. Our experience in Spring 2020 found that *asynchronous* field experience with elementary students helped PSTs:

- Learn how to create engaging presentations for asynchronous interaction;
- Gain experience with educational technology tools (e.g., Google Suite products, Kahoot);
- Develop pedagogical strategies for online learning (e.g., ways to maintain student engagement);
- Consider equity issues regarding resources (both digital and physical); and
- Practice effective virtual communication and collaboration with project team members and faculty.

Synchronous one-on-one collaboration with elementary students provided a unique opportunity for PSTs to gain technical expertise and pedagogical knowledge, both generally, and specific to online teaching. PSTs found their interactions with elementary students motivating and beneficial. Specifically, they:

- Gained experience with educational tech tools (e.g., Zoom, navigating multiple platforms);
- Learned how to support and foster elementary students' independence;
- Gained appreciation for learning alongside students; and
- Gained valuable STEM skills.

Our Spring 2020 experience indicated that PSTs gained valuable skills while preparing for and teaching asynchronous and synchronous engineering lessons and developed different skills in each context. Thus, we suggest that teacher educators prepare PSTs to utilize both types of online interaction.

The Ed+gineering project successfully guided PSTs in transitioning hands-on engineering lessons to virtual learning experiences for elementary students by providing them with adequate resources and support. We offer the following suggestions for structuring virtual field experiences based on our experience from Spring 2020:

1) Leverage the motivational power of interactions with K-12 students. Our PSTs were energized by their interactions with youth, and this energy focused their attention on lesson preparation. We recommend designing field experiences to maximize the potential for back and forth interaction between PSTs and K-12 students. PSTs benefit from understanding how well their instructional materials meet the needs of their intended audience.

2) Allow PSTs to make instructional decisions. Our PSTs benefitted from exploring issues of equity in relation to determining the supplies K-12 students would use in their engineering designs; structuring lessons to address students' interests and needs; and troubleshooting emergent concerns. In our experience, allowing PSTs autonomy and ownership in deciding the materials for their lesson were likely to inspire greater investment in their lesson preparations.

3) Model online instruction, but provide space for PSTs to make non-trivial decisions as explained above. Our experience suggested that the PSTs early in their programs appreciated and benefitted from the lesson templates we provided, while our more experienced PSTs were ready for more creative freedom.

4) Structure virtual field experiences to enable support from peers as well as instructors. Our PSTs drew upon support from their teammates as they ventured into the new experience of teaching online. If we had to provide individual support for all of our PSTs, our task would have proven far more challenging. PSTs benefited from seeing product examples from their teammates and faculty and were encouraged by interactions with engineering and elementary student partners. Through these experiences, PSTs who initially felt overwhelmed by the task developed increased confidence and competence.

If virtual field experiences can be designed intentionally with consideration of the potential challenges and benefits of online teaching interactions, rather than quickly adapted in response to a pandemic, they offer tremendous potential for PST learning and confidence building. Furthermore, the integration of virtual field experiences into teacher preparation will produce a cadre of teachers much better prepared for virtual schooling to meet future needs.

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Using Knowledge of Effective Pedagogy to Design Online Learning Experiences: Restructuring Teacher Education Coursework to Reflect Virtual Learning Shifts

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Abstract: The purpose of this chapter is to share lessons learned during the experience of three teacher educators working through a redesign of a Technology in the Classroom course in response to COVID-19 school closures and an abrupt pivot to online learning in PK-12 schools. A literature review was conducted to determine what is known about high quality face-to-face teaching and apply that knowledge to decisions for transitioning to online course delivery. Outcomes focused on organization, clarity, connecting research-based best practice with educational technology, and facilitating the use of technology tools used by practicing professionals. These outcomes were combined with the experience of moving a class online to create implications to improve teacher education course design and to better prepare aspiring teachers for the potential of future online learning needs.

Lesson Learned: Teacher educators should have learned to draw from expertise and research on effective face-to-face instruction to inform the design of effective online learning experiences.

**AN INTRODUCTION TO USING KNOWLEDGE OF EFFECTIVE FACE-TO-FACE PEDAGOGY
TO INFORM ONLINE LEARNING COURSE DESIGN**

Incorporating technology into education is not a new effort. Educational technology has been around for decades, and most schools have intermittently grappled with how to implement new products and services to best serve teachers and students. But, when the COVID-19 pandemic caused long-term school closures, teachers were asked to quickly pivot to teaching exclusively online. Many teachers scrambled to figure out online learning platforms and how to build meaningful virtual learning experiences for students. Many teachers were overwhelmed at the thought of teaching online and having to learn a new teaching approach in the midst of their careers. This reaction provided evidence that teacher education programs have not done enough to prepare future teachers for teaching online.

The abrupt switch to virtual teaching impacted teacher education programs and prompted teacher educators to re-evaluate and adapt course projects, content, and field experiences to better reflect current needs in the teaching field. Though the online tools and platforms were new to many, knowledge of high-quality pedagogy remained. As teacher educators experiencing an imperative need for more online teaching exposure for future teachers, we learned to draw from expertise and research on effective face-to-face instruction to inform the design of online learning experiences to better equip and empower teacher candidates to enter confidently into an evolving field.

 Even outside of pandemic-related online teaching needs, more awareness of and practice in high-quality online lesson delivery can only strengthen teacher education programs in preparing teacher candidates. For example, virtual schools have increased in attention and popularity as a choice for education (Molnar et al., 2019), and graduates of teacher education programs may take jobs teaching in online settings. Teachers may need to design and implement summer school opportunities to decrease the loss of learning over the break, which is a known contributor to opportunity and achievement gaps (Smith, 2012). Or teachers might use educational technology to offer homework support or learning extension activity during after school hours. Perhaps teachers will begin connecting with students while they are at home sick or in cases of inclement weather when schools must close. Improved knowledge, skills, and dispositions for online learning delivery will be a part of future teachers' careers regardless of the length of the pandemic and should become an integral component of teacher education.

Though the transition to online course delivery may be challenging and overwhelming for some teacher educators, starting with a known effective or engaging face-to-face pedagogy and adapting it to an appropriate technology can result in engaging online instruction. This chapter shares the lessons learned by three teacher educators while restructuring an early childhood and elementary education methods course focused on incorporating technology in the classroom at a mid-sized university in south Louisiana in response to pandemic-related virtual teaching needs.

WHAT WE KNOW

Teacher education programs know effective pedagogy. Programs often focus on supporting teacher candidates in developing knowledge and skills about lesson planning, creating engaging and inclusive classroom environments, and implementing a variety of instructional strategies and assessment practices (Darling-Hammond, Hammerness, Grossman, Rust, & Shulman, 2005). Yet insufficient time is dedicated to teaching and modeling how traditional face-to-face pedagogy can be matched with appropriate technology to support effective teaching in an online format (Duncan & Barnett, 2009; Moore-Adams, Jones, & Cohen, 2016). A 2012 study found that only 1.3% of US teacher education programs responding to a national survey were preparing educators for teaching in online settings through online field experiences (Kennedy & Archambault, 2012). A follow-up study published in 2016 found that only 3.5% of responding teacher education programs indicated addressing online learning field experiences and pedagogy in their teacher education programs, a very small increase (Archambault, Kennedy, Shelton, Dalal, McAllister, & Huyett, 2016).

Though past studies have indicated a need for more online pedagogy in teacher education, pandemic-related school closures created a sense of urgency to make the change. The following sections summarize research on five important factors considered by three teacher educators while transitioning from face-to-face to online teacher education course design in response to the urgent need for more online pedagogy in teacher education. The five factors include: (1) organization, clarity, and purpose, (2) developing connection amongst students and instructor, (3) maximizing use of live facilitation and interaction, (4) collaboration and iterative growth in lesson design, and (5) providing opportunities for real world application and generation of knowledge.

Importance of Organization, Clarity, and Purpose in Coursework

One of the first items to consider when transitioning a course to an online format is structure and organization. Research on cognitive load theory (CLT) can provide some insights on how course organization and clarity of information presented can impact learning in online contexts. CLT considers how the limited human capacity to process information can result in cognitive overload, resulting in negative impact on learning (Sweller, 2004; Sweller & Chandler, 2009; Mayer & Moreno, 2003). Cognitive load can be viewed as intrinsic when it refers to the load due to the complexity of the learning task or concepts being learned, or extraneous, when it refers to load from factors outside of the learning task such as course organization and structure (Sweller & Chandler, 2009). Research suggests that one can reduce intrinsic cognitive load through varying instructional strategies and breaking learning tasks into smaller more manageable parts (Van Merrienboer & Ayres, 2005). One can reduce extraneous cognitive load through clear and consistent course structure and clarity of purpose for learning tasks (Allen, 2007).

He (2014) conducted a case study in an online teacher education course that was designed based on Universal Design for Learning (UDL) principles and found that online course organization was a valued part of the course design. This echoes research showing students in online learning environments relate satisfaction to the perception that they are assisted with their learning through course organization, clarity of information presented, and access to and quality of feedback from the instructor (Young & Duncan, 2014; Asoodor, Vaezi, & Izanloo, 2016). However, organization alone will not ensure course effectiveness. He (2014) also found that instructor presence and prompt feedback were essential components of the online teacher education course under investigation. Next, we summarize what we know about developing human connection in online coursework.

Importance of Developing Connection amongst Students and Instructor

In online learning environments, research shows the importance of consistent connection amongst students and between students and their instructor (Clayton, Blumberg, & Anthony, 2018; Ali, Hodson-Carlton, & Ryan, 2004). These connections can be more challenging to model and facilitate in an online learning environment. However, Joyner et al. (2014) studied what helped students connect to their instructors in an online graduate course and found two emerging themes from student responses. First, students felt they connected with one another through online discussions and with the instructor via synchronous meetings. Second, students felt that having interactive course elements contributed to the connection they felt with their instructor. Teacher education researchers in Indonesia studied teacher candidate perceptions of using social networking services to ease communication efforts between teacher candidates and between teacher candidates and the instructor. By using online media such as *WhatsApp*, *Google Forms*, *Facebook*, *Twitter*, *YouTube*, or other media that facilitated collaboration, communication, and interactive learning, they found teacher candidates were able to collaborate, interact, and receive prompt feedback (Habibi et al., 2018).

Lowenthal (2009) looked at several theories of social presence in a study focused on describing how students and instructors interact in online courses where they are mostly interacting asynchronously. There are a variety of definitions of social presence in an online course ranging from the extent to which instructors and students project themselves as "real" people (Garrison et al., 2000) to a student's sense of belonging in an online course (Picciano, 2002). Though social presence in an online course is difficult to define or study, researchers have found a relationship between social presence and online course student satisfaction (Hostetter & Busch, 2006; Swan & Shih, 2005). We know that simply placing content into an online platform does not reflect awareness of the need for connection amongst students and instructors. Connections develop through facilitation strategies employed by the instructor within the course design. Next, we share what we know about maximizing the use of synchronous class facilitation.

Importance of Maximizing Use of Live Facilitation and Interaction

When delivering instruction online, it can be challenging to determine what components of the learning experience can and should be conducted synchronously as opposed to asynchronously. *Synchronous* instruction means the teaching is happening in real time over platforms such as *Zoom*, *Google Meet*, or other tools allowing for live audio and video streaming. *Asynchronous* instruction occurs when teachers provide content, discussion forums, or other forms of teaching tools that students can consume or complete at their own time and pace.

Bishop and Verleger (2013) described a meaningful method of determining what course information can be delivered asynchronously versus synchronously in their work studying the idea of a flipped classroom. In a flipped classroom, teachers decide what information can be taken in by students on their own in order to leverage synchronous live time with students for facilitation and application with immediate support from the teacher (Bishop & Verleger, 2013). Content, such as articles, videos, and textbook chapters, may be delivered asynchronously at the front end of a lesson in preparation for a real-time discussion and application work with the teacher on-hand for feedback and support. Dooly and Sadler (2020) applied the flipped classroom concept to a collaborative teacher education course conducted by two partner universities located in the USA and Europe. The researchers combined the flipped classroom approach with virtual communication and dialogue during online coursework. Researchers found providing the flipped materials to teacher candidates in advance of communication portions of the course design were initially met with some resistance but eventually challenged teacher candidates to self-manage preparatory activities.

Another effective pedagogy traditionally used in face-to-face settings is presenting new content in a just-in-time manner. Just-in-time teaching (JiTT) provides students with short, thought-provoking assignments for reflection before providing formal content (Novak, 2011). Students are asked to provide or apply their current best thinking about a particular topic before new content is provided. With this approach, students are building new knowledge on the foundation of prior knowledge. The Just-in-Time approach has also shown benefits in teacher education. Greenhalgh and Koehler (2016) looked at ways Twitter has made just-in-time learning possible for continued teacher professional development and allowed new and veteran teachers to engage in discourse to extend learning. The researchers noted the need for just-in-time learning that is driven by teachers and is flexible in nature so that the learners can continue in a natural direction related to need.

When determining facilitation strategies for online teacher education coursework, we know elements of a flipped classroom and approach and providing just-in-time content knowledge or access to veteran teacher dialogue can aid in the process of building effective coursework. From these approaches, we noticed a trend of partnering each content delivery method with an opportunity for collaboration and discussion focused on continued growth and learning. In the next section, we share what we know about the importance of collaboration and iterative and continued growth in teacher education.

Importance of Collaboration and Iterative Growth in Lesson Design

Collaboration in the teaching profession has been connected to student achievement and higher job satisfaction (Reeves, Pun, & Chung, 2017). Teacher education coursework should provide opportunities for collaboration between teacher candidates as a way to build collaborative skills. Teacher candidates also need opportunities to simulate and rehearse lesson delivery practice (Darling-Hammond, 2006; Grossman, Hammerness, & McDonald, 2009). Furthermore, a recent Programme for International Student Assessment (PISA) test showed results on collaborative problem solving with significant deficiencies in student competencies related to collaboration (Fiore, Graesser, & Greiff, 2018). More exposure to collaborative work in teacher education may build teacher collaborative competencies while also modeling how to facilitate collaborative problem solving with their own future students.

A common teacher collaborative structure used in many schools and districts is to designate weekly time and support for professional learning communities (PLCs), defined as inclusive groups of people who continuously seek, share, and act on their learning to enhance their student-centered effectiveness (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). Because PLCs are widely employed in school settings, teacher educators can consider exposing teacher candidates to this process of practicing professionals studying their own practice for continued, student-centered growth.

With the idea of sustained professional growth in mind, teacher educators can draw from the work on developing a growth mindset in students. Growth mindset is the understanding that one's skill level is not fixed but can change as a result of effort and practice (Dweck, 2016). One way to systematically commit to continued growth is through an iterative process of collaborative feedback to redesign and improve lesson plans. The Japanese Lesson Study approach encourages teachers to work together to design a "research lesson" that includes goals, procedures to make student learning visible, anticipated student responses, and points of evaluation (Lewis & Hurd, 2011; Stigler & Hiebert, 1999). The research lesson is observed by the Lesson Study team and revised to improve future implementation. Finally, the Lesson Study team shares their learning from the iterative process.

Research on Lesson Study is nascent in teacher education (Sorton Larssen et al., 2018), but Fernandez (2010) found that participation can provide opportunities for teacher candidates to build pedagogical content knowledge, collaborative

skills, and inquiry dispositions as they work through the cycle of improvement. By incorporating components of Lesson Study in teacher education, along with the development of a growth mindset, programs might better prepare future teachers to view mistakes as opportunities for growth and to continuously and systematically seek out ways to improve their practice. In order to fully engage in improvement efforts, teacher candidates need opportunities to apply and generate new knowledge for their future field, which we expand upon in the following section.

Importance of Providing Opportunities for Real World Application and Generation of Knowledge

One long-standing staple in teacher education programs is teaching the hierarchy of learning objectives in Bloom's taxonomy. The taxonomy showcases different levels of learning that occur when a student is asked to recall specific facts versus asking a student to critically evaluate material for its worth or purpose. The continuum begins with a surface level learning experience, or recalling knowledge, and moves up into comprehension of information, application of information in concrete situations, analysis of information, evaluation and critique, and finally creating or generating one's own plan or product (Armstrong, 2010). Because teacher education programs expect teacher candidates to provide rich learning experiences in the higher levels of Bloom's taxonomy when they enter their own classrooms, teacher education programs should look for ways to immerse candidates in those same higher levels during coursework. There are several trends in effective pedagogy that build on the higher levels of Bloom's that can inform teacher education online course design.

Maker-centered learning. Research on maker-centered learning and its inclusion in classroom settings, including teacher education, is evolving. Maker-centered learning brings systems thinking, tinkering, collaboration, and problem solving into the educational setting (Clapp, Ross, Ryan, Tishman, 2016). Some of the benefits of maker-centered learning include hands-on experiences, increased awareness of objects and society as systems with working parts, growing a sense of maker empowerment to see one's world as malleable, and developing the courage and resilience to engage as an active participant in the world. Makerspaces are exciting, idea-generating spaces where learning is collaborative, interdisciplinary, shared, and driven by interest.

Design thinking. Another body of research focused on design thinking in educational realms is expanding. Design thinking is a human-centered approach to problem solving that includes a process and protocols to approach challenges as an agent of change (Cross, 2007, 2011). Design is a creative act, focused on solving complex, ill-structured problems (Nelson & Stolterman, 2003). Teachers, as designers of educational experiences, design lessons to meet the needs of diverse learners, engage students in meaningful activities, design ways to connect and involve parents, and design strategies to effectively assess student learning (Henriksen, Richardson, Mehta, 2017). The use of design thinking as an approach for solving professional problems of practice is growing (Henriksen, Gretter & Richardson, 2020; Henriksen, Richardson, Mehta, 2017; Koh, Chai, Wong, 2015; Williams, Barber, Lai, & Dolenc, 2016). There are many variations in processes, activities, and habits of mind that fall under *design thinking* (Plattner, H., Meinel, C., & Leifer, 2012; Rauth, Köppen, Jobst, & Meinel, 2010; Cross, 2007; Nelson & Stolterman, 2003). In our work as teacher educators, we use the processes and habits of mind promoted at the Institute of Design at Stanford (d.School; http://dschool.stanford.edu/) with teacher candidates to address issues and create possible solutions for problems in education.

Performance-based assessment. Also, teacher candidates need opportunities to engage in performance-based assessments, such as lesson plan development and implementation. Performance-based assessment occurs when students are evaluated through an application of knowledge, skill, and effort as showcased in a performance of tasks that are meaningful and engaging to the student (Hibbard, 1996). It is important to model the use of alternate forms of assessment to inform teacher candidates' future practice.

Learning the digital tools of the practitioner. The myriad of digital tools and platforms provides a challenge for selecting tools most likely to be adopted by students and teachers. Perceived characteristics of an innovation accounts for 49% to 87% of variance in the rate of adoption (Rogers, 2003). To increase the likelihood of adoption and diffusion, educational technologies should have the following characteristics: (a) *relative advantage*: teachers clearly see the platform is better than current solutions, (b) *compatibility:* the tool fits with the values of teachers, the realities of classroom contexts, and the need to support hybrid/online teaching, (c) *complexity:* the tools/resources are perceived as easy to use and understand, and (d) *trialability:* the tools are easy to try out with limited commitment and effort, and (e) observability: teachers quickly "get" the value of the platform.

LESSONS LEARNED FOR RESEARCH

In the previous section, we presented five sections on what we know from research on effective pedagogy. As we pulled the research together to inform a transition from face-to-face to online teacher education course design, we recognized gaps in the literature that may beckon future teacher education research needs. There was already a need for more knowledge on ideal methods for preparing highly effective teachers (Jenset, Klette, & Hammerness, 2018), but when the pandemic closed schools, there was a pressing need for enhanced preparation in virtual teaching practices. As teacher education programs seek to address this need, researchers should explore how teacher candidates' use their learning about integrating technology in their future classrooms. How do the online learning experiences teacher candidates had in teacher education programs influence their practice in PK-12 settings? How do teacher candidates use technology to support their students' who may be sick or need extra support to meet learning goals?

Cognitive load theory (CLT) provides a helpful framework for thinking about how teacher educators can reduce intrinsic cognitive load (due to the complexity of the learning task) and extraneous cognitive load (due to factors outside of the learning task) through a clear course organization and structure and creating learning tasks that are manageable considering the constraints of online learning (De Jong, 2010). Yet, more research is needed to understand how to best support teacher candidates in online learning contexts. Which course design elements are most important for reducing cognitive load? How might we reduce cognitive load during online learning field experiences? How can teacher candidate online learning experiences influence their own practice when teaching children in their future classrooms? Further research can extend and deepen our understanding of the factors most important for supporting teacher candidates.

Furthermore, because we know the importance of developing connections amongst students and their instructor (Clayton, Blumberg, & Anthony, 2018; Ali, Hodson-Carlton, & Ryan, 2004), researchers can study teacher candidates' experiences in the ways instructors built relationships during the pandemic. Presently, little is known about students' preferences related to learning formats when given opportunities to choose among online, hybrid, and face-to-face courses (Clayton, Blumberg, & Anthony, 2018). Therefore, researchers could also explore the relationship between how teacher educators nurtured connections and how that impacted the preferences and perceptions of online learning.

Additionally, researchers can learn more about the experiences of in-service teachers who moved to online learning in spring 2020 as they were expected to become quick experts of using technology to instruct and facilitate learning. Are teachers using the flipped classroom approach (Bishop & Verleger, 2013) or Just-in-Time teaching (Novak, 2011)? If so, are they seeing student growth? Future research might synthesize teacher and student experiences and the impact of the change on student performance and engagement in order to determine future steps in merging online and face-to-face instruction post-pandemic. School districts and teacher education programs alike would benefit from more knowledge of processes to effectively pivot to online learning in a timely manner while also remaining cognizant of selecting educational technology that adheres to known effective teaching practices.

We also suggest more research on how equipping teacher candidates with processes for leading change in their future careers might connect with inservice teacher expectations and the need for incorporating more educational technology. New and experienced teachers can offer experience and skill in change processes to lead online learning transitions in schools, reflecting the idea of teachers as designers of learning experiences (Henriksen, Richardson, Mehta, 2017). We suggest teacher education researchers look for opportunities to expand upon the use of design thinking as a process to equip teacher candidates to make positive, student-centered change (Henriksen, Gretter & Richardson, 2020; Henriksen, Richardson, Mehta, 2017; Koh, Chai, Wong, 2015; Williams, Barber, Lai, & Dolenc, 2016).

However, even if teacher education empowers future teachers to influence student-centered improvements in their future careers, many teachers do not feel their voices are heard or valued when schools or districts make decisions and mandates. A recent national survey of educators revealed only 32% of teachers felt their voices were heard at the school decision-making level and only 12-15% of teachers felt their voices were heard at the state or federal policy level (Educators for Excellence, 2020). Therefore, more research is needed on how to offer more autonomy and voice in teaching careers if we hope to see the fruits of improvements made in teacher education.

LESSONS LEARNED FOR PRACTICE

Thanks to continued research and improvements, educational technology and online learning have continuously evolved and become more prevalent over the past few decades. Many teacher education programs have shifted to include

more of a focus on educational technology and online learning in order to stay current with educational trends. However, Covid-19 unmasked issues in teacher education that called for immediate enhanced modeling of high-quality online instruction that respected and reflected the existing body of knowledge regarding high quality face-to-face teaching pedagogy. In the following sections, we share five specific lessons learned and practical implications for teacher educators to consider for their practice.

Lesson 1: Create Clear Organization, Clarity, and Purpose in Course Design

One of the biggest challenges with transitioning to online learning was figuring out where to begin. At our university, we use *Moodle* as our Learning Management System (LMS) while surrounding school districts use *Google Classroom* to organize virtual learning. Per the research that states learners are more successful when instruction is broken into manageable parts (Van Merrienboer & Ayres, 2005), we decided to organize *Moodle* pages in ways that provided clarity and organization for teacher candidates. We modeled this while giving them an example option for establishing their own system for organizing online learning modules in *Google Classroom* sites. As we taught our courses using *Moodle*, we also provided teacher candidates with experience setting up a *Google Classroom* and lesson topics with a similar organization strategy.

This organization in the online course intended to scaffold learning goals in a manageable way while also offering consistent opportunities for self-reflection, new content knowledge, rich discussion, and application. One teacher educator pulled from a previous online learning experience, with Dr. Nancy Dana at the University of Florida, as a model for organizational structure. Dr. Dana organized each week of one of her doctoral courses into a four-part progression: 1) Thought Question, 2) Content, 3) Discussion, and 4) Application. With the research and this four-part progression in mind, we created courses that had clear structure and purposeful flow. In the following lessons, we share more about what we learned and that other teacher educators can consider when building out each part of the progression based on what we know from research.

Teacher educators should model clear and consistent organization of content and activities in their specific course learning management system or the learning management system that will be available to their teacher candidates upon graduation. A simple structure that clearly illustrates how the content connects to practice (e.g., thought question, content, discussion, application) can significantly reduce extraneous cognitive load (Allen, 2007) and help teacher candidates understand the purpose of the activities situated together under one topic. We suggest creating modules organized by weekly topics within the LMS. Then, each topic section should be built out using a progression that remains consistent each week. Use each part of the weekly progression to break up complex learning tasks into manageable chunks to reduce intrinsic cognitive load (Van Merrienboer & Ayres, 2005). Finally, teacher educators can enhance clarity with prompt and thorough feedback (Asoodor, Vaezi, & Izanloo, 2016; He, 2014; Young & Duncan, 2014).

Lesson 2: Consistently Use Learning Tools that Facilitate Connection and Interaction

We know from research that it is important to foster connections amongst participants in online coursework (Clayton, Blumberg, & Anthony, 2018; Ali, Hodson-Carlton, & Ryan, 2004). To facilitate connection amongst teacher candidates in our own 16-week course, instructors used a *Thought Question* to launch each new week's module. Just-in-time teaching provides students with a thought-provoking assignment for reflection before providing formal content (Novak, 2011). With this in mind, the thought question provided a space for reflection and discussion before teacher candidates were presented with content each week. Teacher candidates shared their current best thinking on the upcoming topic and built connections amongst one another by replying to classmates in their discussions. Two example thought questions were: (1) What does it mean to develop a sense of maker empowerment? and (2) After digging deeper into your educational issues, what new insight do you have about your problem and who it affects?

Teacher educators can build connections and interactions in an online environment through live discussions, interactive course elements (Joyner et al., 2014), and by establishing and sustaining a social presence in the course (Lowenthal, 2009). We suggest systematically building opportunities for online peer discussion and live discussion into the organizational structure of each week. For example, teacher educators can begin each week with a forum designed for student reflection and connection. To make the course more interactive, another contributor to student satisfaction, we suggest ro-

tating text-heavy forum discussions with audio/video recording platforms that allow for a similar exchange but in a way that may establish more of a social or human presence in the course.

Teacher educators should try educational technology tools designed to mimic in-person exchanges between students and instructors. After trying out several different online discussion tools to facilitate sharing in the thought question, we learned that students appreciated an easy-to-use platform that was free and accessible and would be an available option to them in their own future classrooms. One platform we found useful for the video exchanges was *Flipgrid* because of its usability. This initial experience each week should activate existing knowledge, allowing students to share their current thinking with their fellow learners and instructor as a base to build upon.

Lesson 3: Leverage Synchronous Instructional Time by Using the Flipped Classroom Approach

Once a basis of existing knowledge was built through the thought question, we moved into presenting content immediately following the reflective activity, which modeled the use of just-in-time teaching (Novak, 2011). In developing the *Content* section, the second part of our four-part organizational progression of the weekly online learning modules, we drew from the idea of a flipped classroom, where teachers decide what information can be taken in by students outside of class time so that more attention to facilitation and application can dominate the time spent with the teacher (Bishop & Verleger, 2013). To reflect this ideal, instructors worked on building out the content section to follow the thought question as a way to build background and content knowledge on the weekly topic. The content became a place to push existing thinking through topic-related content in a just-in-time way. We learned that this effective teaching strategy used in face-to-face settings could be transitioned for online use by following the thought questions with related content designed to present further insight into the research or practice around the topic.

Teacher educators can use the flipped classroom and just-in-time teaching approach in online course design and implementation. We suggest building in a content section to each weekly learning module immediately following their initial reflective activity, or what we called the thought question. In this section, instructors can provide content in the form of book chapters, videos created by instructors or found online, TED Talks from professionals in the field, and/or journal articles. However, the content should not stand on its own. Teacher educators can provide prompts for students to consider and ponder as they consume the content. When given opportunities to engage in reflective activities first, then receiving content to build onto base knowledge along with pondering questions, teacher candidates will be primed for rich discussion and application of their growing content knowledge. To continue the development of connection, interaction, and social presence, we suggest incorporating synchronous meetings into course progressions when possible. With background reflection and knowledge established, live meetings can focus on discussion and application of the content rather than using synchronous time to pack in lecture-heavy content.

Lesson 4: Build in Opportunities for Collaboration and Iterative Growth

Expanding on the idea of consuming content asynchronously to maximize instructional face-to-face time, we followed the introduction of new content in our course weekly module set up with a section we titled *Discussion*. We hoped live discussions held virtually would still allow for the open dialogue that occurred in previous face-to-face settings. Most discussions were held synchronously via *Zoom* once per week, so we housed a *Zoom* link under the discussion heading along with a list of topics for discussion.

Research shows evidence that elementary students are capable of leading discussions for their peers and can even bring discussions to higher levels of thinking, awareness, and understanding (Morrison, 2017). Therefore, we wanted early childhood and elementary teacher candidates to model leading discussions that were open-ended and allowed for perspective sharing. We placed teacher candidates in teams to lead discussions centered on book chapters and highlighted this approach as an effective teaching strategy. To scaffold teacher candidates toward success, teacher educators should model leading the first discussion facilitation and offer a checklist of tips for teacher candidates to use in preparation for leading future discussions. We suggest using the following tips to lead a model discussion and to offer guidance to teacher candidates on discussion facilitation with peers:

- Provide a specific task for peers to bring to the discussion such as a powerful quote that stood out or specific sections they found relatable.
- Begin your discussion by stating a goal related to peer involvement and engagement.
- Open your discussion with an open-ended question for the group.
- Encourage peers to add on to responses or to extend another person's thought.
- Discussion should be audience-centered and achieve rich discourse among peers, not just from the facilitators.
- Close with overall takeaways and one new question to consider.

To increase collaboration and connection in online coursework, teacher candidates should explore ways to facilitate as a guide on the side, rather than taking an assertive approach to a more traditional question and answer format. The peer-led discussions allowed teacher candidates to take a leadership role in the course content and provided opportunities for students to develop expertise on the topics they were planning to lead. Unprompted, many students created presentations to help stay on track and divided up tasks amongst team members. And because students knew the student-centered expectations for the discussions, the students not leading the discussion seemed eager to participate in support of peers.

Another way to build in collaboration and connection is through lesson planning and improvement processes. Teacher educators should consider ways to encourage iterative lesson design focused on continuous improvement based on feedback and reflection. To provide this in an online format, we presented a lesson plan template, and then walked teacher candidates through each part in a live *Zoom* meeting, providing examples and answering questions along the way. Next, we provided model video lesson plans either found online or from virtual lessons we created as examples over the summer of 2020. We learned that some teacher candidates struggled to understand the purpose of each part of the lesson plan template, so we created a video going back through the steps of the lesson plan and why each piece was purposefully placed. This way, teacher candidates could refer back to the video before, during, and after the development of their own lessons. We suggest teacher educators walk through lesson planning during a synchronous session and follow up with a video describing each part and purpose for future reference. To extend the importance of collaboration, we placed teacher candidates in teams of two to create lessons.

During the weeks that lesson plans were created, we used the opportunity to share content on growth mindset. We wanted to model how attention to building a growth mindset in students can still be done virtually, so teacher educators informed teacher candidates that we would adhere to the growth mindset idea of "not yet" rather than grading harshly on a student's first attempt at lesson planning. Dweck (2016) emphasized the power behind using the words "not yet" when critiquing student work. These words indicate that success is possible. Teacher educators should consider modeling evaluation focused on growth, with rich feedback and clear future goals, as this assessment strategy can have a lasting effect on students' perception of their ability to grow and can also model alternate assessment strategies for future use in teacher candidates' classrooms.

Teacher educators should also explore strategies for providing prompt and thorough feedback to teacher candidates in online coursework (Young & Duncan, 2014; Asoodor, Vaezi, & Izanloo, 2016). Additionally, teacher educators can consider infusing components of Japanese Lesson Study into online coursework as a way to encourage teacher candidates to continuously improve lessons and to build professional collaboration skills (Fernandez, 2010). To reflect these ideals, we placed teacher candidates into *Zoom* breakout rooms during one of our weekly discussion portions to share their lesson ideas and get feedback from peers. Teacher candidates worked with a partner to improve their lessons, based on feedback from peers and instructors during live discussions, before turning lessons in for evaluation. At this point, students were given extensive instructor feedback and asked to make revisions before receiving additional feedback and a grade. This iterative approach pulled inspiration from the Lesson Study process, where teachers work collaboratively to design and improve lesson plans by providing feedback for revised implementation (Lewis & Hurd, 2011; Stigler & Hiebert, 1999).

Teacher educators should consider providing detailed expectations for lesson planning via live class time and in recorded videos for future reference. Teacher educators should also find ways to provide rich and iterative feedback through multiple rounds of online feedback and reflection that model evaluation focused on iterative growth. When choosing the types of projects for evaluation, we suggest drawing from the higher levels of Bloom's taxonomy framework such as areas calling for an application, analysis, or generation of knowledge. In our final lesson, we will share samples and suggestions for the final component of each week and final components of an online teacher education course.

Lesson 5: Provide Opportunities for Teacher Candidates to Engage in Real World Application

The final component of each week's online four-part module was a section titled *Application*. Teacher education researchers have called for increased attention to strengthening the connection between theory and practice in teacher education programs (Darling-Hammond, et al., 2017; National Council for Accreditation of Teacher Education, 2010). We wanted to maintain the connection to practice in an online course and therefore worked to build out application tasks as anchors for each week. Each weekly application task prompted students to work on a range of tasks contributing to projects or presentations connected to current and future teaching. For example, some application tasks included work on targeted sections of their final portfolio of educational technology resources. Another application example was creating a design challenge lesson video to share with teachers for use in virtual classrooms during the pandemic.

We learned that online course delivery can extend beyond content and objective exams. Teacher candidates could still apply what they learned in meaningful ways and share their experiences with peers. Through a myriad of application tasks, teacher candidates finished the course with a compilation of practical resources in their *Technology in the Classroom* portfolio, a collection of videoed engineering design challenge lessons, and a final presentation highlighting innovative solutions for issues facing education today, which we will discuss in more detail below. The organizational structure helped us build a scaffolded approach to each week's topic, but we still worked to ensure the assignments included in each section maintained fidelity to existing knowledge of effective educational practices, so we turned to the literature once again to aid in each decision.

Teacher educators should ensure that all learning tasks are clearly grounded in practice and facilitate the creation and sharing of a variety of products and resources teacher candidates can bring into their future classrooms. We suggest using a weekly organizational progression to scaffold teacher candidates toward each week's application task. Teacher educators should consider the use of a capstone portfolio in online courses as a way to have teacher candidates compile model lessons, pedagogical practices, descriptions of educational technologies available to practicing professionals, and videos of flipped lessons for use in their future classrooms. We also suggest teacher educators provide opportunities for teacher candidates to engage in processes focused on building a sense of agency and an awareness that they can become generators of knowledge for their classrooms and field. In the following sections, we describe how maker-centered learning and design thinking can enhance online teacher education.

Maker-centered learning. Our teacher candidates read *Maker Centered Learning: Empowering Young People to Shape their Worlds* (Clapp et al., 2016) and led discussions of each chapter. By combining the self-reflection in the thought question at the beginning of each week with the content of the chapters and rich discourse led by students, teacher candidates were able to relate their own schooling experiences to the ideals of maker-centered learning. This comparison often led to realizations that school could have been more empowering, purposeful, and fun. The discussions were a foundation that led into introducing technology and online facilitation strategies that could still promote the benefits of maker-centered learning even online.

We suggest teacher educators explore ways to bring systems thinking, tinkering, collaboration, and problem solving into coursework as a way to build a sense of maker empowerment, or "a dispositional stance in which students understand themselves as individuals of resourcefulness who can muster the wherewithal to change their world through making" (Clapp et al., 2016, p. 10). The course we redesigned was centered on technology in education, so we asked teacher candidates to complete an *Hour of Code* on Code.org as a way to tinker with computer science and block coding. Our teacher candidates conducted a number of design challenges aimed at building awareness for objects as systems of parts, purposes, and complexities. And they investigated an issue in education and used the design thinking process to develop a potential innovative solution. Teacher educators can bring the ideals of maker-centered learning into a wide variety of methods and content courses to model how to use maker-centered learning to increase purpose and engagement.

Design thinking and performance-based assessment. For the culmination of our redesigned online course, students completed a final project and presentation, named the Changemaker Project, that transitioned maker-centered learning from making things to making change. The Changemaker Project pulls from research on design thinking in education. Design thinking is a process of creative problem solving for human-centered change (Cross, 2007, 2011), and design is a creative act, focused on solving complex, ill-structured problems (Nelson & Stolterman, 2003). Teacher education can teach teacher candidates how to view themselves as designers of educational experiences that meet the needs of diverse learners and engage students in meaningful activities (Henriksen, Richardson, Mehta, 2017). Simultaneously, teacher education programs can model the use of performance-based assessment by evaluating teacher candidates' application of knowledge and presentation of meaningful, interest-based learning tasks (Hibbard, 1996).

Teaching is a complex field, filled with opportunities for student-centered innovation. Teacher education programs should consider exposing teacher candidates to the design thinking process as a way to approach problems they are experiencing in their classrooms and schools. To begin our Changemaker process, we asked teacher candidates to think about what they have learned in their coursework to develop a list of issues in education that matter to them. To address these issues, students moved through the phases of the design thinking process: empathize, define, ideate, prototype, and test (Lee, 2018). Students *empathized* with those impacted by the problem through observations and interviews. In the *define* phase, students used what they learned in the empathize phase and additional research to develop an actionable problem statement. When *ideating*, students generated visual representations of ideas and evaluated each. Next, students took one or two ideas and developed simple *prototypes* to gather feedback from classmates and those impacted by the problem. In the *test* phase, students shared the prototype to gain empathy, insights, and learnings. Instructors built each of these components into the organizational structure of the LMS learning modules over the final five weeks of the course.

To aid in online facilitation and to build in clarity of expectations, we created a *Google* document, *Changemakers: Telling Our Story* (https://docs.google.com/document/d/1RDfE0wPXXaZ9u7M4VHeYgRD5azKmnZIRNyLirhgctvs/edit?usp=sharing), outlining each part of the Changemaker project and assigned lettered sections to complete each week under the application section of weekly topics. We also held feedback sessions live in *Zoom*, as the discussion portion of the LMS organizational structure, so that all teams could hear about the projects of peers while offering and receiving feedback in similar cycles as previously described for lesson planning improvement. The feedback sessions strengthened the projects significantly as teacher candidates worked toward their final presentations. Teacher candidates proudly presented their stories of learning, innovative solutions for pressing issues in education, and the research and empathy used throughout the development. Instructors gave feedback within categories of research, innovation, and presentation.

Teacher education programs can prepare future teachers to become advocates for educational equity and opportunity for their future students. By building in change processes and keeping a focus on iterative growth, teacher education programs may equip and empower teacher candidates to embrace challenge and opportunities for positive change. We suggest teacher educators consider exposing teacher candidates to design thinking and projects similar to the Changemaker project we described to prepare them to take leadership roles in their careers. Then, as they enter into the evolving field of teaching, they may be better prepared to approach future challenges with processes and leadership capacities to apply knowledge and generate student-centered solutions.

WHAT YOU SHOULD READ

1. Getting Started with Design Thinking:

   D School at Stanford. (n.d.). Getting started with design thinking. Retrieved from https://dschool.stanford.edu/resources/getting-started-with-design-thinking

2. Flipped Classroom Approach:

   Bishop, J. L., & Verleger, M. A. (2013, June). The flipped classroom: A survey of the research. In *ASEE national conference proceedings, Atlanta, GA* (Vol. 30, No. 9, pp. 1-18). Retrieved from https://peer.asee.org/the-flipped-classroom-a-survey-of-the-research

3. Maker-Centered Learning:

   Clapp, E. P., Ross, J., Ryan, J. O., & Tishman, S. (2016). *Maker-centered learning: Empowering young people to shape their worlds*. John Wiley & Sons. Available here: https://www.wiley.com/en-us/Maker+Centered+Learning%3A+Empowering+Young+People+to+Shape+Their+Worlds-p-9781119259701

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Professional Development is a Plan, Not a Fix

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Abstract: Professional development has long been perceived as the gateway to learning, growth and change in education. Yet, much professional development is authored and implemented that does not meet what teachers need. 'Sit and get' has been the standard structure in far too many cases with results that fall short of the desired intent. Drawing from the literature and experiences of educators and districts shifting to virtual classrooms during the 2020 pandemic, the authors focus on creating the desired educator mindset needed for teacher growth and illustrate engaging pedagogical practices of effective professional development while providing numerous examples of proven activities.

Lesson Learned: Teacher educators should have learned how to design professional development for both in-service and preservice education that focuses on educators' mindset and engaging pedagogical practice in authentic online environments.

INTRODUCTION

Of the many lessons learned during the 2020 pandemic, the impact of professional development on an educational system's ability to quickly adapt to sudden change became forefront. Once the pandemic gained steam, schools were placed in panic mode as teachers and administrators tried to figure out how to move to online teaching and learning. The panic was exacerbated by the need to provide professional development at a distance. Due to a lack of guidance and educator knowledge concerning online pedagogy, the school environment became chaotic at best and a disaster in many locales. The experiences of 2020 illustrated the need for professional development that has a shared focus in pre- and in-service education emphasizing the authentic interrelationships of pedagogy, content knowledge and technology in online learning.

In March 2020, a global pandemic forced schools at all levels of P-20 education to move online with little preparation. Efforts to change the delivery of school was reactive and implemented as an emergency response (Hodges et al., 2020). While some K12 districts and higher education institutions closed or selected a paper-based approach, most choose to provide instruction through a learning management system online, and many took on this new approach with little to no experience in online teaching and learning. Professional development for teaching and learning in online environments became critical as schools recognized the need to support teachers and students. Reports from survey data (Hamilton et al., 2020) about teaching and leading during a pandemic, contain relevant findings about professional development:

- Teachers need professional development to help them address distance learning challenges, especially teachers who are working with the most vulnerable students.
- Educators need strategies to help students stay motivated and engaged while they are learning remotely, guidance to provide students with hands-on learning opportunities (e.g., labs, internships), and resources to assess and support students' social and emotional learning.

However, pre-pandemic professional development was typically provided face to face. Teacher Educators found that they needed to address teachers' lack of knowledge about online pedagogy and engage in professional development through online teaching and learning venues.

It also became apparent that teachers needed to develop Teacher Educator Technology Competencies (TETCs), described as "a framework that describes the knowledge, skills, and attitudes all teacher educators need" to become effective technology using teachers (Slykhuis et al., 2020, p. 474). Many teachers P-20 are new to online teaching and lack preparation regarding online teaching pedagogies and technologies (Gülbahar & Adnan, 2020; Mohr & Shelton, 2017). In light of the pandemic and the necessary move to online teaching and learning, the need to integrate technology in teacher preparation (Foulger et al., 2019) and in-service education is a necessity. One particular model – *Technological Pedagogical Content Knowledge* (TPACK) - provides the integrational framework to bring these forms of knowledge together. "At the heart of the TPACK framework, is the complex interplay of three primary forms of knowledge: Content (CK), Pedagogy (PK), and Technology (TK)" (Koehler et al., 2007). Unfortunately, most educational systems have undertaken professional development efforts that address each of these individually, not emphasizing the important interrelationships between them (Stover & Veres, 2013).

Educational institutions have seemingly been providing professional development in the same manner forever. It is time to rethink how professional development should be structured to model best practices that encompass adaptable contexts for our in-service and preservice teachers, and the current pandemic situation provides a catalyst for change (Williams et al., 2020, Craig, 2020; Schildkamp et al., 2020). The hope is that participants will in turn use these strategies in their teaching. This requires some small adjustments to teacher considerations for professional development:

- Establish a mindset of willingness to try new things and rethink learning
- Allow for creativity and experimentation
- Be present in the learning process (both the teacher and teacher educator)
- Encourage engagement with hands-on activities
- Put into practice the new skills
- Scaffold the development to build upon previous learning

Professional development, like much of education, faltered when put to the task of supporting teachers during the current need for change. Re-visioning how to deliver professional development and what to expect from educators during and after the learning experience can better prepare in-service and preservice teachers for the uncertainties of education that are undoubtedly around the corner.

Professional Development in Education

Professional development has been defined as "structured professional learning that results in changes in teacher practices and improvements in student learning outcomes'' (Darling-Hammond et al., 2017, p. v). Characteristics of sound professional development in the literature include the collective participation of teachers, onsite facilitation, ongoing over a period of time, and focused on practice and student learning (Hung & Yeh 2013; McConnell et al., 2013; Riveros et al., 2012; Darling-Hammond et al., 2009). It has been pointed out that the problem is not so much that professional development is not offered, but the lack of structure and time to experiment/practice negatively impacts its effectiveness (Pharis et al., 2019; Schrum, 1999; OTA, 1995). There were numerous warnings before 2020 about the need for structured professional development and the negative impact of current offerings. In 2005, Marsha Speck and Caroll Knipe stated, "The lack of professional development, as well as its misuse by educators, explains the chronic failure of school reform…The knowledge, skills, attitudes, behaviors, and practices of teaching are only minimally challenged by current practice. In addition, districts do not provide consistent support and leadership for improving teaching practice" (p. 4).

The "failings" of professional development in education include (Rucker, 2018; Berkowicz & Myers, 2018; ASCD, 2016):

- treating teachers as passive learners
- leadership existing outside the professional development bubble
- providing lots of general info with little specifics
- one shot and done format
- not providing ongoing supports and resources
- not focusing on specific problems of practice
- lack of time to experiment, practice, or reflect
- no collection of data to evaluate the effectiveness
- cost

Teachers Were Not Prepared for Online Teaching

All the identified failings of professional development, and not heeding warnings from as far back as 20 years ago about the need to prepare teachers for online learning, contributed to the chaotic situation education found itself during the spring of 2020. Downing and Dyment warned in 2013, "there is scant literature on the experiences and beliefs of teacher educators in relation to their readiness and preparation for online teaching as well as their beliefs in relation to the appropriateness of online education for preservice teachers" (p.99). Throughout the 2000s, enrollment in online learning has grown exponentially. From the 2009-10 to 2013-14 school years K-12 enrollment in online courses grew from 1.5 to 2. 7 million students. During this same time period, the number of school districts offering online learning increased from 50 percent to 75 percent nationally (Connections Academy, 2020). The number of online courses also increased dramatically from 317,000 in 2002-03 to 4.5 million in 2014-15. According to the Digital Learning Collaborative (April 2019), as of 2019, thirty-one states had statewide online schools and 23 states operated virtual (supplemental) online programs. They also indicated enrollment in these programs is growing at a rate of about 6% each year. The Babson Survey Research Group reported a continual growth trend in higher education online learning with over one quarter (28%) of undergraduate students taking at least one online course (Smith, 2016). Even though online learning has existed in P-20 education for decades and has slowly increased, it has been outside the mainstream delivery of courses. Thus, it has not been a focus of educators' preparation of teachers through professional development. The need for preparing teachers to teach in online environments has become abundantly clear.

Online Teaching and Learning in a Pandemic

Research tells us a lot about online teaching and learning; it takes time, preparation, iterations of curriculum, operational management systems, and practice to be effective as either a teacher or a learner in online contexts (Means, 2014).

None of which were afforded to educators and students during this time of educational turmoil. Online learning is complex and has nuanced curriculum and interactions among participants (Means, 2014; Hodges et al., 2020). Emergency remote teaching is not the same as online teaching and learning (Hodges et al., 2020; Lewison, 2020; Craig, 2020). Despite the excitement from some educational leaders that the Corona Virus' impact on education is a catalyst to change practice and innovate education (Craig, 2020), it has proven impossible for educators to suddenly become experts in online teaching and learning during this global event. Even as education transitions from the emergency reaction to a more thoughtful implementation of online teaching supported by a little preparation and professional development, online learning is much more than what is happening in most P-20 educational contexts.

Interactions between learners and content, teachers, and other learners in online contexts is one of the more established topics of research in online learning. It expounds on how each of these types of interactions should be crafted meaningfully; and when done well, interactions can increase student learning outcomes (Means, 2014). Thus, developing online courses is not just about the content that is organized within a learning management system, but also about designing and developing the educational environment (Zappia, 2020; Speck & Knipe, 2005), and building a community of learners with engaged, meaningful interactions (Darling-Hammond et al., 2017; Lave & Wenger, 2017). It is important that teacher educators consider the differences between emergency remote teaching and online learning when designing professional development (Williams et. al, 2020).

Professional Development Models

Of critical importance to a professional development program is the model used. Models such as the TPACK-based Professional Learning Design Model (TPLDM) (Jaipal-Jamani & Figg, 2015), Technology Enhanced Instruction (TEI) (Slykhuis and Lee, 2015), Teacher Educator Technology Competencies (TETC) (Foulger et al., 2017) and EdTech for Teacher Prep (ET4TP) (Greene, 2020) have been created and identify key factors for success:
1. Integrating technology, content knowledge and pedagogy
2. evaluation of personal practice
3. looking at the possibilities (potential solutions)
4. Design
5. Use of professional learning networks to share and collaborate.

Two factors that positively contribute to the professional development program's success are providing options (not one size fits all) and creating community. It is necessary to be as accommodating as possible and offer options when trying to meet the needs of P-20 educators during an event such as the 2020 pandemic. For example, the EdTech for Teacher Prep (ET4TP) model, a technology integration professional development program at the SUNY New Paltz School of Education, "provided *on-demand* (when needed) and *à la carte* (as much or as little as necessary) professional development for teacher education faculty and preservice and in-service teacher candidates through 1) a series of edtech workshops; 2) consistent, on-demand, drop-in support sessions; 3) a curated website of easy-to-access, self-paced edtech resources; and 4) a P-20 technology conference" (Greene, 2020, p.33).

The use of communities or professional learning networks (PLNs) to allow educators at all levels to explore content and engage with one another has been identified as critical to professional growth (Widodo & Allamnakhrah, 2020; Allen & Lewis, 2006}. Additionally, "fostering an atmosphere of community, where teachers and paraprofessionals work together, is important to student achievement and success" (Hord, 1997, p. 54) which is the ultimate goal of education (Speck & Knipe, 2005).

Professional Development Delivery

Online professional development can take several forms. They can be offered in a synchronous, asynchronous, and/or hybrid format (Bates et al., 2016; Fordham University, 2020; Lawless, 2020). Synchronous offerings happen in real time and typically require the participant to be "live" if real-time interaction occurs. In today's world, "live" experience happens while participating in a video call using any number of systems. This is the direct replacement for face-to-face professional development as it differs only in the proximity of participants. The positives include the ability to offer professional development to numerous locations while maintaining levels of interactivity. The downside to synchronous offerings includes "forcing" participants to adhere to the schedule of professional development offerings, potentially lim-

ited interactions if the offering is presented as a webinar or virtual lecture and the idea that it happens once. It is a moment in time much like a single face-to-face class.

Asynchronous offerings are available 24/7 as participants can participate at a time and location of their choosing. Examples of asynchronous learning include independent study courses, Twitter chats, "slow" (i.e., reading and discussion take place over a longer period of time) book studies, etc. (Trach, 2018). Asynchronous offerings allow participants to choose when they want to be online to access information or communicate - it is more learner centric. The benefits of offering professional development in an asynchronous model include allowing participants to move at their own pace, providing nearly infinite opportunities for review, and the ease of sharing resources across numerous sites and with other participants (Cavey, 2020). Offering asynchronous professional development literally allows one teacher to connect with potentially thousands of participants, increases flexibility, and is very cost effective (Lawless, 2020).

Hybrid courses are those that allow for both in-person and online learning (Fordham University, 2020). This course type has been of particular interest to schools during the pandemic due to both the shift back and forth between no face-to-face classes and full in person schooling or in some cases, a combination of both to minimize class size. Hybrid courses require students to have good time management skills and desire to be engaged in active learning environments. These courses provide many of the benefits of both synchronous and asynchronous classrooms. Resources are accessible 24/7, lectures, notes, and comments can be rewatched/reread, and for some, the freedom provided makes it easier for those who have families or jobs (Seattle Pi, 2020).

LESSONS LEARNED FOR RESEARCH

Several reviews of literature (Parsons et al., 2019; Korthagen, 2017; Luneta, 2012; Broad & Evans, 2006) synthesize the research about practices and delivery of established professional development, yet teacher training in online environments is not addressed. Research about online learning focuses on content design and delivery, environment, interactions, and participants' perceptions (Means, 2014), but it too lacks elaboration about teacher professional development. Yet for many, professional development initiated by the teachers' needs to shift their practice to online teaching and learning was conducted in an online learning environment about online learning (Cavanaugh & DeWeese, 2020; Williams et al., 2020; Schildkamp et al., 2020). With a lacking historical research about professional development in online contexts, researchers have anecdotal information from which to conclude current professional development efforts and its influence on the implementation of online learning on the wide scale brought about by the pandemic, or its impact on students. Empirical research that explores if learners achieved intended skills, knowledge, or attitudes through the implementation of the online pedagogy learned during professional development would be of interests to many teachers and teacher educators. Additionally, empirical investigations could promote a foundation of knowledge in the academic literature that identifies best practices of professional development design in online contexts. Darling-Hammond et al., (2017) expounds that the research is well established regarding the failings of professional development in traditional contexts. It is essential to explore the success and failures of online professional development designed to support teachers' efforts to create meaningful online learning environments for their students. From such evaluations, teacher educators can refine their practice of supporting in-service and preservice teachers through online professional development.

Frameworks for technology integration intended to support teacher development are also well established in the education literature (Slykhuis et al., 2020; Foulger et al., 2019; Stover & Veres, 2013; Koehler et al., 2007). A full understanding of education's new learning spaces is unknown, and a new definition of what constitutes classroom ecology may emerge from our experiences. Specifically, investigating the intersection of teacher education of technology integration frameworks and the evolution of classroom ecology as a result of the forced-shift to online learning P-20, may help illustrate the authentic interrelationships of pedagogy, content knowledge and technology in online learning contexts. It may also illuminate the need for professional development that has a shared focus in pre- and in-service education that emphasizes evolving educators' mindset and engaging pedagogical practice in authentic online environments.

LESSONS LEARNED FOR PRACTICE

When rethinking professional development, educators are not creating a task to accomplish or endure but building a series of experiences that match the innovation required to be successful in any classroom environment. With a goal of reimagining education, there is a need to shift professional development to meet these demands.

Mindsets for Professional Development

Suppose the ultimate goal of teacher professional development is to create better learning opportunities for students (Darling-Hammond, 2017). In that case, engagement in such development should provide immersive experiences in productive teaching and learning practices that challenge teachers to transform their practice. Despite this seemingly logical understanding, much of what educators have experienced as "professional development" falls short of supporting their efforts to transform their practice (Berkowicz & Myers, 2018). Recognizing that teachers' beliefs are key influencers of their perceptions about what makes instruction effective and their approach to self-development, much research on professional development has sought to address changes in teachers' beliefs as an influencer to changing instructional practices, with varying results (Spillane, Reiser, & Reimer, 2002; Villegas-Reimers, 2003; Weick, Sutcliffe, & Obstfeld, 2005). Additionally, the educational technology literature abounds with descriptions and examples of effective teaching and learning for specific content areas, grade levels, and technology-rich environments (Koç, 2005). However, when education was required to pivot the teaching and learning experience to remote teaching practically overnight, educators recognized the literature represented a reconceptualization of teaching and learning. Still, it did little to support the specific needs of teachers and students in such a situation. As educators transitioned from the first attempts at emergency remote (Hodges et al., 2020) teaching to developing effective practices in various remote learning contexts, their beliefs about teaching and learning drove education's evolution.

Mindset has emerged as a concept that describes how learning can be cultivated in educational contexts and the educator's attitude to engage in teaching and learning (Spenner, 2017). As classroom educators, personal beliefs about teaching and teacher and learner roles influence how teachers engage in professional development and what they do, or do not do, with the acquired information (Kemper-Patrick & Joshi, 2019). Likewise, teacher educators create and facilitate professional development through a lens crafted by personal beliefs and experiences. Change in practice requires most teachers to rethink their own practice, to construct new classroom roles and expectations about student outcomes, and to teach in ways they have never taught and probably never experienced as students (Nelson and Hammerman, 1996). When faced with the rapid changes in delivery the events of 2020 thrust upon education, did educators innovate their practice or did they try, like many, to digitize already established classroom experiences? Did they rethink their practice or reflect on how their beliefs drove their approach to online learning? Some may have focused on ways to deliver content and ended up instructing blacked-out boxes on Zoom. Perhaps teachers struggled through engaging students in on- and off-line activities simultaneously? Regardless of how educators approached remote teaching, their mindset drove educational decisions (Dweck, 2016).

Responding to different mindsets can be an important notion in professional development. In preparing to teach differently, teachers can benefit from a mindset that embraces a willingness to create new experiences and reconsiders what they already know about teaching and learning (Dweck, 2016; Spenner, 2017). Professional development becomes a game of "Yes, and" as teachers and teacher educators reflect on teaching practice and beliefs to modify them through a willingness to explore ideas and practice strategies and skills. When this mindset is embraced by both the teacher educator and the teachers participating in the professional development, the learning experiences support educational practice to rise to the day's challenges.

Three elements fostering this mindset in education professional development include:
- Engagement creates opportunity
- Familiar environments
- Everyone learns together

Engagement Creates Opportunity. Educators have all been there, sitting near the back of a sit-and-get event, checking email and grading papers. Was the information really that bad? Not necessarily, but there was likely no expectation of engagement. Today, learners can be even more creatively evasive with access to a mute button for audio and video (Craig, 2020). Learning occurs when taking action, but a lack of engagement stops learning in its tracks. The mindset of what professional development looks like should embrace the value of engagement and experience as the underlying force of learning (Schildkamp et al., 2020). When professional development, like classroom learning, occurs in virtual environments, the need for engagement is even more critical because there are potentially more distractions and feelings of disconnectedness. In preservice and in-service classrooms, teacher educators can shift the dynamic of learning by implementing actions that promote engagement. In general, actions should encourage interaction with others, content, and self-reflection (Williams et al., 2020); Table 1 provides specific examples of actions teacher educator or teacher learners engage in promoting a mindset of engagement.

Table 1

Teacher Educator and Teacher-Learner Actions to Promote Mindsets about Engagement

Teacher Educator	Create expectations of engagement among all participants
	Establish a constant presence in the online learning space through responsiveness and feedback
	Plan active learning activities
	Promote an atmosphere safe for learner risk-taking and questioning
Teacher-Learner	Focus on self-development
	Establish a constant presence in OL spaces by sharing, talking, questioning
	Expect to use the new knowledge or skills in practice
	Adopt a willingness to create

Engagement strategies might include activities that promote talk and collaboration among learners, using visual media presentations, promoting kinesthetic activities digitally or off-line, and providing meaningful and continuous opportunities for development. Approaching professional development with a mindset that promotes engagement opens opportunities for learning for educators and their students, who ultimately reap the benefits.

Familiar Environment. Many educators spent the summer of 2020 preparing to teach in whatever learning environment they adopted for the fall, including in person, remote, online, hybrid, and hyflex. Many also had access to professional development. But just like the scramble to move classroom instruction to remote learning, professional development happened in a variety of haphazard ways. And "the way" teachers had access to through their experiences may have made all the difference in their preparedness and mindset about change.

Teacher educators know modeling can be an effective instructional method, especially when learning an unfamiliar skill (Hogg & Yates, 2013). Creating professional development that mimics the classroom experience is valuable for teachers to experience learning in ways similar to students. An example of this is if student learning will be online through a learning management system, then the professional development should be online through the same learning management system in order to model the authentic environment in which teachers will facilitate learning. Additionally, the showing and describing strategies of modeling can support teachers' learning by demonstrating skills and building confidence in the online tools and learning what the student experiences (Schildkamp et al., 2020). As another example, a teacher educator might provide content about student engagement strategies through a whole-class video conference session. Suppose the teacher educator also takes the time to talk through the pedagogical and practical use of the collaborative whiteboard and breakout rooms' pedagogical and practical use to facilitate the learning. In that case, the teachers' learning experience becomes enriched with content and knowledge building about the environment after an experience as a learning in the environment (Kallio et al., 2018). Facilitating such transparency supports teachers' understanding of the learning experience from multiple perspectives and enables them to draw from learners' experiences when designing their own new environment.

Everyone Learns Together. Building an effective community of support (Lave & Wenger, 1991/2017) among teacher educators and teacher-learners (and among teachers and students) is important to establish a creative and flexible mindset that promotes success in new learning spaces.

Believing that the teacher educator and teacher-learners journey through professional development together as partners creates:

- Accountability: clear learning goals and identified expectations of *teacher* and *learner* to which classroom participants can hold each other accountable promotes persistence
- Support: encouragement and learning together builds mutual respect and promotes engagement and collaboration
- Empathy: fosters insight into multiple perspectives and promotes open mindedness
- Transparency: establishes shared understanding about learning and confidence in expectations

The idea of everyone learning together can also be transferred to the classroom environment to promote teacher and student collaborative learning. The same benefits are available to teachers bringing something new into their practice when learning together is employed. While participating in the complete transformation of the learning space that many are navigating, educators and students can recognize together new shared experiences and successes in teaching and learning. These experiences also advance preservice teachers' understanding of pedagogical practices in authentic contexts that they may otherwise have never experienced before taking ownership of a classroom.

Evolving Mindset. Forced new experiences in education have opened the opportunity for innovation and they have moved technology integration and new instructional strategies to center-stage as educators establish new best practices for teaching and learning (Craig, 2020; Williams et al., 2020; Schildkamp et al., 2020). The way educators apply beliefs and mindsets to those experiences promotes the next iteration of education (Spenner, 2017). The desire for the familiar may have educators thinking about when education can *get back to normal*, but the acquisition of new skills and knowledge, and established innovative mindset about creating teaching and learning only push educators onward. Established and future educators now have the opportunity to learn together to identify new strategies, ways of engaging students, and developing school experiences that prepare students for the changing times ahead.

Professional Development Structure

There are a variety of ways that one can structure professional development. It can be a simple session where the presenter shows slides, and the participants listen and look. Or it can be completely interactive where the participants are actively engaged in conversation or tasks. Both have a purpose; both can be highly effective. What matters is the purpose of the professional development and learning outcome expectations.

When teachers switched to virtual learning, their abilities and comfort level with teaching online varied incredibly; things like how to split-screen, pin tabs, or navigate a virtual meeting suddenly became incredibly important. "The steep learning curve and the amount of pressure on teacher educators to quickly transition to remote teaching were immense challenges" (Song et al., 2020, p.172). Teachers were trying to figure out how to do what they always did in a face-to-face environment in the new online environment. Educators needed new skills. Professional development was required to change to online as well.

The structure of the professional development for both preservice and in-service teachers needed to be interactive and transformative. Teachers needed to be instantly successful with remote teaching. In-service educators needed to be actively involved in professional development because these skills were required immediately, "Learning theory suggests that learning is promoted or enhanced (1) when students are actively involved in the learning, (2) when assignments reflect real-life contexts and experiences, and (3) when critical thinking or deep learning is promoted through applied and reflective activities" (Bransford et al., 2000; Driscoll, 2002, p. 202).

So how can this structure be designed? And how do you make it happen? It needs to contain three essential components:
1. A solid framework
2. Interactive components
3. Time to explore and ask questions

A Solid Framework. When structuring professional development, there needs to be a solid foundation as to what will be covered. There is no difference in how a teacher will structure lessons for their students. A useful framework for this is the TPACK model. The three knowledge bases (content, pedagogy, and technology) form the core of the TPACK framework (Bransford et al., 2000). In classrooms, the essential question about the content is often posted and the 'why' is discussed. This is also true for those coming to a session. Sometimes preservice and in-service educators are attending because they want to be, but sometimes it is required. It is critical to state in the professional development description that the session is hands-on and interactive to alert the participants that this is not a lecture-style learning opportunity. The expectation is participation. Once in the session, it is essential to get the participants involved right away. "While engaging course materials, the teacher may encourage students to note key ideas, pull salient quotes, ponder themes, or jot down questions" (Redmond & Henson, 2020, p. 104). The same is true for professional development. Interactive activities to get participants laughing, chatting, and sharing are better. It can be as simple as asking participants to add to the

chat. One way to get participants engaged is by using *Nearpod Collaborate Boards*. This allows participants the ability to add text, images, and GIFs without leaving the *Nearpod* platform. This could also be accomplished using apps such as *Padlet*, *Wakelet*, or even a private *Facebook* page for this activity.

It is important to chunk sessions into small, achievable portions. According to recent studies, most adults' attention span is about 20 minutes (Mautref, 2019). "As a lecture continues, attention spans become shorter and often fall to three or four minutes between periods of inattention toward the end of a standard lecture" (Chaney, 2005, p. 1). Professional development webinars and workshops need to be separated into sections to allow for this attention span. This will maximize attention and help foster engagement. This is where the interactive components come into play. Even if a lecture is preferred, it is essential to break this up into smaller parts. Send the participants off on an achievable task, utilize breakout rooms or shared documents or programs (like *Padlet*, *Wakelet,* or *Nearpod*).

For example, break down a 6-hour online workshop for preservice or in-service educators into smaller parts. It could start with introductions and a review of the agenda. Discuss any resources used in the session. The agenda should outline the topics covered. Each task should clearly state what they need to know and to complete. The participants are released to do the activities at their own pace. The teacher educator is available to answer any questions and support. The participants can ask questions in the chat or unmute and ask for clarification. After a set amount of time, collaborative discussions should commence. Participants should share their work and ideas for peer review. Give breaks at regular intervals with ideas for stretching. By the end of the 6 hours, the participants will have accomplished many tasks. Be sure to give time for reflection. This model allows for a scaffolding approach for any future training. They should come away with ideas to use right away in their classrooms.

In a one-hour webinar, this same structure can still be employed. Keep the introduction short, and then start the first activity. Use a shared *Google Slide* deck, a collaborative tool like *Wakelet* or even a PDF through *Kami*. Keep the instructions short and allow time for free play. Know that each participant will be at a different comfort level, so scaffold the activities to allow for some success for all. Be sure to leave time for questions and open reflections for the next steps. Asynchronous online professional development follows a similar structure and combines instructional text and video to guide the teacher participants through the experience (Williams et al., 2002; Schildkamp et al., 2020). It should promote engagement with the content, teacher educator, and if the event has a start and end date, with other participants. The following table summarizes the online professional development framework components described above that will promote structure and engagement.

Table 2
Professional Development Framework Components to Promote Engagement

Component	Description	Example	
		Webinar	Asynchronous
Introduction	Short contextual and procedure overview of event	Live discussion with slides or shared screen; agenda	Introduction video with walk through of online course navigation
Choice	Teacher-learner selection of topics, experiences, or activities	Choice Board (staff, 2020)	Modules with badging or organization and progress monitoring (instructure.com)
Play	Use tools, engage in practice and exploration; safe environment for failure and success; active engagement	Sandbox learning opportunities to explore tools and concepts (Heick, 2020); practice activities or collaborative interactions with peers	
Reflect	Metacognitive activity; opportunity to vision new learning in practice	Exit ticket in *Google* forms with guiding questions (staff, 2015)	Reflective activity such as *Flip Grid* response to a prompt or Idea Poster

Interactive Components. In order for the professional development to yield meaningful results, participants need to engage with the content and participants with the event (L, 2020). Creating interactive components within the professional development structure promotes engagement (Parsons et al.,2019). It is important to model how a lesson can look

in the classroom during online professional development (Hogg & Yates, 2013). There are many easy ways to get participants to interact during a webinar or asynchronous course. If educators follow the framework suggested, the following are examples of activities that can help structure the choices you provide to engage teacher-learners.

3 Things. This concept is not new but is steeped in research (Roy, n.d.). In this activity, participants list three positive things about their day, themselves, or their schools. It really can be anything as the topic, as long as the focus is on something good. This can be done as part of a beginning ritual in professional development. "Ritual openings establish safety and predictability, support contribution by all voices, set norms for respectful listening, allow students to connect with one another and create a sense of belonging" (Silver, 2020, p. 115).

Selfie Stories. The idea is for participants to create something that explains their selfie. In this activity, they take a photo of themselves (or it can be their Bitmoji). They can put the image on a *Google Slide*, a *Buncee*, or on a *Padlet*. They describe themselves or their comfort level with the topic or anything the teacher educator would like them to use. A fun way to bring in social and emotional learning is to have participants list ideas for relaxing and their favorite activities to unwind. The teacher educator can even have them create 'I Am' poems depending on the time dedicated to this activity. Be sure to save time for the participants to share what they wrote and look at each other's work. "These skills are readily transferable to the processes of creating materials for teaching and instruction and facilitating digital storytelling practices to cultivate creative and narrative-based learning (Redmond & Henson, 2020, p. 98).

Create Something. This is a straightforward way to get participants to apply what they are learning. For example, when teaching Choose Your Adventure activities in *Google Slides*, participants can create one of the pages based on the storyboard shared. That way, they are using the tools, asking questions with support, and working together for a completed project.

What's Going on in the Picture? A teacher educator can use the NY Times feature or use any meme, photo, or sketch of your choice (Roy, n.d.). They can add the image on *Kami* or in a collaborative *Google Doc* and have the participants add in their thoughts, titles, captions, or ideas shared. The idea is to get them creating, collaborating, and having a little fun.

Design School. Similar to the create something concept, this becomes an excellent way for participants to try what is demonstrated. While showcasing how a particular program works, have the participants try each step themselves. In this activity, the participants should be comfortable splitting their screen or having another device to do the work. Getting the participants to do something offline can happen here. For example, the *SONY KOOV* robotics kit is a great hands-on activity to have the participants build offline and then showcase their build collaboratively. When possible, *Legos* or any construction-type materials are excellent choices for this activity.

Finding Pictures. Use images from the internet or create a picture search experience for the participants. Think about the 'Where's Waldo' type of activities for this. Create a *Bitmoji* search by adding multiple *Bitmojis* to a slide. Ask participants to find things of a particular color, shape, concept, etc. They can do this in a *Nearpod Draw It, Kami*, or any tool that lets them annotate a picture. A simple *Google* search will yield tons of free options, but it is fun to create. While simple, this can lead to many laughs, and it gets participants thinking of ways to utilize times that this type of activity would fit nicely into their curriculum.

Virtual Field Trips. Take participants anywhere by using virtual reality (VR). VR is a terrific way to connect ideas, share experiences, and get people to collaborate. "In the education sector, virtual reality applications provide students with real-life experiences and shorten the learning time and extend the retention of information" (Serin, 2020, p. 295). During professional development sessions, participants can learn about locations, shapes, ideas, concepts, and anything else the teacher educator can think of through a VR experience. Examples include VR videos of a farm or the M & M factory. Encourage teachers to take screenshots of interesting details while viewing the VR image or video. Participants should share those screenshots and explain why. Discuss how each relates to the topic. Encourage creation. For example, using a VR field trip of a water slide, have participants discuss or write how they would feel at the top of the slide or the bottom of the slide. Use context clues to guess the location or highlight interesting shapes, textures, and contours.

Drawing. Simple drawing games like passing the drawing or guess the animal is a great way to build community during professional learning. Use a collaborative drawing tool like *Jamboard*, *Nearpod Draw It*, or *Padlet* for these types of activities. Have participants draw first and then display the drawings for others to guess and discuss. The idea is to get them engaged in the learning experience.

These are just a sample of what can be done during a professional development session to foster engagement, community, and creativity. Activities can be adapted to fit nearly any professional development topic. Do not use all the activities in a single session but applying a few to chunk the time into shorter bits will keep participants engaged. These

ideas could be integrated into a choice board. For example, during a half-hour session, participants can be introduced to a choice board with options to explore. Provide them 20 minutes to explore any of the options. While exploring they can ask questions and exchange ideas. Sometimes the session is entirely silent as they explore the options; that can be the most challenging part of being a presenter. While it may be challenging to sit in silence it is worth it if they are engaged. After the time was up, regroup and discuss what they explored. Talk about the potential applications in the classroom and answer questions. That is the magic of using professional development sessions interactively. The why is clear and the participation is high.

Time to Explore and Play. Preservice and In-service teachers need time to explore and apply what they have learned. Exploration can happen at any stage of the learning process. In the *Hyperdocs* model (Hyperdocs, n.d.), the exploration portion is near the lesson's beginning. It gives the participants time to think about what they know and what they want to learn. It is an important opportunity for participants of all ages to think about their why and get them excited about the topic. The exploration phase can come later as well.

One example of exploration is to do a tech tools playground. In this type of session, there is a short opening activity done together. The playground for remote learning is online on the platform of your choice. The participants use the bulk of the session to explore the resources, ask questions, and discuss how to use the ideas shared with their fellow peers. From there, they begin to build their resources and lesson activities based on what they learned. This time is valuable for teachers because they often feel that there is not a ton of time to put into action the new information they learn on a webinar. "The playground is an informal learning environment that welcomes faculty and students to play with emerging technologies and to consider teaching and learning challenges and explore creative solutions in a non-threatening, relaxing environment" (Stansberry, 2016, p. 53). In this model, it is important to provide ample time for exploration and peer discussion.

It is important to note that time can also help with scaffolding future learning opportunities. The hope is that the new learning from professional development leads to new experiences and activities with students. It is important to circle back to discuss what worked and what future training is needed. Surveys that allow for reflection are essential after a professional development session. It is necessary to enable participants to reflect on their learning and think about applying it to their teaching.

When creating professional development opportunities, it is essential to consider how to support what participants need right away. The learning needs to be structured to maximize where the participants engage in the majority of their work. Teacher educators want teacher-learners engaged and excited about the topic and teachers need resources and time to implement new strategies. Approaching professional development with a mindset that embraces new ideas and engages in learning opportunities is necessary by teacher educators and teacher-learners. Professional development should be an exciting opportunity because it is helpful and engaging; implementing small but significant changes in professional development practices can achieve these goals and support teachers' work.

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eXtended Reality (XR) for Teacher Education

Creating Virtual Spaces: Using eXtended Reality and Transformative Technologies to Prepare Teachers to Thrive in an Ever-changing World

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Abstract: How can teacher educators better prepare pre- and in-service teachers to innovate and adapt to an ever-changing world? Recent educational movements have focused on preparing students for an innovation-centered civilization while failing to hold teachers to the same expectation. The spring of 2020 highlighted this problem when the COVID-19 pandemic disrupted K-12 and teacher education—leading to conditions where most educators lacked prior contextual knowledge. As such, many teachers fell back on their existing pedagogy and content knowledge (e.g., worksheets, video lectures) rather than continuing student-centered practices. To address this problem, we suggest preparing teachers as creators in the classroom. Using several WebXR tools as examples, we conceptualize how teacher educators can use eXtended reality (XR)—which includes virtual, augmented, and mixed reality—along with computational tools to support transformative teaching. This chapter provides examples of how creating computational artifacts in virtual environments can support teachers as a "guide on the virtual side." This chapter's implications include research pathways to prepare teacher educators to support creativity by rethinking teaching practices and integrating transformative technologies across pre- and in-service teaching contexts.

Lesson Learned: Teacher educators should have learned that they must prepare their pre- and in-service teachers to innovate and adapt to an ever-changing world.

AN INTRODUCTION TO PREPARING TEACHERS TO THRIVE IN AN EVER-CHANGING WORLD

How can teacher educators better prepare pre- and in-service teachers to innovate and adapt to an ever-changing world? Over the past two decades, there have been multiple educational movements—such as 21st century learning, project-based learning (PBL), and the maker movement—aimed at transforming how teachers prepare students with the skills they will need to thrive in "life, work, and citizenship" (Partnership for 21st Century Learning [P21], 2019, p. 1). These student-centered movements recognize that the century-old industrial model of education, which aims to prepare students to enter a knowledge economy, has shifted towards preparing them for new ways of thinking and learning (Fishman & Dede, 2016; Kereluik et al., 2013). This shift is not new, as companies and countries have already accepted that to succeed in a global economy they must "continually innovate, to create *new* knowledge—not simply to master existing knowledge" (Sawyer, 2014, p. 727). Therefore, if the field of education hopes to prepare students for an innovation-centered society, teacher educators must also prepare their pre- and in-service teachers to become more innovative and adaptive.

To develop new skills, teachers frequently participate in professional development. For example, organizations such as the Partnership for 21st Century Learning (which champions the 4Cs of critical thinking, communication, collaboration, and creativity) and the Buck Institute for Education (which trains teachers to implement the fundamentals of PBL) have worked with thousands of educators towards preparing our students to succeed in an innovation-centered civilization (Buck Institute for Education, n.d.; P21, 2019). Both the 4Cs and PBL aim to make learning more active and authentic by moving away from *instructionism* (Papert, 1993)—"with the teacher lecturing in a transmission-and-acquisition style" (Sawyer, 2014, p. 737)—towards student-centered practices that focus on the creation rather than the consumption of knowledge.

While these and other movements aim to prepare *our students* with the skills they will need to adapt to an ever-changing world, the teacher education community has largely failed to prepare *our teachers* with the same expectation. This lack of preparation became evident in the spring of 2020, when the COVID-19 pandemic forced schools to go virtual (UNESCO, 2020). While some teachers used this as an opportunity for innovation (Ferdig et al., 2020), many were unprepared and untrained to navigate the complexities of such a rapid transition online (Black et al., 2020). Despite aspirations for innovative classrooms, the 21st-century version of instructionism emerged as a series of (un)muted Zoom calls, PowerPoint notes, and "Reply All" e-mails. If teacher education has learned anything from 2020, it is that they must prepare their teachers to be more flexible, adaptive, and tech-savvy. Therefore, as research practitioners, the authors of this chapter advocate that teacher educators should model strategies using transformative technologies that enable pre- and in-service teachers to collaborate and create across multiple teaching and learning contexts.

This chapter explores how transformative tools, such as eXtended reality (XR)—an umbrella term used to define immersive technologies such as augmented reality (AR), mixed reality (MR), and virtual reality (VR)—can be used to prepare teachers as a "guide on the virtual side" across in-person and virtual settings. In addition, this chapter presents pathways for researchers and practitioners to support transformational classroom practices through the creation, sharing, and remixing of computational artifacts, 3D models, and virtual worlds.

WHAT WE KNOW

Disrupting Schools

The field of education is resistant to change. For over 125 years, schools have been structured around standardized subjects, grade-levels, and teaching practices (Fraser, 2007). As a result, those seeking school change must confront these structural elements while also navigating complex barriers such as teachers teaching the way they were taught (Lortie, 2002), veteran teachers preserving their nostalgia (Goodson et al., 2006; Snyder, 2017), chronic teacher turnover (Carver-Thomas & Darling-Hammond, 2017), and a failure to develop the leadership capacity of our students and teachers (Fullan, 2015).

Despite these barriers, there has been a profusion of national and global reform movements seeking to improve the quality of student and teacher education (Jennings, 2012; Noddings, 2017; Ravitch, 2001). These movements, however, take an incremental approach that is akin to educational evolution, where the introduction of new tools and technology replicate existing practices (Fishman & Dede, 2016; Hughes et al., 2006). Yet, as emphasized by Fishman and Dede

(2016), "One cannot prepare children for a global, knowledge-based, innovation-centered civilization by making slow, small improvements in an industrial model of schooling. We urge that design, practice, research, policy, and leadership focus on transformation and disruption, not evolution" (p. 1321).

Transformation and disruption are easier said than done. This is partially because it is difficult to engage in transformative practices—defined as using technology to invent "new instruction, learning, or curricula" (Hughes et al., 2006)—when teacher educators model technology to replicate existing practices. Furthermore, while some entrepreneurs believe that classrooms will benefit from disruptive technologies (Christensen et al., 2008), educators often view the same technologies as digital distractions (McCoy 2016, 2020). Yet, over the past decade, numerous technological disruptions such as smartphones, laptops, and Bring Your Own Device (BYOD) have become ubiquitous in public education (Ross, 2020; Song 2014). These infusions of technology, along with improved internet infrastructure and the development of user-friendly Learning Management Systems (LMS), have begun to disrupt the classroom by shifting learning online. In fact, as of 2019, 57.5% of high schools in the United States offered at least one course online, and 3.6% provided all courses online (U.S. Department of Education, National Center for Education Statistics, 2019).

Before the COVID-19 pandemic, the shift towards online learning followed the traditional educational evolution of incremental change. However, in March of 2020, the announcement of "The Great Pause" resulted in a disruption that affected how we all live, work, and learn (Gambuto, 2020). Overnight, schools and universities were forced to close, leaving students, teachers, parents, and administrators to navigate uncertainty during a crisis. While the pandemic brought many challenges, it has provided teachers and teacher educators opportunities to implement new technologies and pedagogies across environments where they lacked prior contextual knowledge (Mishra, 2019).

Challenges and Opportunities Provided by the Pandemic

One of the universal challenges facing schools and universities was a lack of time to transition online (Quezada et al., 2020). Although many teachers were already familiar with using various LMS and videoconferencing tools, they had never been entirely reliant on them (la Velle et al., 2020). The rapid shift online amplified system-wide weaknesses by stressing LMSs that were designed for a limited number of simultaneous users (Van Nuland et al., 2020), exposing a lack of online security with pranksters "Zoombombing" classes (Secara, 2020), and shifting teachers into a technical support role (Greenhow et al., 2020). Furthermore, the transition to virtual teaching also amplified the challenges related to the digital divide in urban areas—where students lack technology and infrastructure—and rural areas—which are remote and under/unserved by high-speed internet (Chandra et al., 2020; Van Nuland et al., 2020).

Teachers who lacked prior online teaching experience faced challenges adapting to virtual teaching (König et al., 2020; Van Nuland et al., 2020). These challenges included an inability to gauge student participation due to inactive webcams (Donitsa-Schmidt & Ramot, 2020), universal "Zoom fatigue" (Donitsa-Schmidt & Ramot, 2020; Quezada et al., 2020), and teacher concerns about students who were experiencing anxiety and feelings of isolation (Scull et al., 2020). Teacher education programs also experienced accreditation issues due to government-mandated field hours (Ellis et al., 2020). Furthermore, teacher educators have expressed concerns that the pandemic has stunted undergraduate students' identity development as teachers (Donitsa-Schmidt & Ramot, 2020).

Despite these challenges, virtual teaching provided numerous opportunities to expand technology skills. Some previously reluctant teachers experienced a shift from resistance to enthusiasm about technology adoption (Ellis et al., 2020). The transition encouraged teachers to collaborate, with educators scheduling "Zoom get-togethers" to share tools and knowledge with peers (Donitsa-Schmidt & Ramot, 2020). This is significant since the industrial schooling model rarely provides time for teachers to collaborate (Darling-Hammond & Hyler, 2020). Additionally, educators worldwide used social media platforms, such as Twitter, to share free online teaching resources (Harron & Liu, 2020). As a result, many teachers and teacher educators gained experience with advanced technologies and expanded their comfort zone.

Educators used the pandemic to increase their pedagogical skills when tasked with accelerated course development (Ellis et al., 2020). The new teaching context allowed teachers to try alternative forms of assessment such as blog posts, digital posters, mind maps, and online portfolios (Donitsa-Schmidt & Ramot, 2020). As such, the pandemic has provided an opportunity for "rethinking practices" (Ellis et al., 2020). This includes finding better ways to support student learning through assessments that are authentic and meaningful, enabling educators to support social-emotional learning through informed practices (Darling-Hammond & Hyler, 2020), and promoting active learning through the use of computational thinking (Barchas-Lichtenstein et al., 2020; Khaddage & Margaritis, 2020).

The rethinking of teaching practices goes beyond pedagogy. Rather than preparing teachers to use new tools and technologies to "*do conventional things better*", teacher educators should be preparing teachers to use transformational technologies to "*do better things*" (Fishman & Dede, 2016; Roschelle et al., 2000). Therefore, with the widespread adoption of 1:1 computing, smartphones, tablets, and affordable wireless VR headsets, the idea of "rethinking practices" should center around how transformational technologies can support collaborative learning across a broad spectrum of teaching environments. While there are many emerging technologies with transformational potential, eXtended Reality (XR) stands out due to its ability to provide fully immersive experiences that are interactive and entertaining while also fostering deeper learning.

eXtended Reality (XR)

Extended reality (XR) is a comprehensive term used to describe: (a) augmented reality (AR), commonly used on smartphone and laptops to overlay graphics on webcam images; (b) mixed reality (MR), a semi-immersive form of virtual reality that uses a transparent heads-up display (HUD) to blend the physical and virtual world; and (c) virtual reality (VR), a technology that uses stereoscopic images projected from either a smartphone or VR headset (see Figure 1), providing a fully-immersive experience where users feel a sense of "presence" in the virtual world (Sanchez-Vives & Slater, 2005). Users can interact with these virtual environments by either tapping on their smartphone screen, pressing buttons on a game controller (e.g., Xbox gamepad), or through hand gestures using wireless VR controllers. Experiences can also be made more immersive with haptic feedback (e.g., controllers that vibrate) by enhancing the visual and auditory information present in the virtual environment (Civelek et al., 2014).
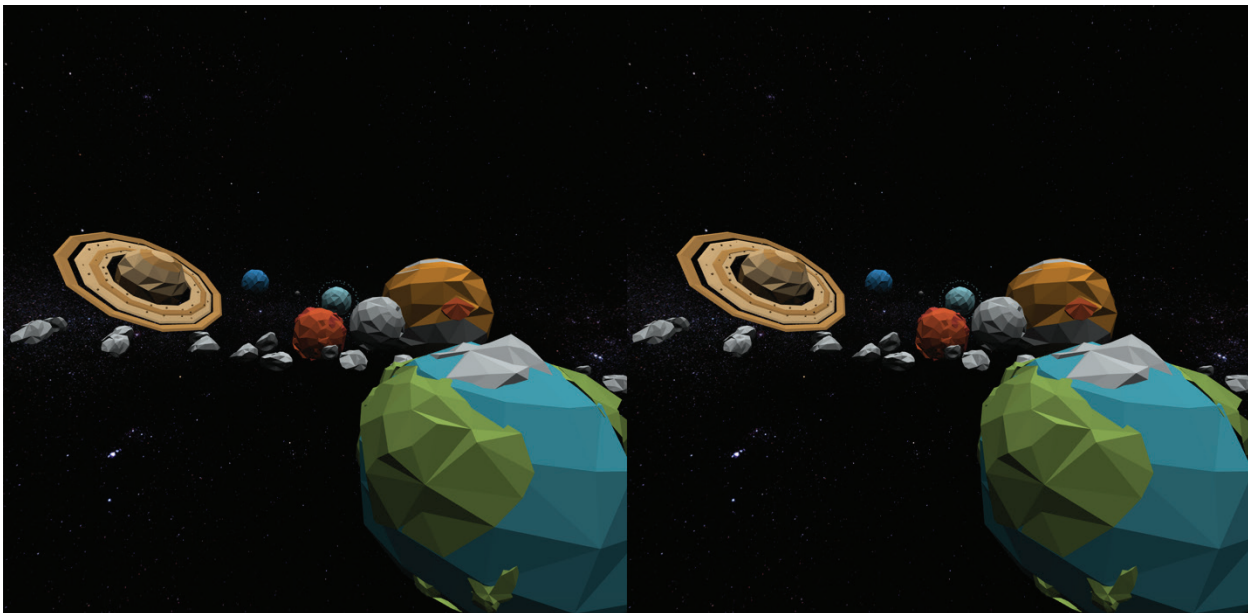

Figure 1. Example of a WebXR stereoscopic projection that can be used with a Google Cardboard to create a semi-immersive VR experience.

There are a variety of hardware solutions for experiencing XR in educational contexts. One of the most inexpensive ways is by using a viewer such as Google Cardboard (i.e., an affordable cardboard box with two lenses) which allows users to view stereoscopic images on a smartphone screen. Recently, high-end commercial VR headsets, such as the Oculus Quest 2 (https://www.oculus.com/quest-2/), have become much more affordable ($299). These wireless headsets have cameras that scan the room, allowing users a full six-degrees of freedom with the ability to walk through their virtual environments. In addition, the headset comes with two wireless controllers that make it possible to track hand gestures and interact with 3D objects (see Figure 2). As XR becomes more widely available, there are a growing number of free and commercial tools that teacher educators can use to integrate this technology into their practice (see Table 1).

Figure 2. Google Cardboard (left) and Oculus Quest 2 (right) VR headsets.

Table 1

List of WebXR Tools

Tool	Description
A-Frame (Open source)	A web framework for building 3D/AR/VR experiences. Allows users to make 3D worlds with HTML. Support Oculus Quest, Rift, Windows Mixed Reality, SteamVR, mobile, and desktop devices. (https://aframe.io)
Babylon.JS (Open source)	A simple web rendering engine aimed at artists and developers who want to create powerful, beautiful, and simple 3D web experiences. Babylon.JS supports WebXR and physics. (https://www.babylonjs.com/)
CoSpaces EDU (Commercial)	A commercial web-based tool that supports the creation of AR and VR environments. Using a drag-and-drop interface, CoSpaces EDU makes it easy to create immersive 3D environments that users can experience on laptops, tablets, smartphones, and VR headsets. These customizable 3D environments can include interactive elements that users control with their CoBlock programming language or more advanced text-based scripting. (https://cospaces.io/edu/)
Gravity Sketch (Free)	A real-time platform for developing concept sketches and transforming them into detailed 3D models. Gravity Sketch supports creating in VR and on tablets with multiple users collaborating. This commercial design software is free to users. (https://www.gravitysketch.com/)
Thingiverse (Free)	A website dedicated to the sharing of user-created digital design files. Providing primarily free, open-source hardware designs with an extensive library that serves as a repository for 3D printing models. (https://www.thingiverse.com/)
Three.JS (Open source)	A JavaScript 3D library that uses WebGL to render 3D graphics in the browser window. Three.JS is the underlying technology used by most WebXR tools. (https://threejs.org)
Tilt Brush by Google (Commercial)	Tilt Brush allows users to paint in 3D space with VR. The 3D space of the room becomes the user's canvas, and they can select from a broad palette of colors, brush strokes, and textures. (https://www.tiltbrush.com/)
Tinkercad (Free)	An online 3D modeling program that runs in a web browser. Simple and easy of use. One of the most popular platforms for creating models for 3D printing and an entry-level introduction to constructing solid geometric models in schools. (https://tinkercad.com)
VRChat (Free)	A virtual world where users can interact with people all over the world. Users can experience VRChat with or without a VR headset. With this tool, users can interact via voice and text chat and communicate body language with motion capture from 3D headsets and controllers. This tool is not K-12 classroom appropriate due to public servers. (https://hello.vrchat.com/)

eXtended Reality (XR) in Education

Over the past decade, there has been exponential growth in the number of research-based studies using XR technologies in K-12 education. Recent research has included using AR in science education to teach about electrical circuits (Wang, 2020), study the movement of the moon (Liou et al., 2017), and explore 3D models of landforms (Huang et al., 2019). AR has also been used in mathematics to provide an augmented layer to paper-based workbooks (Arvanitaki & Zaranis, 2020) and special education to support individual student needs (Cakir & Korkmaz, 2019). Like AR, recent studies using VR tend to center around STEM education. VR has been used in science to experience virtual field trips (Cheng & Tsai, 2020) and collaborate with peers while exploring cellular structures (Thompson et al., 2020). Outside of STEM, VR has been used in social studies to view a reconstruction of the Roman Empire (Villena Taranilla et al., 2019) and to study the history and science of ancient ruins (Ioannou & Ioannou, 2020). VR has also been used in music education to explore the spatial relationship of instruments and learn about musical genres (Degli Innocenti et al., 2019).

While there has been a deluge of XR research in K-12 education, only a handful of these studies focus on teacher preparation. In science, this includes pre-service teachers using VR to develop their science process skills in a virtual lab (Artun et al., 2020) and virtual field trips to support pre-service teachers in a science methods course (Harron et al., 2019). Studies with in-service teachers have used AR tutoring systems to support the development of geometry concepts (Ibili et al., 2019) and found that VR can be used for more than just "hype" in high school classrooms when combined with interactive chemistry, physics, and history simulations (Fransson et al., 2020).

As the research demonstrates, teachers can use XR technologies across various STEM and non-STEM contexts. Up to this point, however, the research has primarily focused on individual experiences with AR/VR where the student is either a passive participant looking at a 360-degree photosphere, exploring static 3D environments, or using pre-created simulations. If teacher educators want pre- and in-service teachers to adapt and innovate using transformational technology, they need to model these technologies across a wide variety of teaching contexts. Therefore, based on the literature review, the following sections outline the next steps that researchers and practitioners should take to prepare teachers to innovate and adapt to an ever-changing world.

LESSONS LEARNED FOR RESEARCH

Researchers need to continue capturing the broader impact and long-term effects of the pandemic on teacher education and the field as a whole (Levine et al., 2021). These impacts include documenting effective and ineffective problem-solving strategies to inform the field about the opportunities and challenges that lay ahead (Ferdig et al., 2020). While some of these challenges may include ongoing issues related to teacher recruitment and retention (Donitsa-Schmidt & Ramot, 2020; la Velle et al., 2020), researchers should use the lessons learned from 2020 as an opportunity to rethink how teacher educators prepare pre- and in-service teachers for hybrid teaching environments and how technology can support transformational practices across multiple learning contexts.

Supporting Transformational Practices

To support transformational practices, researchers should investigate how teacher educators can use virtual platforms to engage students in critical thinking and problem solving (Fishman & Dede, 2016). These investigations should include research about using XR technologies to support scientific inquiry through interactive chemistry, physics, and lab simulations (Artun et al., 2020; Fransson et al., 2020). Future lines of inquiry should investigate how teacher educators can model simulations and XR technologies across both STEM and non-STEM subjects. These investigations should go beyond the use of virtual field trips as a teacher-guided exercise with smartphones in cardboard boxes (Cheng & Tsai, 2020). Instead, researchers should study how teacher educators can leverage fully immersive XR using 3D models and simulations for cross-disciplinary learning (Ioannou & Ioannou, 2020; Villena Taranilla et al., 2019).

Co-teaching, Identity Development, and Technical Support

Conventionally, teacher educators prepare pre- and in-service teachers to work autonomously since they are often the only adult in the room (Fraser, 2007; Lortie, 2002). Virtual platforms, however, eliminate the barriers created by classroom walls and open the space to rethink how students may benefit from co-teaching (Tsui et al., 2020). Co-teaching benefits could be transformative in concurrent and hybrid teaching contexts where teachers currently lack the human resources needed to manage both in-person and virtual students simultaneously (Deyamport, 2020). Researchers should investigate how teacher educators can better prepare and support pre- and in-service teachers to co-teach across virtual and concurrent contexts.

Additionally, further research is needed to address concerns that the pandemic has stunted undergraduate students' identity development as teachers (Donitsa-Schmidt & Ramot, 2020). Researchers may consider using Identity Theory (Gee, 2000) to investigate how undergraduate pre-service teachers express their natural, institutional, discursive, and affinity perspectives as future educators. Furthermore, researchers need to examine how teacher educators can better prepare pre- and in-service teachers to step into technical support roles with both students and parents (Greenhow et al., 2020).

Third-party Communication Tools

As research from the pandemic has demonstrated, inactive webcams (Donitsa-Schmidt & Ramot, 2020) and "Zoom fatigue" (Donitsa-Schmidt & Ramot, 2020; Quezada et al., 2020) are problems that teacher educators will need to learn how to overcome. Therefore, researchers should investigate how other third-party tools, such as Slack, Discord, and VRChat, can be used to provide an additional layer of real-time communication between teacher educators and their students. In doing so, researchers should also investigate how to develop virtual communication tools specifically designed for teachers and teacher educators that account for student safety and privacy across virtual, hybrid, and in-person learning contexts.

Expressing Creativity

Researchers should investigate how teacher educators can use technologies to transform how pre- and in-service teachers express creativity in their professional practice (Sawyer, 2019). This includes recognizing that 3D modeling is a new digital literacy that teacher education programs rarely teach (Radniecki, 2017). Therefore, researchers should investigate how 3D modeling and the sharing of 3D assets (Kaya et al., 2019) can support transformational practices such as creating interactive simulations by teachers and students (Dickes et al., 2019; Petrosino et al., 2018). Researchers may also consider investigating how teacher educators can use 3D tools to support new forms of reflective practice and how these tools open the door for research about teachers creating and customizing their own virtual teaching environments.

Computational Thinking

Lastly, researchers should investigate how teacher educators can better address computational thinking as part of pre- and in-service teacher professional development (Dede et al., 2013; Grover, 2018). This includes finding ways to fill the gap between block-based and text-based programming languages (Weintrop & Wilensky, 2017) and developing creative computing tools to aid in the development of interactive apps and virtual environments (Frydenberg & Andone, 2019; Khaddage & Margaritis, 2020). This research should ultimately inform best practices for teacher educators integrating transformational technologies, such as XR, rather than immediately returning to conventional practices after the pandemic.

Based on the lessons learned for research, the section below outlines practical advice for teacher educators regarding what they should do next to prepare pre- and in-service teachers to adapt to an ever-changing world.

Supporting Transformational Practices

To support transformative technology use, teacher educators should introduce their pre- and in-service teachers to frameworks such as the replacement, amplification, and transformation (RAT) (Hughes et al., 2006) or the substitution, augmentation, modification, and redefinition (SAMR) models (Romrell et al., 2014). In doing so, teacher educators can support classroom practices that aim to move beyond simple replication and move toward transformative practices.

As supported by the research, teacher educators should use the pandemic's disruption to support alternative forms of assessment. Teachers should be encouraged to implement different formative assessment types such as blog posts, digital posters, mind maps, and showcase their work by creating online portfolios (Donitsa-Schmidt & Ramot, 2020). Teacher educators should also consider using transformational tools, such as XR, to foster critical thinking and problem-solving skills. For example, XR tools such as CoSpaces EDU and Babylon.JS have built-in physics engines that can simulate applied forces and the effects of gravity (see Figure 3). Teachers and students can use physics engines to perform experiments in virtual space that might be too dangerous or too expensive for the classroom. While students can conduct physics experiments on their laptops or tablets, they can also experience them in fully immersive XR, which provides the perception of distance and depth versus the flat paper-like appearance of other browser-based simulations.
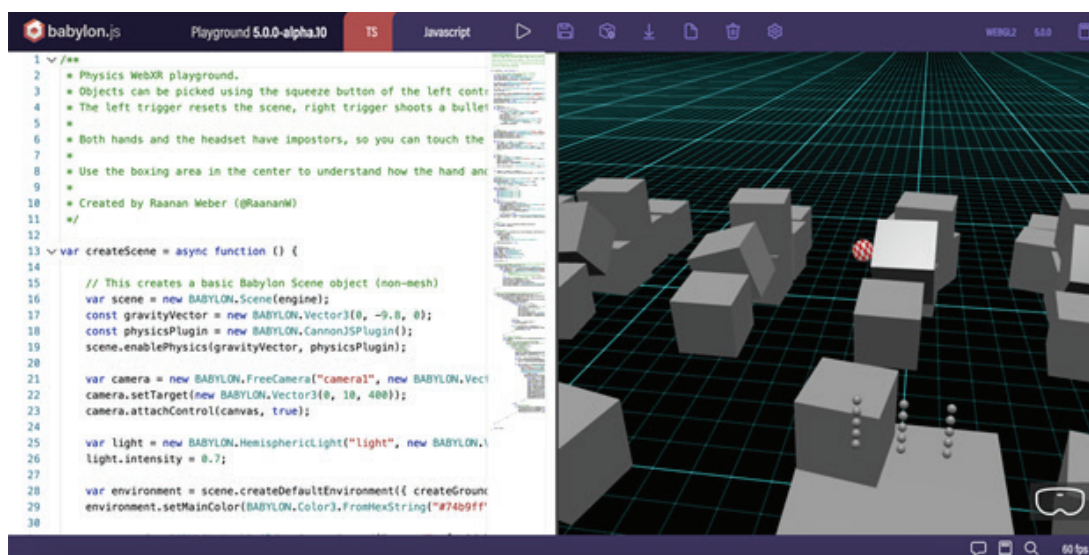

Figure 3. Example of code editor and preview of WebXR physics playground made in Babylon.JS.

Co-teaching, Identity Development, and Technical Support

Teachers and teacher educators frequently use Professional Learning Communities (PLC) as a space for collaboration (Harris & Jones, 2010). These PLCs typically include subject-specific teachers at the same school or as an online community of educators who share a common interest (Carpenter & Morrison, 2018). As part of these PLCs, teachers will often share tools and knowledge with their peers. At the start of the pandemic, these practices shifted online using videoconferencing and social media platforms (Donitsa-Schmidt & Ramot, 2020; Harron & Liu, 2020). While conventional PLCs are typically limited to a handful of participants, the use of virtual platforms opens the door for collaboration across schools, districts, states, and internationally.

The pandemic has dramatically changed how teacher educators collaborate and mentor their pre- and in-service teachers. While traditional teacher education programs often focus on field hours and observations, the move to virtual teaching has complicated the conventional teacher accreditation process (Ellis et al., 2020). Teacher educators should use this as an opportunity to rethink how pre- and in-service teachers can support their students through co-teaching across in-person and virtual environments (Deyamport, 2020; Tsui et al., 2020). To support co-teaching, teacher educators need to explore how to use collaborative virtual environments to prepare teachers to act as a "guide on the virtual side." This includes preparing teachers to give up some of their authority by opening their classrooms to other educators' perspectives. By doing so, teachers can work as a community to lessen the burden of concurrent teaching while also striving to provide both the agency and structure needed for student growth.

While some researchers are concerned that the pandemic has stunted undergraduate students' identity development as teachers (Donitsa-Schmidt & Ramot, 2020), teacher educators should instead embrace this opportunity to redefine how pre- and in-service teachers develop their identity as innovators in education. This includes fostering a growth mindset and demonstrating a failure positive attitude when integrating technology into the classroom (Martin, 2015). Teacher educators should encourage their students to play and experiment with emerging technologies and serve as leaders by sharing their discoveries as part of their PLCs and online communities.

Furthermore, teacher educators need to better prepare pre- and in-service teachers to step into technical support roles with both students and parents (Greenhow et al., 2020). This is especially true for more experienced educators who have previously resisted technology adoption in the classroom. Teacher educators should model a positive attitude with the aim of shifting resistance to enthusiasm (Ellis et al., 2020) when dealing with technical support issues. Rather than viewing technical support as another barrier to learning, teacher educators should leverage their students' expertise to help support each other. Additionally, technical support issues with parents should be viewed as an opportunity to build relationships between the school and family, focusing on supporting student success.

Third-party Communication Tools

The pandemic has served as an opportunity for teacher educators to experiment with third-party tools that expand the capabilities of their LMS. While educators can create new content in these systems, students are often limited to discussion posts and attaching files (Adams Becker et al., 2017). Leveraging apps and software outside of the LMS can provide an additional layer that supports communication and creative output. To support more flexible and adaptive teaching, teacher educators should model real-time group communication via Discord and Slack (Harron et al., 2020). In addition, teacher educators could host rounds of the popular online game *Among Us* (Innersloth, 2020) as a way of developing pre- and in-service teachers' communication skills while building community as a cohort (Gracey, 2020).

Furthermore, there are emerging tools that allow for virtual "in-person" communication using XR. One of these tools, VRChat, enables users to interact with each other using 3D avatars with a full range of head and hand motion. This allows users to communicate with body language, such as giving a thumbs up and tilting the head when asking a question. Teacher educators could use VRChat as a tool to help combat the feelings of anxiety and isolation that students are feeling during the pandemic (Scull et al., 2020). This type of communication could be genuinely transformative for teacher education since it can allow cohorts to meet virtually and even allow for simulations where pre- and in-service teachers roleplay classroom scenarios to tackle complex issues such as confirmation bias.

Teacher educators must address several ethical issues before this type of virtual chat/meeting is commonplace. First, the tools that enable these chats are commercial products that are open to all ages. As such, they currently lack the privacy and safety features needed for implementation in K-12 environments. Secondly, some of the most common VR headsets, such as the Oculus Quest 2, are owned by Facebook and require a Facebook account to use. School districts often block these accounts since the information they share may violate the Family Educational Rights and Privacy Act (FERPA). Third, since these communication tools are created for the general public, they usually lack the features that would allow a teacher to monitor students' progress in virtual space. Finally, since users can virtually reach out and touch somebody, what are the ethical and legal ramifications of violating a student or teacher's virtual space? These are complicated issues that both practitioners and researchers will need to tackle moving forward.

Expressing Creativity

There is a growing recognition that developing both teacher and student creativity is essential for innovation to occur in education (Sawyer, 2019). For example, the Revised Bloom's Taxonomy (Krathwohl, 2002) places the ability to create above evaluation. In addition, the OECD's 2022 PISA will include an Assessment of Creative Thinking, in recognition that educational systems should enable creative learners (OECD Program for International Student Assessment [PISA], n.d.). Furthermore, the ISTE's Standards for Educators also indicate that the teacher should work towards becoming a facilitator of creativity by creating "learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems" (ISTE, 2021).

Teacher educators should be modeling creativity by creating new and original works they share with pre- and in-service teachers. The goal is not to create the most amazing exemplar but rather to demonstrate a willingness to try new things, model a failure positive attitude, and work towards personal and professional growth. Teachers should be encouraged to remix lessons and environments created by others and share their work with online communities, such as the ScratchEd (Resnick et al., 2009). In doing so, teachers can shift the profession away from the industrial model of education towards recognizing the value of creativity in the classroom (Sawyer, 2019).

In recent years, the maker movement has brought more creative opportunities into schools. However, due to the pandemic, maker tools (such as 3D-printers and laser cutters) have been left collecting dust since teachers and students no longer have physical access. Digital platforms, such as CoSpaces EDU, Scratch, and Tinkercad, are akin to a digital makerspace where students can create computational artifacts that they share with others. Furthermore, tools such as Tilt Brush can allow students and teachers to virtually paint and sculpt clay, while Gravity Sketch allows teams to collaborate in a shared XR space to create 3D designs.

Teacher educators can use these collaborative platforms to support pre- and in-service teachers in developing the knowledge, skills, and ability to create 3D models and simulations. Traditionally, teachers tend to share resources such as worksheets and presentations, which are easily photocopied or duplicated on platforms like Google Drive. While 3D models may seem more complicated, educators can easily share them across platforms such as Thingiverse and Tinkercad (Kaya et al., 2019). Additionally, tools such as CoSpaces EDU, Babylon.JS, and A-Frame allow users to import 3D models to create 3D scenes and environments. For example, teacher educators could use 3D modeling tools to construct a model that includes the various organelles in a cell. This model can then be viewed in AR/VR or imported as an asset to create an interactive digital story. Additionally, these models can be 3D-printed to support hands-on learning and to provide a tangible artifact.

Furthermore, the use of 3D design software could open an entirely new dimension where teacher educators engage in reflective practice (Jay & Johnson, 2002). Educators could create virtual artworks, sculptures, and other computational artifacts that they share with others. Rather than merely relying on pre-made spaces that replicate the look and feel of a traditional classroom (e.g., rows of desks, teacher lecturing at the front), these tools also open the door for educators to create and customize their own virtual teaching environments. By doing so, teachers can further express their identity as an educator while also designing spaces that support active learning.

Computational Thinking

Over the past decade, there has been an increased call from the education community to encourage computer science for all (CS4All, 2021). Block-based programming languages have been gaining popularity as a gateway to computer science since the introduction of Scratch (Resnick et al., 2009). Taking an object-oriented approach to coding, block-based languages typically use different colored blocks that snap together like Lego bricks to create programming scripts that control objects and variables.

It is essential that teacher educators prepare pre- and in-service teachers to develop computational thinking skills. For many teachers, this means learning how to code for the first time alongside their students. An hour of code each November is not enough to prepare our teachers and students with the cross-disciplinary skills they need to thrive in a digital world (Patterson, 2016). Instead, teacher educators can infuse tools that support block-based programming languages as an introduction to key computational thinking practices such as the steps of algorithms, abstraction, decomposition, generalization, iteration, and debugging (Shute et al., 2017). Block-based programming languages also serve as a stepping stone towards learning text-based scripting (Weintrop & Wilensky, 2017). These introductory programming languages are typically web-based, making them accessible across various in-person and virtual contexts.

Teacher educators need to present more examples of infusing computational thinking in authentic ways as part of pre- and in-service teacher preparation. This includes designing and making apps (Khaddage & Margaritis, 2020), creating interactive digital stories (Fields et al., 2014), programming robots and microcontrollers (Grover & Pea, 2013), analyzing public data for citizen science (Hestness et al., 2018), and creating XR environments (Frydenberg & Andone, 2019). The teaching of computational thinking should not be limited to K-12 computing courses, but rather teacher educators should find ways to infuse the creation of computational artifacts as a standard classroom practice.

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Redefining and Transforming Field Experiences in Teacher Preparation Through Personalized Mixed Reality Simulations

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Abstract: The COVID-19 pandemic has prompted an abrupt, unplanned pivot and reimagining of field experiences for teacher education programs. Overnight, many faculty moved from partnering with mentor teachers at local schools to using mixed reality simulations to develop and assess preservice teachers' (PSTs) skills. Mixed reality simulations offer opportunities to practice teaching through interactions with avatar students in a virtual classroom. The avatars, controlled by a human simulation specialist, respond to teaching practices and may also initiate challenges, feedback, and coaching. Teaching practices learned through experiences in the virtual classroom may build confidence and skills that transfer to PSTs' interactions with real students. For faculty, mixed reality simulations provide benefits, such as a standardized experience for assessing growth. By leveraging the technology's affordances (e.g., online access, immersive learning, standard challenges, and pausing or restarting), mixed reality simulations can redefine and transform field experiences, increasing opportunities for differentiated instruction, personalization, and formative assessments in ways not possible through in-person field experiences. However, little information is available regarding effective simulation design, use of culturally relevant pedagogies, and integration of simulations as field experiences within teacher preparation course work. This chapter provides practical guidelines and examples that support preservice faculty in developing simulation scripts, embedding simulations in course syllabi, and training simulation specialists to conduct mixed reality simulations.

Lesson Learned: Teacher educators should have learned how to use mixed reality simulations to redefine and transform PST field experiences providing new opportunities for differentiated coaching, personalized learning and practice for making culturally affirming teaching decisions.

AN INTRODUCTION TO MIXED REALITY SIMULATIONS AS PRESERVICE TEACHER FIELD EXPERIENCES

As the doors to preschool through high school classrooms closed during the pandemic, the opportunity opened for teacher preparation programs to provide novice teachers with digital field experiences using mixed reality simulations. Leveraging avatar students controlled by a human simulation specialist and access to the classroom through online technology, mixed reality simulations provided a safe space for preservice teachers (PSTs) to develop their skills as practitioners and receive coaching (Gundel et al, 2019). Parallel to standard patient simulations used in medical education to develop the communication and practice skills of doctors, research suggests that mixed reality simulations have the potential to provide innovative immersive learning experiences that may better equip PSTs for their interactions with students (Dieker et al., 2014; Cohen et al. 2020). Although teacher preparation programs are increasingly using mixed reality simulations as a pedagogical tool, prior to 2020, we knew little about how preservice faculty design and implement simulations effectively and even less on methods to leverage the technology's affordances (e.g., online access, immersive learning, standard challenges, and pausing or restarting) to personalize teacher learning (Bondie et al., 2021). The purpose of this chapter is to provide teacher preparation faculty with guidelines for design and use of mixed reality simulations to promote and assess PST learning.

WHAT WE KNOW

Field experiences are ubiquitous in teacher preparation programs in the United States, playing a significant role in providing practice opportunities (Anderson & Stillman, 2013; Ingersol & Strong, 2011). Among many goals, one purpose of field experiences is to develop the capacities of novice teachers to listen, observe, and learn from students while practicing teaching skills alongside a mentor teacher (Anderson & Stillman, 2013). Highlighting the importance of working with students and mentors in teacher preparation, Grossman et al (2009) identified that "...many of the most difficult aspects of teaching lie in these interactive dimensions of practice" (p. 2095). However, given the variations among available mentor teachers, the differing amounts, and types of daily experiences with students at local schools, and minimal coordinated connections to university courses, novice teachers rarely engage in teaching or interactions that guarantee the practice of a specific set of skills during field experiences (Zeichner, 2010). Further, Anderson & Stillman's (2013) review of research found a need for greater measurement of the teaching practices learned through field experiences.

Grossman et al (2008) explained that teacher preparation was "missing opportunities to practice elements of interactive teaching in settings of reduced complexity" (p.109). Without much control from faculty (Grossman et al., 2008), field experiences taking place in local schools may be suboptimal as vehicles for adult learning due to the lack of immediate feedback offered and systematic alignments of the novice teacher's specific professional learning needs (Pape, 2021). These challenges of appropriate and rigorous practice during field experiences are not unique to teaching; professions such as medicine and business have addressed similar issues using simulations in professional preparation where rapid decisions in a complex nondeterministic, multivariable system can be practiced (Dotger, 2015; Mayer et al., 2011). Currently, the reduced access to local schools during the COVID pandemic has pushed teacher education faculty to explore mixed reality simulations as a substitute for or supplement to in-person field experiences at local schools (AACTE, 2020). This shift presents an opportunity for teacher educators to redefine field experiences to include both virtual and in-person professional learning and transform field experiences through differentiated coaching and personalized practice in teacher preparation (Bondie et al., 2021).

Simulations and Professional Learning

Teacher preparation faculty look toward research across professions to better understand how to design simulations with interactive, yet standardized, dimensions of practice within realistic contexts (Dotger, 2015). For example, medical educators define simulations as "instruction in which learners interact with facsimiles of a clinical task, a clinical context, or an environment to learn clinical skills that can then be applied directly to actual patient care" (Everett et al., 2019, p. 129). McGaghie et al. (2016) reported that simulations using standard patients in medical education impacted confidence, knowledge, and skills when paired with feedback, reflection, and opportunities for repetition. In addition, stronger learning outcomes have been associated with simulations than traditional clinical approaches to medical education (Mc-

Gaghie et al., 2016). Taken together, lessons from medical education suggest that mixed reality simulations in teacher education could be designed similarly, with embedded mastery opportunities, and implemented with measurements of PSTs' confidence, knowledge, and skills (Cohen et al., 2020; Bondie et al., 2021).

In addition to learning from simulation use across professional fields, faculty can also build on the past and growing literature examining the impact of simulations within teacher education. Indeed, as far back as 1865, Edwards described in his lecture for the National Teacher Association the use of role-play simulations in teacher education. Past research has explored simulations that prompt interactions to build teaching skills and learn from self-reflection (Cruickshank, 1988; Walker & Dotger, 2012). For example, Klesius et al. (1990) observed a positive long-term outcome of classroom implementation of practices that were learned in teacher preparation methods courses through immersive learning experiences (e.g., role play and video) versus direct instruction. Dotger (2015) used role play simulations to build teacher identity through individual decision-making used during simulations and shared analysis of teaching dilemmas that occurred. Adding technology to simulations in teacher preparation over the past decade, Bondie et al. (2021) found that mixed reality simulations have been used to develop a wide range of teacher practices including communication skills used in parent-teacher conferences, behavior management, and higher-level questioning. Recently, Cohen et al. (2020) employed experimental design finding a positive impact of coaching in between two mixed reality simulations lasting less than about five minutes each, to rapidly develop teacher skills in redirecting off-task student behavior. As technology has developed, research on simulations in teacher preparation has moved from role-plays in methods courses to mixed reality simulations showing promising results for improving teaching practices.

Why Mixed reality Simulations Now

In summer 2020, the AACTE held weekly demonstration webinars that attracted 1,100 registrants to learn about mixed reality simulations (M. Jo, personal communication, February 17, 2021). The burgeoning interest appeared because virtual simulations met current needs during the pandemic, while also addressing longer-term challenges with field experiences in preparing novice teachers. Unlike in-person schools, where daily teaching and learning opportunities unfold in uneven and unpredictable ways, simulated field experiences are planned and designed to respond to PSTs' specific learning needs (Cohen et al., 2020). Simulations can provide a standardized field experience where student avatars present PSTs with predetermined opportunities, challenges, and differing responses based on the teaching practices that might occur (Dieker et al., 2014; Walker & Dotger, 2012; Gundel et al., 2019). These opportunities can only be realized through a deliberate iterative design process to develop mixed reality simulations and implementation that includes assessment and feedback loops for both PTs and faculty (Bondie et al., 2021).

LESSONS LEARNED FOR RESEARCH

Two lessons learned from previous research illuminated the importance of teacher preparation through mixed reality simulations. General research on effective practices in teacher preparation build a case for the use of mixed reality simulations in teacher preparation, such as how Schön (1983) observed, "the extent professionals take this risk and set-back is dependent on their ability to find a context to practice at low risk (p. 279)." In addition, Kavanagh et al. (2020) cautioned that studies examining teacher professional education should focus on how teacher practices are thoughtfully adaptive and responsive to students. Past research helps us imagine how a standardized context in a mixed reality simulation holds the potential to "improve teaching quality by assessing and evaluating, in a robust and valid way, not just what teachers know about learning and teaching, but how they enact their practice and use evidence thereof to impact student learning outcomes" (Meuwissen & Choppin, 2015, p. 20). However, PSTs and faculty are only beginning to discover the possible opportunities, challenges, and uses of mixed -reality simulations in teacher education.

Field experiences are redefined and transformed when mixed reality simulations in teacher preparation leverage opportunities unique to a virtual classroom including instantly changing locations and reducing or increasing the class size (Bondie et al., 2021). For example, because live simulation specialists control the actions of the avatars, simulations may be designed to adapt to the PSTs' teaching practice and support PSTs in developing more responsive expertise versus routine expertise (Kavanagh et al., 2020). The simulation procedures should include recognizing and building systematically on the strengths PSTs bring, identifying the unlearning that needs to take place, and providing new learning

that will transfer to improved classroom teaching and management (Cross, 2003). Unlearning may include recognizing assumptions, while new learning may include PSTs practicing language and decision-making habits that counter unconscious responses often rooted in childhood learning and lived experiences (Gay & Kirkland, 2003; Doucet & Adair, 2013). Practice makes permanent--therefore, the teaching practices rehearsed through simulations should be carefully determined (Kavanagh, et al., 2020) critically examined (Sleeter, 2012), and rooted in research-based practices (Cohen, 2021, Gundel et al. 2019). Most importantly, mixed reality simulation design should reflect a contemporary personalized adult learning model that adjusts to the unique strengths and learning needs of each PST (Pape, 2021).

Although there is a growing body of research, a review of the literature published in the last 10 years suggests that studies have generally not articulated practical simulation information such as: how scripts were developed, reliability measures to ensure that the intended outcome was learned, the role cultural relevance plays in the avatar student responses and scenario, the novel opportunities the technology provides, and processes to ensure validity (Bondie et al., 2021). In addition, many previous simulations did not leverage the affordances of a virtual classroom such as controlling time (e.g., restarting and erasing the first trial) and personalizing the professional learning experience based on teacher performance (Bondie et al., 2021). Future research and implementation of simulations in teacher preparation will benefit from addressing these lessons from research.

LESSONS LEARNED FOR PRACTICE

The *Substitution, Augmentation, Modification, Redefinition* (SAMR) model of technology use in education (Hamilton, Rosenberg, & Akcaoglu, 2016) offers a framework for considering how to apply mixed reality into teacher preparation program practice. To avoid simple substitution, guidelines are needed to support faculty in leveraging the unique aspects of mixed reality classrooms to redefine and transform field experiences. For example, faculty should design mixed reality simulations to include personalization, differentiated instruction, and standard assessment measures not available through typical in-person student teaching. Equally important, faculty need to understand the limitations and challenges of this technology, such as having one simulation specialist puppeting a classroom filled with student avatars who appear to have different races. Further, deliberate attention must be paid to the socio-cultural context developed through the planned scripts and improvised experiences in the virtual classroom.

In addition to information about the design of mixed reality simulation scripts, faculty need guidance on teaching with mixed reality simulations. For example, faculty need to know how to orient PSTs to teaching in the virtual classroom (Bondie et al., 2021). Lessons for teacher educators include simulation script development, embedding simulations within course syllabi, and procedures for training simulation specialists, who operate the software and improvise the avatar dialog with PSTs.

Mixed Reality Simulation Script Development

Zeichner (2010) noted, "A perennial problem in traditional college- and university sponsored teacher education programs has been the lack of connection between campus-based, university-based teacher education courses and field experiences" (p. 91). Faculty and school-based partners formed a design team to create simulation scenarios by collaboratively exploring problems of P-12 student learning and related teaching practices. Once a design team was formed, the infinity graphic (Figure 1) displays the iterative process used to develop simulation scripts and the related materials to promote and measure PST learning. Culturally affirming pedagogy was at the center, launching the design process and providing a through line that was considered as the design team completed each of the eight iterative steps. The eight script development steps were divided into two parts: designing a scenario, and then creating a model of teacher learning that included activities before, during, and after the simulation. If the information required at each step was available, this process was completed in an afternoon or conducted more iteratively over a semester. The next section describes in detail each step of the iterative script development process starting at the center with culturally affirming pedagogy and then continuing with each of the steps in part 1 develop a scenario and part 2 plan a model of teacher learning.
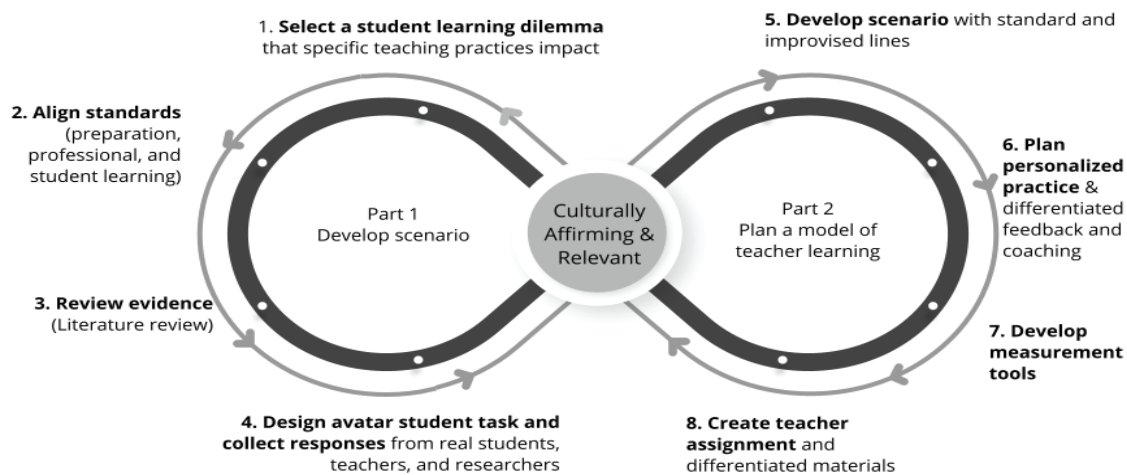
Figure 1. Script development process.

Culturally Affirming and Relevant Teaching. Cultural awareness was centered and was a through line at each step because the technical affordances of the virtual classroom were particularly well suited to provide learning experiences that develop critical consciousness as the action can be slowed, fast forwarded, and stopped at any moment to isolate and make salient opportunities that are unfolding (Gay & Kirkland, 2003; Bondie et al., 2021). For example, the simulation specialist paused the action and moved the PST to analyze perceptions, generate options for teaching responses, and consider the impact of language used to communicate with students. In the virtual classroom, PSTs may have experienced increased self-efficacy as well as comfort in implementing unfamiliar teaching practices (Gundel et al., 2019) and engaging in challenging conversations (Walker & Dotger, 2012).

While mixed reality simulations provided 'safe' teaching experiences because the avatar students were not real, unless used intentionally, simulations could have been harmful. Teaching avatars may have suggested to PSTs that teaching can be done without knowing the students personally, or without valuing the students' perspectives, therefore reinforcing racial stereotypes. To avoid this concern, simulation scripts included deliberate opportunities for PSTs to learn from the avatar students. For example, PSTs entered the virtual classroom during a student discussion simply to practice listening to students and learning to recognize and value student cultural funds of knowledge (Moll et al., 1992). After a few minutes, the simulation specialist removed the PST from the virtual classroom to debrief their perceptions and analyze student strengths and needs with an avatar coach. Following reflection and coaching, PSTs returned to the virtual classroom with a deliberate plan of action. This type of slow reflective practice was impossible in a real classroom; there PSTs made many rapid decisions during a lesson and could only reflect on all those decisions after the lesson.

Whether mixed reality simulations were purchased or developed by teacher education faculty, simulation scripts needed to be continuously examined for the relationships between culturally affirming, relevant, and sustaining pedagogy and the teaching practices developed and measured through interactions with avatar students. Early role-play simulations of parent teacher conferences have demonstrated that simulations could promote the development of teacher communication strategies and skills (Walker & Dotger, 2012). Doucet and Adair's (2013) recommend that teachers should be prepared to engage in and facilitate conversations about race with young children as well as critically examining their own language and actions that may promote oppression. Taken together, mixed reality simulations scenarios supported PSTs in practicing conversations discussing race and reflecting critically on their own perceptions, responses, and teaching practices. In addition, mixed-reality simulations focused on specific pedagogical skills, such as providing feedback or asking questions, had planned avatar responses that provided teachers with opportunities to engage in conversations about race.

Devine et al. (2012) explored the long-term reduction of implicit bias through five strategies: re-association (stereotype replacement), refuting (counter-stereotypic imagining), individuation (obtaining specific information about group

members), increasing opportunity for positive contact, and perspective-taking. These strategies were deliberately incorporated into the mixed reality simulation script. For example, script developers intentionally planned student avatar responses that refute or provide opportunities for re-association from dominant stereotypes. Students in the back row responded first to a teacher's question, rather than students in the front or center of the classroom. An avatar of color may respond with a correct answer using complex sentence structure, while a white student may have an incomplete response. Deliberate effort was constantly made to avoid reinforcing stereotypes through student avatar language and behavior. To ensure that the PST learning experience deliberately promoted culturally relevant pedagogy, designers sought feedback from program stakeholders to bring a critical lens to the mixed reality simulation scenario and model of learning designed to support PSTs in developing critical consciousness and self-reflection (Gay & Kirkland, 2003).

Ultimately, having cultural awareness at the center and as a connecting through line of simulation development provided an opportunity for faculty designers to reflect on their own beliefs and assumptions that shaped: values for teaching and learning, goals for PSTs, questions asked about PST learning, types of data collected, analysis methods, and audiences for findings. Simulation designers wrote a short statement or made a video to record and make visible their own lived experiences, perspectives, strengths, values, and potential blind spots. Simulation designers returned to this reflexivity statement throughout the development process to be reminded of potential blind spots. It was critical to acknowledge the beliefs, judgments, and teaching practices of the simulation designers that influenced the choice of learning challenges, the opportunities presented through the simulation, and the representation of avatar students who had different racial and ethnicity backgrounds in the virtual classroom. Rather than using mixed reality simulations as simply a substitute for needed field experience hours, teacher educators leveraged the technology affordances of mixed reality simulations, along with careful planning, to redefine field experiences by creating new types of learning experiences that develop PSTs culturally affirming and relevant pedagogy skills.

Part 1: Develop scenarios. Continuing from the center of Figure 1 to the left side, Part 1 describes the four steps used to develop scenarios or the narrative storyline for mixed reality simulations. The scenario for a simulation was rooted in a frequently occurring complex dilemma observed in student learning that revolved around interactions with the teacher as the vehicle for learning (Kavanagh, 2020). The following paragraphs describe the four-step iterative process identified in Figure 1 used to develop simulation scenarios.

1. **Select a student learning dilemma that specific teaching practices impact.** Faculty interviewed and surveyed mentor teachers and PSTs about persistent student learning challenges to brainstorm possible scenarios. In addition to considering P-12 student learning, the faculty explored the PSTs' teaching strengths, needs, and learning goals to plan differentiated challenges and supports to meet the varied learning needs of PSTs and model differentiated instruction (Bondie et.al., 2019). The simulation scenario should focus on dilemmas of P-12 student learning that are impacted by the desired teaching practices.

   For example, a dilemma was that students struggle to use vocabulary and take equitable turns during peer discussions. PSTs often had trouble adjusting the discussion directions to address these challenges. Another dilemma focused on 'responding to student understanding' where some students have only partial understanding of a reading while other students are ready to move on to the next task. PSTs needed to quickly provide quality feedback to the small group of students who needed to further their understanding. These example dilemmas were rooted in frequently occurring classroom situations where teaching practices impacted student learning. Simulations were aimed at core teaching practices that were used across P-12 classrooms (e.g., giving directions, asking questions, and providing feedback). In addition, simulations could be grade- and subject-specific, serving only a portion of the PSTs in a preparation program.

2. **Align standards**. Once dilemmas were identified, then faculty aligned the dilemmas to standards for teaching, such as culturally relevant state standards (Muñiz, 2019) or national board for Professional Teaching Standards (NBPST, 1996), and professional expectations (Danielson, 2007). In addition, the student task in the dilemma was aligned with learning standards, such as the Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). For example, the 'responding to student understanding' dilemma mentioned above was aligned with teacher preparation standards related to formative assessment (Danielson, 2007), culturally responsive teaching standards for high expectations (Muñiz, 2019), and student standards for reading comprehension (Common Core Standards Initiative, 2010). As standards are identified, the student learning dilemma may be revised.

3. **Review evidence.** Teaching practices developed through simulations should be firmly rooted in research evidence connecting the teaching practice with student learning. When reviewing the literature, it was helpful to

explore past ways researchers have measured the use of the targeted teaching practices. These measures may be adapted to measure PST learning within the simulation. Teacher educators used task analysis to break the teaching practice down into parts that may be differentiated for teachers at different stages of development. The literature review iteratively led to a refinement and revisions of the scenario and targeted teaching practices.

Let us return to the example of a frequent dilemma where PSTs provided feedback to the small group, leading to revised student responses that both build understanding of the text and metacognition. After the teaching practice was aligned to formative assessment professional standards (Danielson, 2007) and the student task of reading informational texts was aligned with English language arts standards for students (Common Core Standards Initiative, 2010), teacher educators moved on to reviewing research examining teacher feedback. The literature reviewed found that Hattie and Timperley's (2007) meta-analyses reported teacher feedback had been strongly associated with gains in student achievement. In addition, models of teacher feedback in the literature, such as Perkins's (2003) 'ladder of feedback,' provided criteria for how to measure effective teacher feedback in the virtual and in-person classroom. Ladson-Billings (2008) identified key features of teacher feedback aligned with culturally relevant teaching, such as communicating high expectations for all students and showing interest in the student perspectives. Given the evidence from research and alignment to professional and student learning standards, this dilemma of 'providing feedback to student understanding of a non-fiction text' is well-suited for a mixed reality simulation. If the dilemma cannot be aligned to standards and rooted in an evidence-base supporting the teaching practice under study, then options other than simulations may be better suited to develop the teaching skill or other dilemmas might be considered for the scenario.

4. **Design avatar student task and collect responses**. The heart of the simulation was the avatar student task and responses that provided opportunities for PSTs to interact with students and develop the teaching practice. The most effective way to develop the dialog for the script was to assign the task to real students and collect their questions and responses that the simulation specialist used during the simulations. Assigning the student avatar task in real classrooms also allowed the simulation designers to observe actual teaching related to the task. Further, the student task should be tested in classrooms similar to those where PSTs aspire to teach, with attention to the grade levels, subjects, and school contexts. If real students were not available, then experienced teachers offered a range of hypothetical student responses thinking about how their students might respond.

Part 2: Plan a Model of Teacher Learning. During the second part of mixed reality simulation scenario development, the design team embedded a model for teacher learning within the simulation scenario. Seamlessly, the student task and targeted teaching practice occurred within a scenario or narrative storyline where a model of PST learning unfolded that included practice, planning, and coaching or self-reflection (See Figure 2). Returning to our example of the reading comprehension dilemma, the scenario presented to PSTs might be, 'As the class was individually answering comprehension questions, you noticed five students had partially correct responses to the first question. You have pulled the five students into a group where you plan to spend about 7 minutes giving students feedback and then prompting students to consider the thinking that led to their improved response.' The scenario provided a realistic situation where the targeted teaching practice was needed.

To embed a model of teacher learning, the simulation scenario must be broken down into sections that create an arc for teacher learning. Sections included: welcome, introduction to the classroom or task, anticipatory coaching or preparation time, classroom scene- trial 1, debrief and coaching, classroom scene - trial 2, and finally a debrief and coaching (see Figure 2). Although individual PST simulations varied, each section of the script was planned for completion in a designated amount of time.

5. **Develop scenario with standard and improvised lines.** Within each section, both standard and improvised avatar responses were created to ensure each PST has reliable opportunities to develop the teaching practice. Planned responses included actual real-student sample responses that were collected during the script development. For example, at two minutes into the simulation a student avatar said, 'I don't know why I am in this group' or at seven minutes, to end the scenario, a student avatar said that it is time for the students to go to the next class. A planned response included the student avatars complimenting the PSTs on a practice that worked well for them, such as providing a visual aid or acting out a definition for a word. Having both planned and improved responses ensured reliable experiences and opportunities for each PST.

6. **Plan personalized practice and differentiated feedback and differentiated feedback and coaching.** The model of teacher learning leveraged the unique opportunities afforded by mixed reality simulation technology, such as the ability for PSTs to start over or instantly move to the coaching setting. The teacher learning model

provided mastery-oriented experiences by offering several trials of a teaching practice with opportunities to step out of the virtual classroom for reflection, coaching, and planning (See figure 2). During at least one of these trials, personalized practice was offered in which PSTs selected the type of practice that seemed most useful. For example, PSTs chose to restart as though the previous try never happened, or to continue by picking up where the action stopped, or to try the practice out on a new question or task. In addition, the number of avatar students was varied to support the development of PSTs feedback practices. Following coaching, PSTs tried out a new strategy with an individual student before launching the practice with a small group or class. These personalized practice opportunities were not possible in real classrooms. Indeed, faculty redefined and transformed PST clinical practice through mixed reality simulations.

Avatar responses were tailored to the learning needs of PSTs using If-Then-So statements in the simulation script. For example, in the 'adjusting directions for peer discussion dilemma' mentioned previously, if the PST did not specify how turns will be taken during peer discussions, then only one avatar student in each paired discussion spoke so the PST could hear inequity in student voices. There was planned If-Then-So statements for each key component of the teaching practice (identified through task analysis of the teaching practice) that ensured all components of the practice were made visible to PSTs, practiced, and developed through interactions with different avatars. For example, if the teacher told students to use a vocabulary chart in their responses but did not explain how to use the chart then the avatars demonstrated confusion, so the teacher heard avatar student questions about how to use the chart and then responded without vocabulary. Or if the teacher provided directions with too many steps then an avatar student asked if they could do the steps one at a time, so the teacher received feedback from the avatar students that was strategically designed to inform and develop the teaching practice.

Measurement tools provided formative assessment data needed to differentiate instruction. For example, prior to the simulation, PSTs completed a preparation activity where they were asked to analyze samples of student work for the task that took place during the simulation. Faculty used the results of the analysis of student work to differentiate anticipatory coaching tailored to PSTs' specific strengths and needs. For example, if PSTs were unable to generate a high-quality responses to the student task, then the anticipatory coaching during the simulation focused on exploring a correct response to the task. In contrast, if PSTs needed support in identifying strengths in sample student work then coaching during the simulation focused on how to ask students questions about their work. A huge benefit to mixed reality simulations is that PSTs taught a common task in a single school context at a time scheduled by faculty. This was very different from preparing PSTs for unpredictable school contexts. With mixed reality simulations, faculty differentiated the coaching based on PST skill going into the simulation, so that each PST experienced optimal challenge and worked on the part of the teaching practice that was most relevant for the PST as an individual. A transcript was automatically generated from a recording of the mixed reality simulation that provided an additional means for measurement including how time was used, observable teaching practices, and the complexity of language spoken.
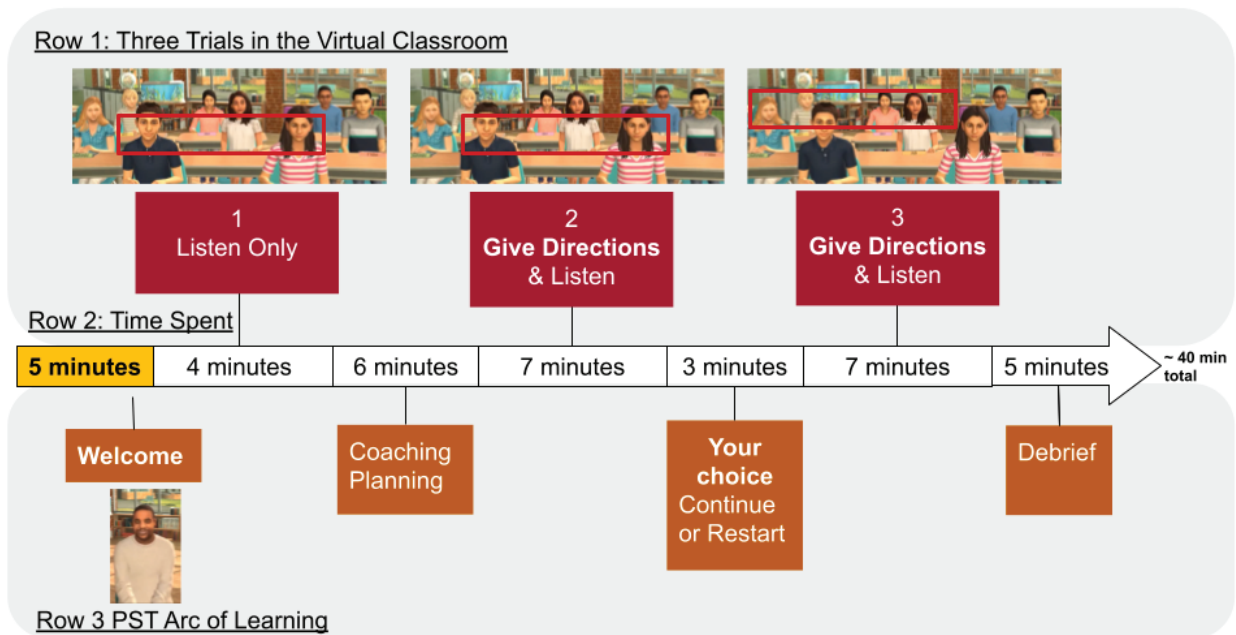
Figure 2. Model of Teacher Learning by Section.

7. **Develop measurement tools.** During simulations, measures of teacher learning often focused on the presence, absence, and frequency of specific observable teaching behaviors. In addition, data such as antecedents, types, qualities, and consequences of the interactions among the PST and the avatars were available. Unlike real classrooms, the contextual aspects that greatly impacted the effectiveness of the teaching practice, such as antecedents and consequences, were controlled and measured in a virtual environment. Figure 3 displays an example of measurement tools used before, during, and after a simulation. These tools included: baseline measurement of skills, practices, and beliefs; assessment of understanding of the task and current abilities to respond to student work; self-reflection of practices used during the simulation and planning; post-reflection activities where PSTs watched their simulations; and post-surveys of skills, practices, and beliefs.

Previous research in simulated learning has demonstrated that immersion (the suspension of disbelief that what is simulated is real and has real-world stakes) can facilitate the development of sophisticated problem-finding and problem-solving skills (Dede, 2009). Because teaching in the mixed reality classroom allowed PSTs to 'step out' of their real-world identities, particularly those associated with low achievement or self-efficacy, measures included questions that explored changes in feelings of efficacy and identity as a teacher (Dede, 2009). Taking place prior to the simulation, during the simulation in oral or written form, and following the experience, these assessments provided PSTs with feedback and faculty with data that used to further tailor the learning experience in courses based on PSTs individual needs.

8. **Create teacher assignment and differentiated materials.** Faculty created assignments and materials for each section in the model of teacher learning (Figure 3). Current assignments in course syllabi were easily revised to prepare PSTs for the simulation. For example, in a reading course, faculty swapped an assignment to read a children's book with an assignment for PSTs to read a text that the student avatars read in the simulation. There were many options for implementing assessments that easily integrated into learning activities in teacher preparation courses. For example, Table 1 lists options for baseline assessments that measured PSTs' teaching practices prior to new learning and the simulation. Baseline data was documented using checklists, rubrics, surveys, lesson plans, and teacher diaries; this baseline data was critical so that both PSTs and preparation faculty measured the growth.
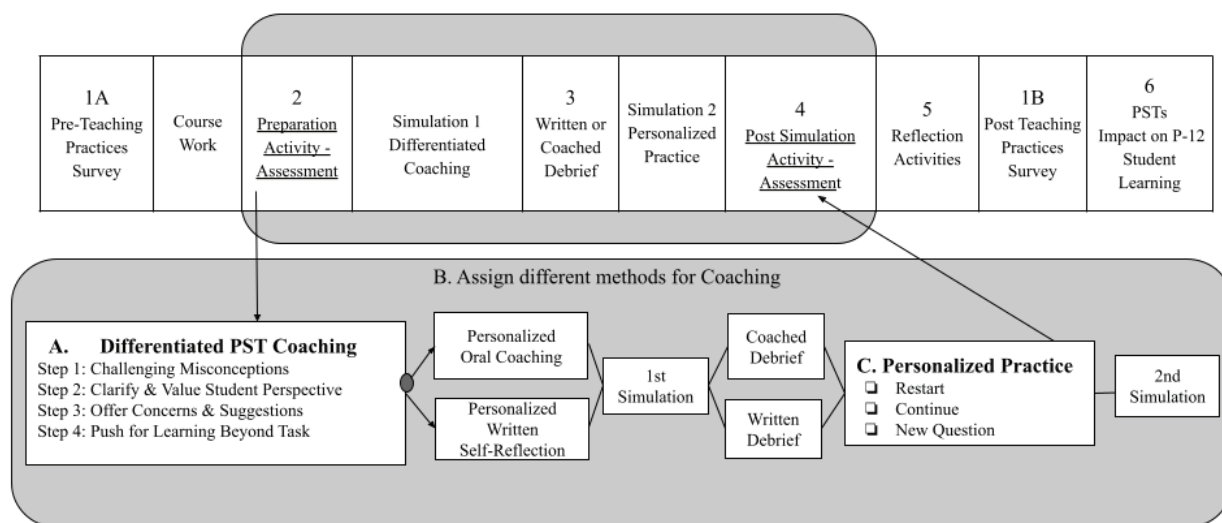
Figure 3. Sample Model of Teacher Learning with Personalization and Differentiated Coaching.

Following the simulations, faculty reserved time for post-simulation activities and reflections. PSTs repeated the activities from Table 1 as post activities. For example, PSTs watched the video of their simulation and reflected on their learning individually and with peers during courses. During class, PSTs shared a video clip of the most important moment from their simulation. PSTs measured their growth by comparing their baseline assessments, simulation videos, and actual student teaching or transfer of learning to written assignments such as lesson plans. Faculty embedded the same simulation in more than one course to assist PSTs in synthesizing learning from multiple courses into a teaching practice. Transfer of learning into new contexts was more likely when PSTs were made aware of the potential transfer opportunities. Therefore, debriefs of simulations included explicit connections between what was practiced and applications to PSTs' future teaching contexts (Anderson et al., 1996).

Table 1
Options for baseline - post assessments of PST teaching practices

Purpose: Use a rubric or checklist to assess teaching practices before and after simulation

Analyze student responses and teaching practices	Record rehearsal	Observe role play	Observe student teaching	Engage in parallel Simulation
Analyze sample student responses and teacher practices used in a recorded example simulation	Record a rehearsal or practice of yourself teaching the simulation task on a cell phone or using a web camera	Measure PST use of practice through role plays in preparation courses	Measure PST use of practice with students prior to simulation	Create a short parallel simulation to measure PST use of teaching practice

PSTs needed differentiated materials that break down the teaching practice into specific parts (e.g., sentence frames for different types of questions) as well as materials that supported practicing the whole teaching practice (e.g., videos of lessons, role plays) to understand how to implement and adjust the teaching practice in response to student learning. Creating materials provided faculty with an opportunity to model differentiated instruction and the use of technology tools that PST needed for P-12 teaching including: short animations describing the teaching practice, videos with embedded quizzes to practice analyzing student responses quickly, and sorting games to recognize qualities in student work. Faculty recruited current PSTs to help create the needed materials. Faculty brought a critical lens to all materials used to develop the teaching practice and prepare for the simulation. For example, explicit connections to culturally relevant pedagogy were identified.

Assessing Simulation Scenarios. Developing a scenario was an iterative process where the design team continuously returned to and revised components to develop the script and create a model for teacher learning. Throughout this process, faculty often wondered, 'Is this simulation scenario design good enough?' Six criteria for assessing simulation scenarios supported the revision process:

1. The student avatar task was clear, aligned to professional teaching and student learning standards, and connected to a teaching practice supported by evidence that impacted student learning.
2. The scenario provided a clear understanding of the student avatars' perspectives, experience, knowledge, strengths, interests, and learning needs related to the selected task.
3. PSTs had opportunities to grow or revise their approach and responses through multiple trials and periods of coaching or reflection.
4. The avatar students had opportunities to interact with each other as well as the PST and to opportunities to develop their responses.
5. The cultural relevance of the task and avatar responses were explicitly placed within the scenario.
6. Faculty explained how the simulation scenario transformed opportunities for professional learning beyond those available through traditional field experiences.

Simulations that meet these criteria were more likely to be efficient and effective.

Embedding Simulations within Course Syllabi

Embedding simulations within course syllabi was essential whether a mixed reality simulation was purchased from a company or developed by a design team. Simulations were more effective when situated within the learning trajectory articulated in course syllabi and the overall preparation program (Snow, Gehlen, & Green, 2002) and placed strategically to both further and measure PST growth. The model for PST learning (see Figure 3) was included in the syllabus with each assessment listed as a required assignment. In addition, PSTs needed an orientation to the avatar students and virtual classroom.

Orientation to the Virtual Classroom. Teaching in the virtual classroom is different from student teaching in physical school. PSTs likely had experience attending physical schools as children, so even though being in the role of a teacher was new, the environment including the opportunities and constraints of the physical classroom space were familiar for many PSTs. The mixed reality classroom environment was unfamiliar to PSTs, who often felt surprised or shocked when entering for the first time - similar to jumping into cold water. PSTs often began their experience with an uncomfortable laugh and hesitation, making suspension of disbelief more difficult when the PST were not prepared for the world of the simulation. Further, when PSTs were focused on mechanics of the virtual classroom (e.g., what avatar students could and could not do), it was difficult for PSTs to engage avatar students in the task.

Generally, we know that heightened negative emotions like anxiety hinder learning (Ashcraft & Kirk, 2001) and, in the case of medical simulations, we know that increased anxiety and decreased tranquility are negatively associated with learning (Fraser, et al., 2012). PSTs' initial shock or sustained anxiety associated with the unfamiliarity of the virtual world may have had negative effects on their learning. Therefore, simulations were more effective when PSTs, individually or in small groups, were oriented to the virtual environment and mechanics of working with avatars (Mayer, et al., 2011; Snow, Gehlen, & Green, 2002). In addition, orientation simulations were used to promote PSTs' curiosity to know the avatars as individuals and to model teaching adjustments based on the PSTs' knowledge of the avatar students.

Table 2

Orientation to virtual classroom

Purpose: Introduce student avatars' interests and strengths and learn the capacities and limitations of mixed reality avatar students

Video introduction	Text introduction	Introduction within a simulation	Orientation simulation
Watch video and complete a graphic organizer or quiz about the strengths and interests of avatar students	Read a biography of students, story about their life and learning in the virtual classroom and take a quiz	Begin simulation with a short visit to the classroom for PST to introduce themself and meet avatar students	Design and implement a short simulation with the sole purpose of orienting PST

Training Simulation Specialists

Simulation specialists with expertise in technology (specifically, gaming type equipment), observation, improvisation, teaching, and coaching were key to effective simulations in teacher preparation. We engaged teaching artists from a local arts organization and educational theatre to become simulation specialists. The teaching artists were already familiar with school curriculum, had experience both in collaborating with teachers, and were skilled at improvising with real students in physical classrooms. Because of their experiences and training to observe and listen carefully, when working as simulation specialists to conduct mixed reality simulations, teaching artists were more likely to respond as a real student might in the classroom and were highly skilled at coaching and providing feedback to PSTs.

However, even trained and experienced teacher-coaches as simulation specialists encountered challenges including coaching, representation of students, and standardization versus improvisation. For example, coaching PSTs required skill and coordination with faculty goals and state requirements. If the simulation specialist did not have P-12 teaching experience and training in instructional coaching, then there was no coaching during the simulation. The coaching and reflection was a written survey or was completed with faculty outside of the simulation.

One actor representing various avatars who present an appearance of different races and ethnicities was a challenge. Simulation specialists worked to avoid reinforcing stereotypes through their improvisations. This challenge was addressed by developing complex profiles for each avatar. In addition, clarifying the background and cultural knowledge that each avatar brought to the simulation's student task and what each avatar knew and needed to learn helped simulation specialists provide consistent rich experiences in the virtual classroom. Grounding the script in real student responses was helpful throughout this process. Another challenge was if more than one simulation specialist provided simulations to PSTs. The specialists needed to rehearse together and create characters for the avatar students that were consistent across all simulations. Even with that work, there were inevitable differences in the simulations run by different specialists that impacted teacher performance and in turn measures of teacher growth.

Simulation specialists created a virtual classroom for practice teaching that felt real to PSTs. A key factor in building belief was the quality and differences of the avatar voices. Although voice morphing software changed the register of the avatar voices, the simulation specialist needed to create very different speech patterns and sounds for each avatar. Also, how the avatar spoke (e.g., length, speed, and feeling) had to align with what the avatar was saying to create a believable experience. Because much of the simulation was improvised, planning and rehearsal was necessary so that avatar characteristics stayed consistent as PSTs became familiar with the avatar students.

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Integrating 360 Media in Teaching and Teacher Education

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Abstract: One of the most disruptive aspects of 2020 for teacher education, mainly due to CO-VID, was the loss of field placements for future teachers. Teacher educators attempted to respond to this gap with videos of exemplary practice—something used commonly in teacher education to supplement such field experiences. Teacher educators, however, should have learned about the potential and promise for the use of 360 video for teaching and teacher education. This chapter highlights the research behind the use of 360, also showcasing how it has been used successfully in mathematics teacher education and physical education teacher education. The chapter includes evidence supporting the use of 360 as a dissemination technique and a technology skill needed to be taught to current and future teachers. Finally, evidence is provided to suggest that the use of 360 should be continued even when field placements return fully face-to-face.

Lessons Learned: Teacher educators should have learned about the potential and application of 360 video in teaching and teacher education.

An immediate consequence of the pandemic's effect on teacher education in early 2020 was a dramatic decrease in availability of field experiences for preservice teachers (PSTs). As a result, many teacher educators increased their use of videos of classroom practice (Mollenkopf & Gaskill, 2020; Schelling & Rausch, 2020; Zolfaghari et al., 2020). Prior to the COVID-19 global pandemic, use of video to supplement field placements was commonplace; its incorporation within teaching methods courses was considered beneficial to PSTs' professional learning (Gaudin & Chaliès, 2015; Grossman et al., 2009). Indeed, pre-pandemic, most teacher educators reported using standard videos of pedagogy between three to six times per course (Arya et al., 2016; Christ et al., 2017).

Although considered useful, standard video is limited in the amount of the "blooming, buzzing confusion" (Sherin & Star, 2011, p. 69) it conveys about the classroom. PSTs viewing standard videos are able to look in only one direction, chosen a priori at the time of the recording. By contrast, a 360 video allows the viewer to adjust their viewing perspective in any direction (Kosko et al., in press). This increased *perceptual capacity* (Ferdig & Kosko, 2020), or the capacity of a video to represent all aspects of a recorded scenario, allows PSTs to view more student actions (Roche & Gal-Petitfaux, 2017; Walshe & Driver, 2019); it is more effective in improving the specificity and detail of what PSTs notice within the recording (Kosko et al., in press).

Using a multi-perspective 360 video (see Figure 1 for an illustrated example) to replace a field-based assignment during a state-wide COVID-19 stay-at-home order, Zolfaghari et al. (2020) noted that PSTs generally found the activity to be beneficial. The various literature on the effectiveness of 360 video (Ferdig & Kosko, 2020; Kosko et al., in press; Roche & Gal-Petitfaux, 2017; Walshe & Driver, 2019), particularly during the COVID-19 global pandemic (Zolfaghari et al., 2020), suggests a key lesson for teacher educators to learn from pedagogy amidst the pandemic. Specifically, we argue that teacher educators should have learned to use 360 media (video and photos) for teaching and teacher education during the pandemic, and should consider using and creating such media beyond the pandemic. This lesson will have significant implications for teacher educators moving forward, even when traditional field placements return. This chapter provides evidence that the past, current, and future use of 360 video has and can supplement improvements in teacher education in ways that face-to-face field placements or placements supported by traditional, standard video cannot.
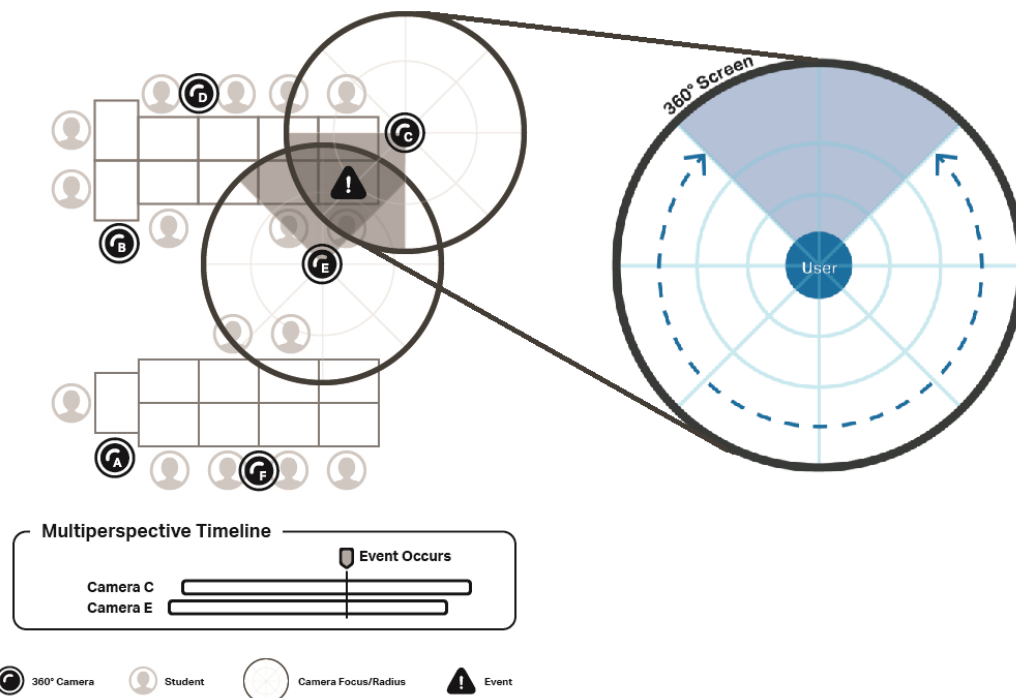

Figure 1. Illustration of how a PST may view a multi-perspective 360 video. Different camera positions are denoted by letters, with a PST able to switch from one 360 camera perspective to another.

WHAT WE KNOW

Following Roche & Gal-Petitfaux's (2017) pilot of 360 video with physical education PSTs, numerous studies have emerged that advocate for the various observed benefits of 360 video in teaching and teacher education (Ferdig & Kosko, 2020; Ferdig et al., 2020; Joglar & Rojas-Rojas, 2019; Kosko et al., in press; Theelen et al., 2019; Walshe & Driver, 2019). For example, Kosko et al. (in press) studied PSTs professional teacher noticing when viewing standard or 360 videos. *Professional noticing* is defined as attending to and interpreting events within the context of teaching. Kosko et al. (in press) found that PSTs who viewed the same class lesson recorded with 360 video observed more student actions and attended to them with more specificity than their peers who watched the scenario recorded with standard video. In the context of K-12 education, Paraskevaidis and Fokides (2020) found that primary students (aged 11-12 years) learning volleyball demonstrated better skills following viewing of 360 videos with embedded annotations than their peers who learned the same set of skills face-to-face with their coaches. Also, while working with primary school students (aged 8-10 years), Baumgartner (2020) found that students' spatial reasoning skills improved after creating and producing their own 360 videos.

Other scholars studying PSTs' use of 360 video amongst PSTs have noted shifts from attending to the teacher to an increased focus on students and student actions (Joglar & Rojas-Rojas, 2019; Theelen et al., 2019; Walshe & Driver, 2019). In such cases, "it appeared that 360-degree video became a proxy for real-life classroom settings, such that [PSTs] were able to engage with the lesson in an embodied way but without disturbing the children or teacher" (Walshe et al., 2021, p. 7). Although commonly inferred as a proxy in studies of 360 video, scholars consistently argue for 360 media to supplement, and not replace, real-world experiences (Joglar & Rojas-Rojas, 2019; Theelen et al., 2019; Walshe & Driver, 2019). However, as noted by Zolfaghari et al. (2020), 360 video is a useful supplement when face-to-face experiences are available and are a viable alternative when such real-world interactions are not.

Despite mounting evidence regarding the effectiveness of 360 media for teaching and teacher education, some scholars have expressed concern that the media may overwhelm teachers or their students. However, Gold and Windsheid (2020) found no statistically significant differences in PSTs' reported working memory load when viewing standard and 360 video of classroom practice. Moreover, there are various examples from the literature where scholars, seeking to create more realistic, immersive experiences, have increased the complexity of information conveyed in such experiences. For example, Kosko et al. (in press) observed that PSTs viewing 360 videos with virtual reality (VR) headsets were less likely to move their head rapidly around the classroom than PSTs viewing 360 videos on a laptop. Zolfathari et al. (2020) observed that, despite being provided with multiple viewing positions to 'move around the classroom,' PSTs tended to find location to observe students and focused on specific areas (see Figure 1). Studying the effect of ambisonic audio in 360 video, or audio that conveys the directionality of sound, Ferdig et al. (2020) found that PSTs who viewed 360 videos with standard audio (monophonic) moved the camera perspective much more frequently than PSTs who viewed the same 360 video with ambisonic (spatial) audio. Thus, by increasing the amount of information conveyed in the 360 video (i.e., directionality of sound), Ferdig et al. (2020) observed that PSTs were more focused in where they attended to students' actions.

Across such studies, a common rationale is posited for such positive results in favor of more immersive 360 media: the closer a representation can approximate real-world experience, the less demanding it is on the viewer. Thus, by increasing the perceptual capacity of representations (i.e., capacity of a representation to convey what is perceivable in real life), PSTs focus more on what is recorded in a video and not on what is absent. Further, such representations may have benefits for PSTs' future students as early as elementary school (Baumgartner, 2020; Paraskevaidis & Fokides, 2020), which suggests the medium may be useful for reflection on teaching *and* the teaching and learning of students. Thus, use of 360 media to reflect on one's own teaching is one useful application, but teacher educators should also consider teaching PSTs how and when to use such media with K-12 students in their own classrooms.

Researchers have provided evidence that 360 media has successfully been used across multiple teacher education contexts in teacher education. Specifically, 360 video has been used for teacher education in a variety of content and contexts including: general secondary teacher education (Theelen et al., 2019), science (Joglar & Rojas-Rjoas, 2019), mathematics (Balzaretti et al., 2019; Kosko et al., in press), geography (Walshe et al., 2021), physical education (Roche & Rolland, 2020a), and art (Nortvig et al., 2020). However, to highlight its potential and the promise behind this lesson, research is explored here in two specific content areas: mathematics teacher education and physical education teacher education.

A recurrent issue in preparing future teachers of mathematics across K-12 is that many such teachers tend to focus too little on the specific mathematical actions of their students. Rather, it is quite common for PSTs to attend more to what the classroom teacher is doing than the students (Huang & Li, 2012; Jacobs et al., 2010). Piloting 360 video of a third-grade mathematics lesson on the Commutative Property, Kosko et al. (in press) compared PSTs' professional noticing when viewing standard or 360 video of this same scenario. They found that PSTs viewing the 360 video version noticed more student actions than PSTs viewing the standard video. Yet, beyond this, the descriptions of such student actions were more specific regarding the mathematics – particularly when PSTs wore a VR headset instead of viewing the scenario on a flat screen device. In analyzing where PSTs had moved perspectives in the 360 laptop and headset conditions, Kosko et al. (in press) found that the former group of PSTs tended to look in a wider range of locations in the classroom. The PSTs using laptops appeared to be less focused in their professional noticing than their peers wearing the headsets.

In a later study focusing on PSTs' viewing a 360 video of fourth-grade fractions, Kosko et al. (2021) observed a similar interaction. Specifically, PSTs who described the use of multiplication to find an equivalent fraction to 3/8, instead of using the teacher-provided manipulative (fraction strips), had a proportionally higher tendency to focus on two of the tables in the classroom (where such discussions took place). PSTs who did not describe use of 3/8 or multiplication for equating fractions tended to look in a larger variety of locations in the classroom. Such findings have specific implications for how teacher educators should consider using 360 video to prepare future mathematics teachers.

One clear implication for mathematics teacher education is that merely providing 360 videos allows for more student actions to be observed by PSTs. However, PSTs may not necessarily take up such observations. Although the additional perceptual capacity provided by 360 video is enough for some PSTs to attend to students mathematics in more specified ways, such noticing behaviors must be explicitly scaffolded for others. One means of doing this is to have PSTs view a 360 video (at least) twice. In the initial viewing, PSTs may be tasked with identifying student mathematical actions that are considered important. In the second viewing, the teacher educator can specify one or more mathematical actions the PST should have noticed (using a map similar to Figure 2).
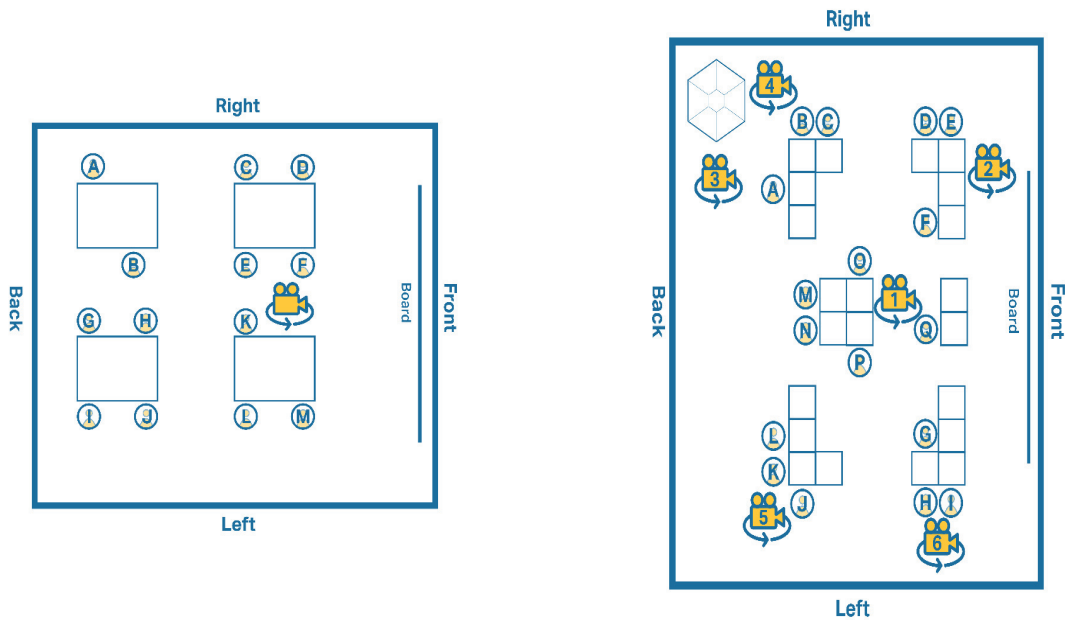

Figure 2. Example classroom maps for a single-perspective 360 video (left) and multi-perspective 360 video (right).

This specifying of the mathematics, as well as the student(s)' location(s) engages PSTs in the focusing behavior found to be beneficial in viewing 360 video (Kosko et al., in press; Kosko et al., 2021). Essentially, it positions the PST to focus on where and what to attend, with the description of the students' mathematics solicited for further engagement. Such pedagogical approaches to teacher education are also useful should multi-perspective 360 video be used. As noted by Zolfaghari et al. (2020), PSTs generally attend to important aspects of students' mathematics, but this is not universal. Rather, as the PST interacts with the virtual classroom (360 video), they are being tasked with attending to both the recording students and the mathematics operationalized by the students. Providing explicit feedback on which instantiations of mathematics are worth attending to, and why, can aid PSTs in developing their professional knowledge as K-12 teachers of mathematics.

360 Video in Physical Education Teacher Education (PETE)

The use of video in physical education teacher education (PETE) has a long and storied tradition (Greenberg, 1971). However, a new generation of video recorders have recently been used in PETE such as GoPro (Baghurst, 2016) and 360 video cameras (Roche & Rolland, 2020a). Using these new video cameras in PST teacher education programs can help expand the spectrum of what can be seen and can help convey more events co-occurring at a given point in time (typically in a classwork setting). Research is emerging in PETE that examines how 360 can positively impact PSTs' experiences (e.g., what they feel, the aspects they focus on, and what knowledge sets they mobilize and build upon).

This new type of video offers the possibility for PSTs to explore the whole classroom situation and more specifically explore the gym where the lesson is being conducted. With this new viewing possibility, it is important to examine how PSTs use these videos and where they focus their attention. Roche & Gal-Petitfaux (2017) showed that 360 video helped PSTs understand the global organization of the gym during a teaching situation. Roche and Rolland (2020a) also found that PSTs focused essentially on classroom management and teacher activity when watching 360 video with either VR headsets or on laptops. PSTs were focused on class climate and student's engagement in the task, but they didn't focus on student's motor skills learning processes. This is obviously problematic as a main objective in PETE is to develop PSTs' ability to assess and provide feedback on students' motor skills.

To address this, and also to address PETE during the COVID-19 pandemic, Roche & Rolland (2020b) set up an experiment that examined the use of 360 video with two different sets of viewing instructions. In the first instructional group, PSTs were asked to watch the 360 video, observing the entire situation. They were also asked to identify and comment on remarkable, or significant, instances in the recorded scenario. With this approach, PSTs ultimately made comments about their global exploration, but they never focused on students' motor performance, even when the facilitator questioned them about what they observed of students' motor skills. In the second instructional group, PSTs were asked to watch the 360 video, but to specifically focus on students' activity and motor performance. When PSTs were asked to focus on student activity, their use of the 360 video changed, leading them to build new knowledge about professional gestures to correct inappropriate student's motor skills. Most notably, they used the video's zoom function to try to hear and see (in detail) the work organization within each group of students in the situation as well as social relationships between students. They also used the zoom feature to observe students' motor skills, body positioning, and safety aspects linked to the students' performance. PSTs focused their attention on these aspects in order to try to identify difficulties and learning problems encountered by the students, and to be able to provide appropriate feedback to recorded students. Roche and Rolland (2020b) suggested that these detailed instructions helped PSTs build a categorization of typical students' errors in motor skills learning. It also helped PSTs anticipate pedagogical solutions and feedback to be provided to students. In sum, the more specific instructions of what to attend to within the 360 videos led PSTs to develop the pedagogical knowledge needed to assess and provide feedback regarding students' motor skills.

These research studies have obvious implications for the use of 360 video in PETE and for PE facilitators. In line with results from Zolfaghari et al. (2020), 360 video can be used online or during workshops to provide virtual field experiences that are close to real classroom experiences. They give PSTs experiences and access to authentic situations like gyms (Roche & Rolland, in press). These experiences immerse PSTs into the heart of teaching and learning situations, immersing them in the sound and visual environment of a gym that is close to the one they would work in during their internships. With specific instructions, PSTs can develop knowledge for providing feedback to students as they learn and practice motor skills. They can also reflect on what they are seeing; they can also play back those instances with their facilitators. Finally, the use of 360 video can support PETE facilitators in the development of inquiry activities

(Dewey, 1938) to elaborate new knowledge and a practical experience for teaching. This can be incredibly useful during a pandemic or to support existing field experiences.

LESSONS LEARNED FOR RESEARCH

The emergent literature on 360 media in teaching and teacher education suggests there may be many benefits to use of this technology. Yet, there is much that remains unknown. Although various scholars have found 360 video to be beneficial for teacher education (Ferdig & Kosko, 2020; Kosko et al., in press; Roche & Gal-Petitfaux, 2017; Roche & Rolland, 2020a; Roche & Rolland, 2020b; Walshe & Driver, 2019), others have found little such effect (Gold & Windscheid, 2020; Tan et al., 2020). This suggests that, much like standard video, what scenarios are recorded, and the scaffolding provided within such videos, matters significantly (Roche & Rolland, 2020b). Currently, there are few studies comparing viewing of standard and 360 video (Ferdig & Kosko, 2020; Kosko et al., in press; Gold & Windscheid, 2020), and more research in this area is needed. Additionally, scholarship is needed to evaluate what makes certain 360 videos more effective in promoting pedagogical knowledge than others.

As technological tools evolve for teacher educators in use of this medium, future research is needed to better understand how the affordances of 360 media may be best implemented in practice, and what specialized resources may be needed to scaffold interaction with the content in such media. Related to this line of research is the need to better understand how various sensory-related scaffolds may facilitate use of 360 media. Specifically, use of VR headsets to view 360 media is more beneficial than viewing on a flat screen device (Kosko et al., in press), incorporating spatial ambisonic audio is more immersive than standard audio (Ferdig et al., 2020), and multi-perspective 360 video may have benefits over single perspective 360 video (Zolfaghari et al., 2020). Yet, such immersive features require additional equipment to create 360 content (additional cameras or specialized microphones) or to implement for testing or instruction (VR headsets for students). A fundamental question is not only whether such differences large enough from a research perspective, but are such differences large enough, pragmatically, to justify the cost of equipment and implementation? Such questions are pressing not only for the future, but in reflecting on the lessons learned from the COVID-19 pandemic including PSTs and teacher educators' access to and familiarity with various technologies.

Teacher educators will also need to understand the varied uses of 360 video in teacher education. An obvious use is the delivery of videos to supplement (or replace in a time of pandemic) face-to-face field placements. There is some literature that discusses ways to scaffold PSTs' viewing of 360 video (Roche & Rolland, 2020b; Zolfaghari et al., 2020), but much more is needed to extend from these early studies. Researchers also need to examine best practices in preparing PSTs to capture their own video. Such video could be useful for supporting reflection of practice; it also could be important for future teachers who will engage students in capturing video (e.g., to learn STEM concepts; see Baumgartner, 2020). Stated differently, there may be various purposes for PSTs to capture their own 360 video (or photos) and these different purposes may affect what aspects of pedagogy is more effective and pragmatic.

An additional lesson for teacher educators from the pandemic that this chapter has discussed is on the use of 360 media for both virtual field placements and field trips. Currently, there is a significant need for research on virtual field trips in general, as well as needed implications for practice. Such virtual visits, whether to a classroom or a specific location on the planet or in the universe, should be examined not only for interactions between the viewer and content, but also the facilitator of such content. Specifically, additional research is needed to better understand how teacher educators implement such virtual visits with their PSTs, and how they should teach the pedagogy of using such technology. Such scholarship requires both deep theoretical roots and intentional efforts at connecting theory to practice, thereby evolving from a literature of advocacy for the technology.

One final area of needed research we wish to discuss is that which relates to developing common theoretical perspectives for 360 video. For example, many scholars researching 360 video in teacher education have mentioned embodied cognition either tacitly or explicitly (Kosko et al., in press; Theelen et al., 2019; Walshe & Driver, 2019). Kosko et al. (in press) have attempted to use the concept of perceptual capacity to align embodied cognition with immersive technology. Similar efforts are needed to better connect the work of scholars in this area and improve implications for 360 video in teaching and teacher education. Such theoretical perspectives need not agree, but efforts must be made to further develop theory as it informs practice.

LESSONS LEARNED FOR PRACTICE

There is clear evidence that use of 360 media has potential benefits for teaching (Baumgartner, 2020; Paraskevaidis & Fokides, 2020) and teacher education (Kosko et al., in press; Theelen et al., 2019; Walshe & Driver, 2019). Based on our own experiences as teacher educators and researchers prior to and during the pandemic, we posit there are clear implications for an increased and more prevalent use of 360 media in teaching and teacher education. But what does such an increased use look like? Here, both the research and practitioner literature are less robust. Yet, our own experiences, and those of our colleagues around the world using 360 media, suggest some specific implications for teacher educators.

Using 360 Media with PSTs

360 videos allow users to see what is happening in any direction around them, providing a new layer of control and involvement of the experience observed. This degree of autonomy makes 360 videos potentially more immersive than standard videos. One of the more interesting challenges we (Gandolfi et al., in 2021; Roche & Rolland, 2020b) and others (Tan et al., 2020) have noted working with PSTs in terms of autonomy is an initial sense of wonder that, for some, is due more to the novelty of the technology than the complexity of the situation observed. As such, PSTs must be guided in how to watch such content, such as through viewing an initial 360 video that serves as an orientation by actively guiding the viewer on engaging with the video (e.g., how to change the perspective), as well as specific scaffolds and directions of what and how to attend in viewing the videos. Such scaffolding is necessary because unlike one static perspective from a standard video, PSTs are surrounded by several possible events of interest occurring at the same time. As with being in a classroom, PSTs must monitor the entire spatial domain of the video, ideally noticing important events but also risking not noticing others.

This increased perceptual capacity in the spatial sense appears to be beneficial for fostering engagement and presence. In our own work, we have observed many PSTs who reported feeling *present* within the 360 environments managed to attend to relevant events but were also able to switch between moments of interest (e.g., from teachers' behaviors to students' discussions) (Gandolfi et al., 2021). Thus, an increased sense of presence, or the feeling of being in the classroom, appears to facilitate more focused viewing of 360 videos. Although many scholars suggest 360 video allows for an increased sense of presence (Ferdig & Kosko, 2020; Theelen et al., 2019; Walshe & Driver, 2019), there still remains variance in the degree of presence reported by PSTs viewing 360 videos (Gandolfi et al., 2021; Roche & Rolland, 2020b). Some of this appears to be due to PSTs' interest in the context recorded (e.g., whether they believe they may teach such a grade level or topic), as well as various other factors related to their prior knowledge and experiences. More research obviously needs to be completed to better practical implications, including research in content domains and grade bands not currently investigated. However, there is enough evidence to suggest that PSTs do better when viewing 360 videos after having an orientation, when given explicit instructions on what to look for, and when viewing videos that are aligned with their area of interest.

Preparing PSTs to Use 360 Media in K-12

While AR and VR content for consumption continues to grow, tools for creating 360 media are becoming more accessible in K-12 settings. This offers opportunities for designing rich, authentic learning experiences. It also shifts the focus from PSTs consuming 360 media to the preparing inservice and preservice teachers to use 360 in K-12 classrooms (see Baumgartner, 2020; Paraskevaidis & Fokides, 2020).

Rather than providing ready-made media for student consumption, teachers may create their own content or scaffold learning by designing opportunities for students to use 360 media to explore curricula and demonstrate new knowledge. Providing opportunities for students to create 360 media aligns closely with established learning theories and frameworks of constructivism (Piaget, 1974) that emphasize the importance of the learner in an active role in order to construct meaning. Such opportunities can support guided inquiry and help students to make deeper connections within and among concepts as they study, analyze, and synthesize content to answer their inquiry and create their 360 product. The experience can provide an authentic context for meaningful collaboration when students work with their peers on 360 projects, creating opportunities for students to consider the perspectives, backgrounds, and experiences of others in the design process. Additionally, creating with 360 media (video or photos) provides opportunities for students to use their creativ-

ity within the curriculum while also learning to use digital technologies in a creative way that is essential to being career-ready.

There are at least three ways PSTs (or even inservice teachers) need to be prepared to use 360 in the classroom. First, they need to be prepared to record video for reflection in improving practice (Weber et al., 2018). Instruction is similar, in many ways, to the use of standard video. However, PSTs and inservice teachers will need specific instruction on the nuances of 360 video camera placement. Second, current and future teachers need to be instructed in how to contextualize videos. In other words, there has to be a reason and purpose for the use of 360 videos in the classroom. One of the potential uses is in virtual field trips. But the truth is that not every educational opportunity warrants the use of 360 video (or photo), regardless of whether the video is found on the internet or created by the teacher.

In the first two examples, the current or future teacher is being taught to implement 360 video. A third important area of preparation, however, is to teach teachers how to have students use 360 video or photos in their learning. Teachers here focus on putting the cameras in the hands of the learners, rather than giving them the finished product (see Goldman, 2014). Research is extremely limited in this area. However, early research has shown the potential of having students learn STEM concepts and to improve spatial recognition through using 360 video (Baumgartner, 2020).

The Cost of 360 Media

Too seldom discussed in implications for practice are the costs of implementation. These costs may be monetary or related to time. In the context of 360 media, there are several costs that must be weighed in determining not only whether it is used but in what manner. First and foremost in such considerations is locating media to use for specific purposes. Thankfully, there is a growing corpus of 360 video and photos for both classroom practice and virtual field trips freely available online[1]. Such content can be viewed on flat screen devices (i.e., laptop, phone) with little technical knowledge.

However, should one wish to create their own content, quality 360 cameras can be purchased for as little as $200, edited with free software, and uploaded to a free repository such as YouTube for dissemination. VR headsets are similarly becoming less expensive with dedicated headsets costing as little as $300, and phone-based headsets costing even less (as little as $1). It should be noted that while headsets like the Oculus Quest ($299 at the time of this writing) are worthwhile investments, many phone-based headsets have significantly lower quality viewing. In fact, when the first author provided their own students with phone-based VR Goggles, they found that only one in ten PSTs ended up using them when viewing 360 videos due to the quality of the picture (the rest used their laptops or phones). By contrast, when provided the option of using a dedicated headset or their laptop/phone, these same PSTs almost universally adopted the headsets. Rupp et al. (2019) compared participants' viewing experiences of 360 video on phones, Google Cardboard headsets, and two variations of Oculus VR headsets. They found that the better resolution provided, the more immersive viewers reported the experience to be. This included a preference of using Google Cardboard over phones with no VR viewing mode enabled. The general takeaway here is that dedicated headsets with better resolution are more immersive, but using lower quality viewing experiences is still beneficial.

The Pragmatics of 360 Video Recording

Teacher educators attempting to record their own standard video must decide where to place and focus the camera perspective for future PST viewing. Teacher educators interested in the use of 360 video for capturing classroom practice have similar decisions. As evident from studies specific to MTE (Kosko et al., in press; Zolfaghari et al., 2020) and PETE (Roche Gal-Petitfaux, 2017; Roche & Rolland, 2020b), the content-specific activity students are engaged should directly inform where such cameras are positioned. Said a different way, cameras should be placed so one can see where the action is, with specific attention on what action is relevant for a teacher in that context. For example, in the context of an elementary mathematics lesson, a teacher educator may wish to record what different groups of students (seated at tables) do as they engage with mathematical manipulatives. Thus, the 360 camera should be placed so that student engagement can be observed and the PST can adjust the perspective from one table to another. Notably, even in the context of multi-perspective 360 video, such immersive experiences cannot record every aspect of a classroom (Zolfaghari et al., 2020). Thus, choices must often be made regarding what facets of a school-based scenario are most useful to record.

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[1] https://www.youtube.com; https://vimeo.com; https://xr.kent.edu; https://360cities.net; https://www.airpano.com

Similar to standard video, the length of 360 videos should be limited to allow for focused intervals of relevant pedagogical practice. Beyond this, however, 360 videos have significantly larger file sizes than their standard video counterparts. Although a 1080p resolution standard video is considered sufficient for clarity, a 360 video must have 5.7K resolution to have a similar recorded clarity. Rather, a 360 video records omnidirectionally and allows for a portion of the entire recorded scene to be viewed at any given time. In Figure 3, this selected portion may have a resolution that is similar to 1080p of a standard video, but the entire 360 video necessarily has a larger resolution. This difference in video resolution means that 360 videos are often three times larger (or more) than their standard video counterparts. Thus, selecting manageable timeframes for a recorded scenario is pragmatic both for maintaining attention of PSTs and for disseminating 360 video to PSTs.

Figure 3. Stretched out 360 video frame (left) compared to a selected perspective of the video in 360 mode (right).

A last recommendation extends from all others provided throughout this chapter. As noted by Roche and Rolland (2020b) and Kosko et al. (in press), the content recorded in a 360 video (or a standard video) is of central importance. Tasks that recorded students engage, within a 360 video, should be challenging enough to elicit mistakes, encourage engagement and productive struggle, and interesting for the novice teacher to view and learn from. The specifics of such factors are content dependent and inform all applications and recommendations of 360 video discussed here. As more teacher educators in a wider range of content areas create 360 experiences for teacher education, additional content-specific and generalized best practices will emerge. This chapter provides a useful starting point for teacher educators willing to learn about the potential and applications of 360 video.

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The Use of Digital Field Trip Guides for
'Learning On-site' and 'Virtual Excursions' in a Covid-19 World

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Abstract: The global pandemic has led to a sharp rise in demand for innovative teaching concepts, particularly for virtual field trips. Teacher educators now face the opportunity and challenge of designing virtual field trips while trying to capitalize on the benefits of traditional field trips. Over the past 12 months, digital field trip guides have emerged as a solution to this problem. These guides are a hybrid of *Learning On-site* and *Virtual Excursions*. They take learners through self-led field excursions. This chapter focuses on the approach teacher educators should take to guide pre-service teachers through such digital field trips, and how these educators can teach students to develop and effectively use digital guides in their own teaching. The merits and challenges of such teaching methods are shared through inclusion of a case study. Practical advice is also provided regarding how to incorporate such digital resources into teacher education.

Lesson Learned: Teacher educators should have learned that digital guides are an excellent tool by which to develop pre-service teacher competencies in developing and leading field trips, particularly when teacher educators use a hybrid approach of *on-site learning* and *virtual excursions*.

AN INTRODUCTION TO USING DIGITAL FIELD TRIP GUIDES FOR 'LEARNING ON-SITE' AND 'VIRTUAL EXCURSIONS' IN A COVID-19 WORLD

Field trips are often perceived as being at the heart of university education by both students and educators (e.g., Meyer, 2006). Nevertheless, field trips have had to undergo a process of reimagination as delivering educational resources digitally becomes increasingly common. While numerous examples of digital versions of field trips have been developed, empirical research on their effectiveness has, thus far, been sparse (Brendel & Schrüfer, 2013). However, it is clear that it is vital to offer pre-service teachers the opportunity to both experience such empirically verified learning spaces and develop their own understanding of the underlying concepts of field trip pedagogy.

In 2020, the Covid-19 pandemic revealed gaps in the digital infrastructure of many schools. It also highlighted areas in which teachers' knowledge at schools, colleges and universities was lacking in alternative approaches to teaching and learning (Jude et al., 2020). Consequently, it is now even more evident that there is a need for future teachers to be competent in the use of digitally supported teaching methods. Tied to this, the question of how teacher educators can help future teachers gain expertise in developing digital resources, such as a set of guidelines for digital field trips, has arisen. In this chapter, a comparison of digital and traditional field trips, and what can be learnt from the comparison of these two concepts, is discussed. An example of teaching the concepts of field trip is also included to support the discussion. The case study amalgamates the "*Le*rnen vor *O*rt (Learn On-site)" approach and "*V*irtueller *Ex*kursion (Virtual Excursions)" (LOVE), where both digital and traditional field trip teaching concepts are used to complement one another. Following this discussion, a series of guiding principles for planning such excursions are presented, and the potential for integrating these principles into teacher education are addressed. Finally, consideration is given to the potential of digital field trip guides for inclusion in teacher education.

WHAT WE KNOW

Learning on-site refers to physical field trips, in which sites are visited in person by the teacher and student. It is considered to be a useful learning tool with a variety of positive elements (Budke, 2009). On-site learning visits offer the learner an original encounter, enabling learning with all the senses and generating strong emotions about the subject area or case study on which the trip is focused (Hemmer & Uphues, 2009). Additionally, on-site visits provide an opportunity to enhance understanding and application of geographical methods such as cartography, surveying, or the observation of nature (Brühne, 2016).

Seckelmann (2020a) argued that virtual field trips, or excursions, can only ever be second to traditional on-site field trips. However, others have considered use of Web 3.0 to be a chance to generate a new learning culture for university teacher education (Bredel & Schrüfer, 2013). Budke (2014, 2020) & Kannwischer (2006) argued for the inclusion of virtual field trips in university courses and school geography lessons, suggesting that they enabled case studies to be shared with students with little effort and allowed for cost-efficient exploration of distant regions. Furthermore, such digital field trips can incorporate critical use of digital media andenhance geographical expertise, media literacy, personal and social skills.

If we consider the use the inclusion of both on-site and virtual of field trips by teacher educators, the focus shifts to the institutional frameworks of the universities and whether the use of such methods are viable within this framework. This aspect is essential as many teaching concepts and new ideas concerning field trip pedagogy, which seem attractive on paper, have been halted due to university institutional frameworks or by their practical application in a teaching setting (Hüttermann 2006; Seckelmann 2020b) This is often due to a lack of understanding of the process by which these methods would have been taught or because of a lack of justification for why a hybrid approach to field trips is relevant to teacher education (Seckelmann, 2020c). However, digital guidelines can often be adapted to the often-restrictive institutional frameworks of universities as field trip didactics are a core learning outcome for teacher education in geography (Hemmer & Miener, 2013).

Planning field trips independently is an integral part of teacher education (Hüttermann, 2006; Hemmer & Miener, 2013; Budke, Kuckuck & Reumont, 2020), but the time and effort involved in their organization deters some teacher educators from including planning a field trip in the syllabus. However, when field trips are made digital, the workload is often shared by several parties, which is valuable for the instructors as their teaching load is often sizeable (Seckelmann, 2020b). Digital field trips can also decrease instructors' workloads in the long term, as they can be reused and updated for subsequent academic years. Thus, whilst additional effort and time may need to be spent to develop the resources initially, this input of time is rewarded in subsequent years (Seckelmann 2020c).

A further advantage of digital field trips is that pre-service teachers can prepare individual field trip days and are therefore given part of the responsibility, which is a valuable learning experience (Hüttermann, 2006). Furthermore, time-restricted traditional field trips can be, in some cases, replaced entirely by digital field trips. By doing so, student teachers can, to an extent, work independently at their own speed, which is regarded to be positive by both teacher educators and the pre-service teachers being taught (Seckelmann, 2020c). The effect on workload and promoting independent learning is also relevant for school settings, where teachers are time poor (Seckelmann, 2020b) and learning to work independently is a core skill for students to develop.

Field Trips in Teacher Education

Field trips can build on most theories in geographical education that are taught in the classroom by providing context and real-world examples. Consequently, a variety of methods by which to apply these theories through field trips have been developed, which are based on the geographical philosophy of science (Budke, 2009). These educational concepts aim to convey the expertise needed for planning and delivering field trips. Examples of such methods include traditional field trips conducted by instructors, teaching-learning field trips offered by student teachers (Hemmer & Miener, 2013; Amend & Wirth 2020), and self-organized field trips by student teachers for students (Lindau & Renner, 2020). More recently, research has focused on combining physical and virtual field trips (Budke, Kuckuck, & v. Reumont, 2020) and the development of *digital guides* for smartphones by students (Seckelmann, 2020c).

The variety of different approaches to field trips led Hemmer and Uphues (2009) to classify types of field trip into *Überblicksexkursion* (overview excursion), *Arbeitsexkursion* (field trip activities), and *Spurensuche* (self-led exploration). These field trip types involve varying level of self-organization required during the learning process; they span from the highly passive overview excursion, which conforms to the traditional notion of a field trip, to the constructive concept of self-led excursions (Hard, 1993; Budke & Kannwischer, 2007). However, Hemmer and Uphues (2009) emphasized that this differentiation is less to do with comparative judgment and more to do with evaluating the range of potential methods to be used and their respective strengths and weaknesses when implementing these methods.

Within the range of methods presented, a set of guidelines to plan field trips have been developed that are based on a series of general geographical concepts (Dickel 2006; Hemmer & Uphues, 2009; Ohl & Neeb, 2012). Together, these guidelines serve as a set of quality criteria for (and provide direction in) planning and arranging field trips. Thus, the observance or non-observance of these guidelines directly impacts the nature, content, and focus of a field trip. In this context, adopting a *problem-based approach* to field trip planning is key, where the key question of a field trip determines the learning outcomes and methods. Ohl and Neeb (2012) termed this *the principle of planning a field trip tied to a certain topic*. They demonstrated how, depending on the focus of the key question, the methodological and conceptual focus of a field trip, as well as the focus of the participants, can vary considerably even for one site.

Brühne (2016) emphasized that the key question should always be the starting point of a field trip. They suggested that the first location of a field trip should be deliberately selected and utilized to tackle the key problem and promote formulation of this predefined question. Böing and Sachs (2007) use the term *pre-discovering activities* for this evolution of the key question and the subsequent planning of the field trip in form and content on-site. Pre-discovering activities are followed by *while-discovering activities*, which are comprised of the active on-site examination and development of a strategy to solve the problem. These, in turn, are succeeded by *post-discovering activities*, which refer to communicating and reflecting the solution of the problem, as well as evaluating the spatial experiences and impressions. Together, they follow the principle of *structure*, a core principle of field trip pedagogy (Brühne, 2016; Hemmer & Uphues, 2009), which states that field trips should be arranged into segments or phases.

Budke (2009) describes in the introduction of *Kompetenzentwicklung auf geographischen Exkursionen* to her anthology Exkursionen selbst gemacht, as the gradual integration of *various concepts of place* in field trip didactics. The perception of *place* also involves considering and investigating these places as elements of communication and action if the traditional field trip is to be conceptionally and methodically developed further.

By considering place as an individual and a social construct on field trips, it is therefore important to consider *subject centricity* (Böing & Sachs 2007), *multiperspectivity,* and *potential controversy* over perceiving place in such a way. It should also be considered when planning a field trip in terms of how the key questions should be approached. Furthermore, reflection is an important aspect of constructive field trips as it unites all other guiding principles concerned with content and method (Ohl & Neeb, 2012). The teacher educator has to schedule certain field trip phases so that students

can reflect upon their thoughts and actions, and also provide clear methodological progression and an educational goal, for students both collectively and individually.

The "LOVE" Field Trip Concept

The central educational goal of *Learning On-site* and *Virtual Excursions* (LOVE) is that student teachers devise their own digital field trips. A broad range of diverse educational concepts exist in field trip didactics, but LOVE is based on with Seckelmann's (2020c) creation of *digital guides* by students for students. LOVE is segregated into several phases: *field trip preparation; conducting the field trip;* and *evaluating the field trip.*

In the *field trip preparation stage*, student teachers need to acquire a core body of knowledge in field trip pedagogy. This knowledge includes the core principles of field trip pedagogy (Ohl & Neeb, 2012), how school field trips are classified on the level of self-organized learning that is involved (Hemmer und Uphues, 2009), and how field trips are divided into spatial study environments (Brühne, 2016). Following learning of the core principles, students are introduced to the methods by which they will develop their digital field trip. In the case study included here a web-based application called *Padlet* (https://padlet.com/; see Figure 1) was used to create digital field trips. With the help of a field trip created by an instructor, Padlet was presented and tested on-site. Once the student teachers were familiar with the software, they then went on to create their own digital field trips for a range of selected topics using Padlet. The students were encouraged to use a range of elements when developing their field trips including photographs, audio files, animations, and simulations.

Padlet as an example for a digital field tripe guide

A Padlet is a web-based application based on the principle of a digital bulletin board, which can be utilized creatively and collaboratively. Both teachers and students can make use of various Padlet templates to depict the process and content of field trips concisely, using multimedia formats such as audio files, texts, videos, images, and work sheets, which can all be uploaded on the digital bulletin board. Padlet can be used by teachers to instruct, structure course material, and organize classes, and students can collect and organize information and results.

Figure 1. Example of a digital field trip Padlet devised by students; it is a coherent and guiding collection of exercises, videos, tutorials, and sites composed by the students.

The *conducting a field trip phase* involves the digital field trips being tested by other students. For this case study, topics included structural transformation and gentrification in Cologne-Ehrenfeld, historical urban development in Bonn, land use disputes in the Rhenish Gardens, and urban development in Bonn. In the final stage (evaluating a field trip), the student teachers assessed and evaluated the content within the framework of field trip didactics in a group discussion (see Table 1).

Table 1

Phases of the "LOVE" concept for field trip construction

Field Trip Didactics Seminar LOVE – Digital Field Trip Guidelines as Hybrid of "Learning On-site" and "Virtual Excursions"	
Phase	**Content**
Field Trip Preparation	• Acquisition of a core body of theoretical knowledge in field trip didactics (classification of various field trip formats, principles of field trip didactics, segmenting field trips into phases, identifying types of methods…) • Participation in a field trip created using the digital guidelines (by an instructor) • Analysis of the field trip example using the theoretical knowledge acquired in the first two stages. • Identification of potential opportunities and challenges for various field trip formats and determining which principles and methods of field trip didactics are appropriate. • Group research and preparation of individual field trip days in small groups • Field work and computer-based work to create individual digital field trip guides • Instructor's feedback and advice concerning planning and ideas for field trips • Completion of the field trip guides on Padlet
Conducting the Field Trip	• Active participation of students in individual field trip activities created by fellow students, and utilization of the digital field trips
Evaluating the Field Trip	• Detailed evaluation of each field trip activity • Theory- and question-based evaluation and analysis of the student's own field trip and digital field trip guidelines

When the planning exercise was undertaken as part of a geography education seminar at the Rheinische Friedrich-Wilhelms-Universität Bonn (Germany), it became evident that student teachers need to be adequately trained to create high-quality digital field trips (Hüttermann, 2006). Thus, when undertaking the first phase of the field trip planning exercise (see Table 1), teacher educators should provide their students with appropriate didactic and methodological tools to enable effective planning of digital field trips. In contrast to standard teaching sessions, the guidance needed for development of digital field trip was relatively time-consuming. However, evaluation of the seminar participants (n=20) and qualitative evaluation of the digital field trip guides showed that this time spent on guiding student teachers was worthwhile. A total of 68.75 % of the participants strongly agreed that creating their own stations in the digital field trip enhanced their didactical reduction and reconstruction skills (see Figure 2).
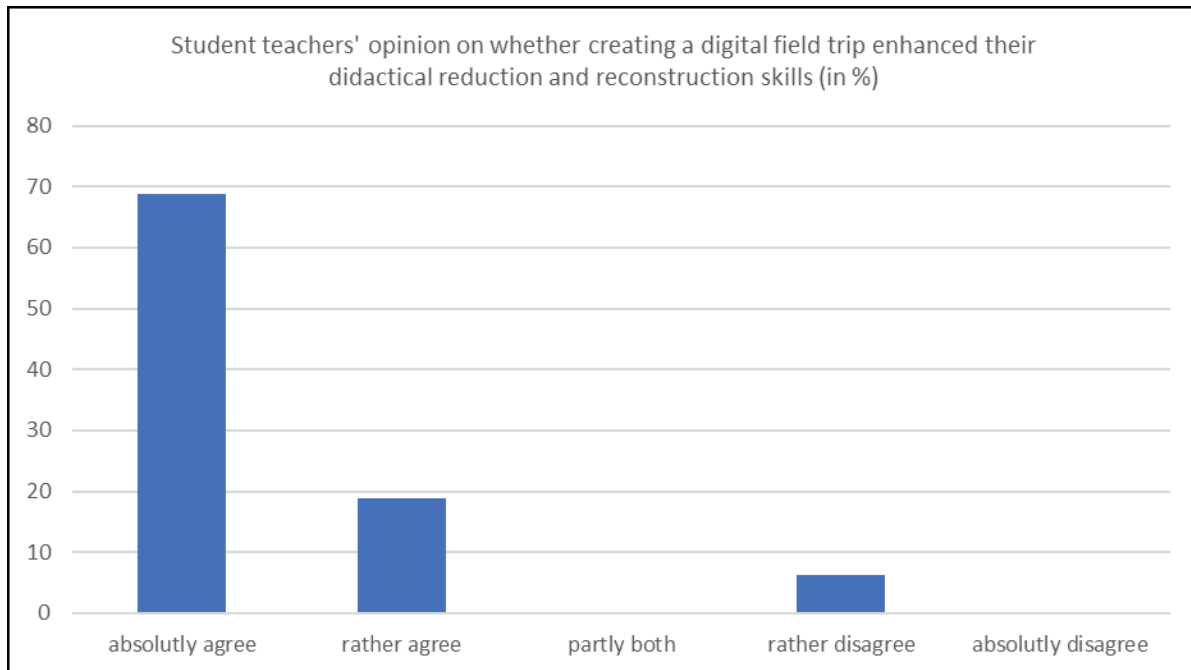
Figure 2. Results of the student evaluation from the seminar (n =20).

This data provided evidence that, in contrast to traditional field trips, digital field trips are likely to include less chances for misconception and ambiguity as digital field trips need to be self-explanatory. Students knew that their fellow students would test their digital guide, and that they would not be able to explain or correct anything face-to-face while others were in their field trip; as such, students increased their dedication to apply core qualitative criteria and didactical principles to the field trip development. Student teachers also said they found it was also possible to apply the principles of planning an on-site field trip to digital field trip guides; 80 % of the students in the test seminar agreed that creating digital field trip guidelines provided them with good experience for their future career (Fig. 3).
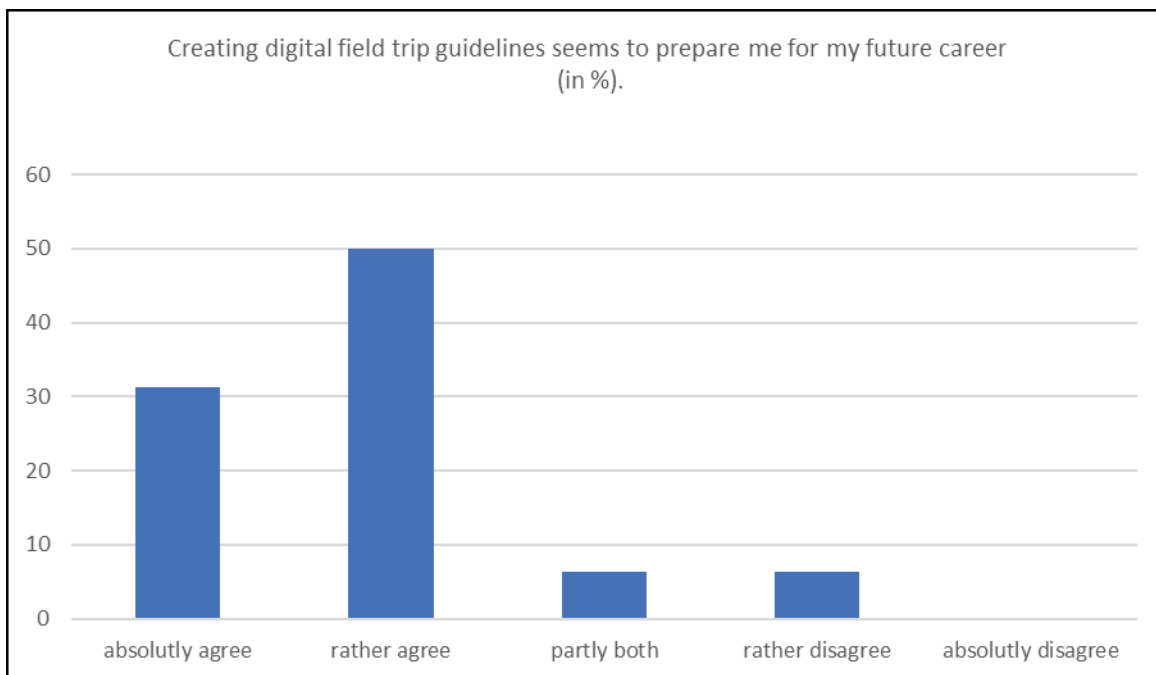

Figure 3. Results of student evaluation from the seminar (n =20).

However, creating digital field trips did not increase the student's expertise in field trip pedagogy entirely. The formation and use of digital field trips create highly static teaching settings; digital field trips are, therefore, unsuitable for creating open learning environments. Furthermore, the application of the self-led field trip was not entirely effective, as student teacher's found undertaking digital field trips that involved a high level of self-organization challenging. In particular, applying the setup of traditional field trips to digital versions, where student teachers were encouraged to develop their own problem-based questions during the field trip and select and implement their own methods to tackle a problem, was considered too challenging by student teachers. In our case study example, 31.25 % of the respondents were indifferent with regards to the level of difficulty of a task while 12.5 % or respondents found it very difficult to integrate participant-oriented aspects into the field trip (see Figure 4). Consequently, if teacher educators intend to instruct their students in this area of field trip didactics, traditional on-site forms of field trips are more suitable, as the teacher can counsel the students, and problem-based questions and methodological approaches can be developed on-site.
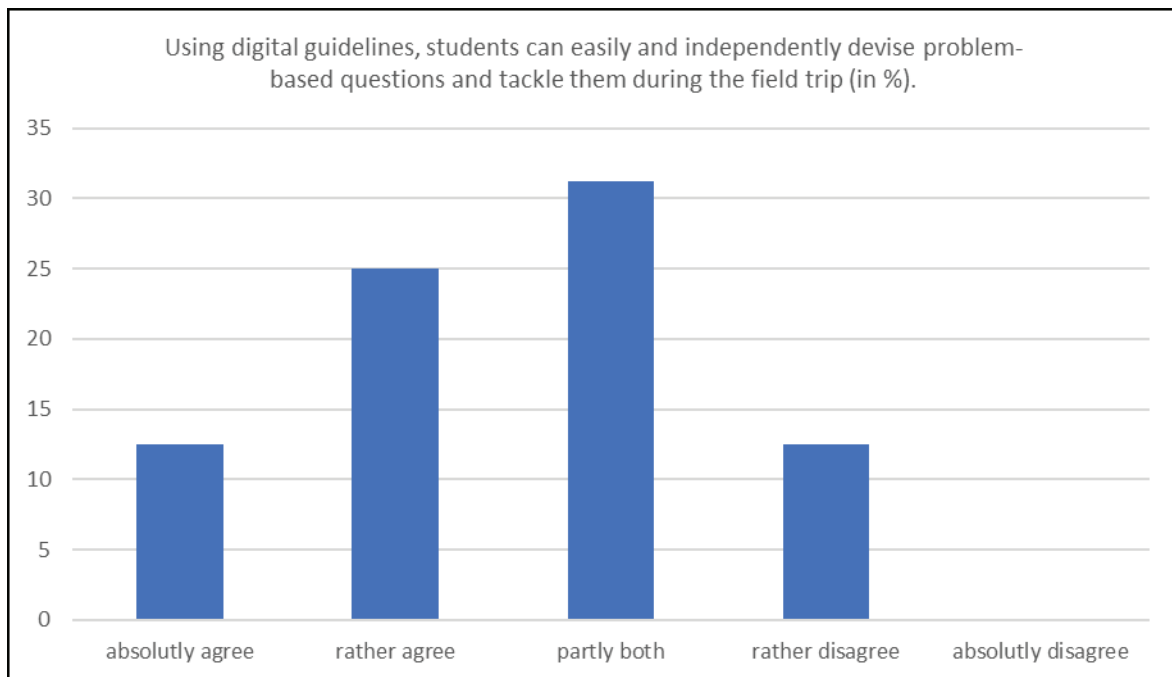

Figure 4. Student feedback on ease of use of digital guidelines.

It is worth concluding by noting that while these methodological considerations are important, an overriding advantage in the production of high-quality digital field trips is that they can be reused and shared with colleagues, decreasing workload, and enabling continuity between teachers (Seckelmann, 2020b).

LESSONS LEARNED FOR RESEARCH

This relatively new field of research is predominantly presented in the academic literature as a series of best practice examples (Seckelmann, 2020a). As such there is an urgent need for empirical research in the field, as it is clear that digital field trips, in theory, have many advantages for students and educators (Kannwischer, 2006).

One of the areas future work should focus on is the extent to which virtual excursions can be used to explore distant countries, regions, and specific topics in depth (Budke et al., 2020). Particular consideration should be given to identifying the extent to which the original encounter involved in learning on-site can be recreated through a computer or smartphone. Moreover, researchers should explore, if it is possible to replace the original encounter in this way, the technical requirements or media representations are needed (Budke & Kannwischer, 2006)? With this knowledge, teacher educators could conclusively identify which elements of an excursion can only be taught on-site versus which can be taught virtually.

Further work is also needed to determine the extent to which pre-service teachers' proficiency in using digital media can be developed through learning to create digital field trip guides. For example, can student teachers present changes of perspective and conflicts of interest within a particular topic effectively in a digital guided field trip (Lindau & Renner, 2020)? The competence of student teachers could be investigated through comparative studies between traditional on-site field trips and digital field trips.

Another question yet to be answered is to what extent the designed digital field trips are used after the seminar, and who uses them (Hüttermann, 2006). It would be useful to investigate whether student teachers who created digital field trips go on to integrate these into their teaching when they become in-service teachers, and their evaluation of these digital field trips once they have been applied in a school setting. To build on this, the opinions of school students regarding using digital field trips should be explored (Hemmer & Miener, 2013), as well as the extent to which institutional thresholds of universities and schools can be crossed to anchor this promising approach into the system of education.

Overall, research on the integration of field trips in teacher education needs to focus on planning of field trips. The majority of previous studies have investigated field trips led by lecturers. Fries et al. (2016) showed clear differences in the experience of the real world and the virtual world from the perspective of student teachers as field trip participants. However, how these pre-service teachers evaluated these two forms of field trips when they planned and conducted field trips when in-service was not known.

Finally, it would be of great interest to ask the few teacher educators who have already switched the responsibility for field trips to their students about what to look for when designing such an innovative seminar, in terms of content and methodology (Seckelmann, 2020c). This would enable a set of empirically- and theoretically developed guidelines to be produced, which teacher educators could then apply to their practice.

LESSONS LEARNED FOR PRACTICE

1. Teacher educators should use digital field trip guides as an additional tool to achieve their educational goals.

Teacher educators should be aware that creating digital field trips is a demanding and time-consuming task for student teachers. In particular, it is the aspects of devising a concept and its content that are challenging, rather than working with digital tools. Teacher educators need to provide student teachers with the pedagogical knowledge, tools, and enough time to develop reusable high-quality field trips with the help of digital media. Teacher educators need to understand that students often lack expertise in field trip pedagogy rather than media literacy. Consequently, they should give learners plenty of time to think through the goals of the field trip and the arrangement of the learning setting before transferring it to a digital guide. For students, the challenge in planning a field trip is to consider the quality criteria of a field trip. So, it is more about the art of teaching and less about the ability to operate a digital guide. However, the example presented here shows that this is possible, as students systematically gain these expertise by creating digital field trips (Hüttermann, 2006). Thus, instead of being the core of teacher education at universities, the digital medium should become for teacher educators, from a pedagogical perspective, a positive supplementary tool (Seckelmann, 2020c).

2. Digitization of excursions increases flexibility for all participants.

Digital guides allow for individualized participation in field trips, regardless of date, time, or weather conditions. Developing digital versions of field trips is, therefore, not only a useful tool for teacher educators during the Covid-19 pandemic, but also as a part of regular academic teaching programs. The main advantage of the digital field trip as a tool is that both instructors and learners benefit from being able to control the pace of the field trip to suit their individual learning needs. According to Seckelmann (2020c), 67% of participants (n= 86) liked it when they could determine the day, pace, and length of stay at individual sites within a field trip. However, student teachers do also like working with other pre-service teachers. In the example given 72% of participants did not do the field trips alone, and around 80% of participants communicated with each other about the field trip content. Thus, greater individual flexibility for participants does not necessarily isolate individuals, which is an encouraging result for both teacher educators and pre-service teachers. When planning their seminars, teacher educators should therefore ask themselves whether these facts and potential benefits will help them in their future work with students. They should know that high-quality digital field trips can be used as positive examples in future courses. Digital field trip guides can be valuable teaching resources that can reduce the workload in the stressful university life.

An additional consideration for teacher educators is that digital guides enable them to work with large groups of student teachers (Seckelmann 2020c). However, whilst this could be seen as an advantage from the lecturer's point of view as they can consolidate their teaching into a smaller number of groups, it could also have a negative effect on student teachers' learning as individual support may decrease because of larger class sizes.

3. Excursions based on constructivist theory are less suitable for conversion to digitally guided field trips.

Excursions based on constructivist theory are oriented towards learners' individual perceptions (Hemmer & Uphues, 2009). Central questions of the excursion are developed and answered by the learners on-site, with learners deciding how and what they want to explore independently. To achieve this approach in open learning settings, learners need personal support and guidance from an accompanying teacher (Gudjons 2006). However, a digital field trip guide cannot provide this, as interaction between teacher educators and students can only take place on prior to or following the student learner undertaking the field trip. Consequently, the limitations of a digitally guided field trip become apparent when a field trip is based on this approach (Seckelmann 2020c). Teacher educators should therefore make student teachers aware that the degree of difficulty in designing a digital excursion increases with the openness of a learning setting. The greater the possibilities for learners to make individual decisions on the excursion, the more open the tasks must be on the one hand and the more concrete the supports within the digital guides must be formulated for the learners on the other. A good aid can be, for example, a catalog of methods presented in the digital guide, from which the excursion participants can select a method to answer their own developed question. In summary, depending on the pedagogical skills of the student teachers and the potential excursion participants, teacher educators should consciously decide whether strongly constructivist excursions should also be designed in digital form in their seminars.

4. The pedagogical value of digital guides increases when teacher educators give the responsibility of their development to the pre-service teacher.

While student teachers generally prefer field trips led by teacher educators (Friess et al., 2016), the value of digital field trip guides as a learning tool increases when student teachers have to develop such experiences themselves. When personally undertaking such development the didactic challenges for the student teachers are high (Hüttermann, 2006) as these pre-service teachers must consider the key quality criteria for excursion planning (Ohl & Neeb, 2012) whilst also integrating content and methodological procedure into the digital guide in a clear, understandable way. Individual case studies show that pre-service teachers consider these tasks to be highly motivating, particularly when their digital teaching materials are to be made available to the public (Budke et al., 2020). Consequently, teacher educators should gradually empower student teachers to independently design digital field trips. One example of implementation could be the "LOVE" field trip concept described above; Teacher educators should let pre-service teachers experience existing digital field trips and should then reflect on these field trips with learners and examine them for quality criteria. They should also engage in repeated feedback loops with students as they plan their field trips, whilst always bearing in the question: Do our pedagogical and content decisions fit the purpose and guiding questions of our field trip?

5. The preparation and evaluation of digital field trips requires professional feedback and the guidance of teacher educators.

The main aim of digital versions of a field trip is to replace an instructor in the field. Therefore, the tasks, content, methodological suggestions, and assistance provided for the student teachers within the digital field trip must be comprehensive and unambiguous. Teacher educators need a plan to examine the results of this work to provide student teachers with targeted feedback. Figure 5 is an example of a tool to analyze and evaluate educational goals, which enables teacher educators to analyze digital field trips in three steps. It can also be seen as a guide, with the help of which teacher educators as well as preservice teachers can significantly increase the quality of their work. At the same time, this guideline can be used by teacher educators as discussion points during a feedback session with the teacher students.
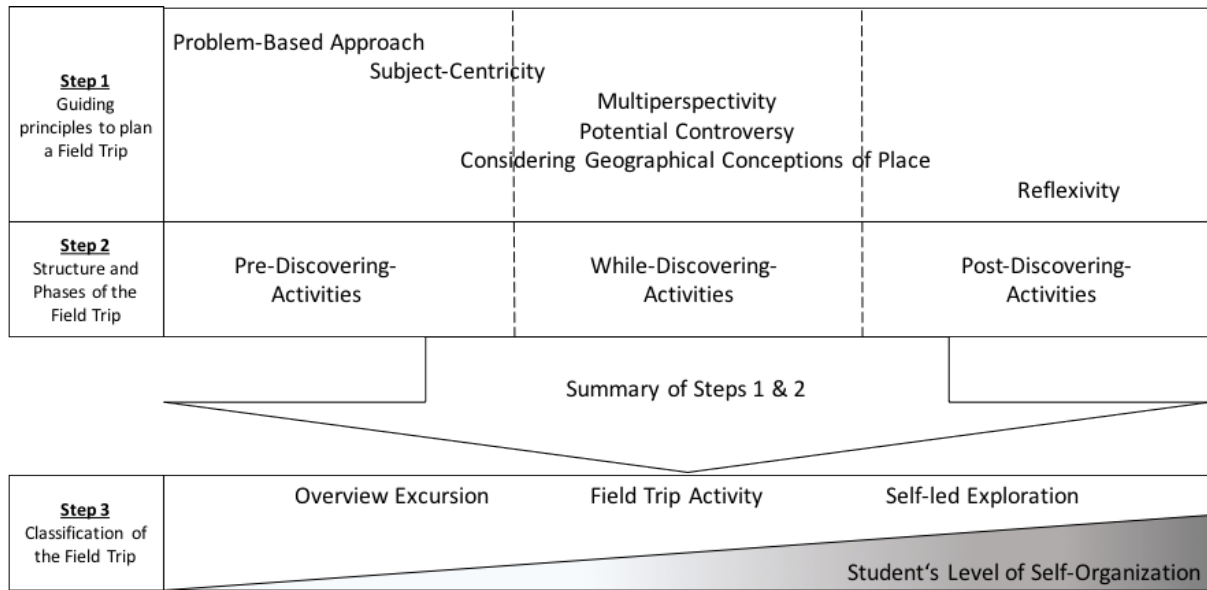
Figure 5. A tool to analyze and evaluate digital field trip guidelines (see. Brühne 2016; Ohl & Neeb 2012).

A methodological approach, such as the one outlined in Figure 5, aims to identify the principles of field trip pedagogy that student teachers have incorporated when planning a digital field trip, and whether they have successfully segmented the field trip into phases. Step 1 involves analyzing how the instructions provided in the digital field trip are organized, based on a series of core principles for field trip didactics. Tasks, selected content, and the assistance given through the instructions should be examined in the order described in Figure 2. Step 2 involves segmenting the field trip into phases and involves differentiating between pre-, while- and post-discovering activities, with the principle of structure in mind. Step 3 combines Step 1 and 2 and aims to classify the field trip based on the extent to which students work autonomously during the field trip.

It is important for teacher educators to understand that the student teachers not only require strong guidance and counseling at the beginning of the seminar (Brühne, 2016), but that the students also consider the final reflection on their field trip experiences to be a particularly valuable part of the learning process (see Figure 6). Therefore, both teacher educators and students should evaluate the field trips extensively at the end of the activity, with particular consideration to the trip's central educational goal and the theories of field trip pedagogy. Student teachers also emphasize the importance of preparation and reflection of their work with their educators (Seckelmann, 2020c), which enables them to become reflective practitioners themselves (Schön, 1984).
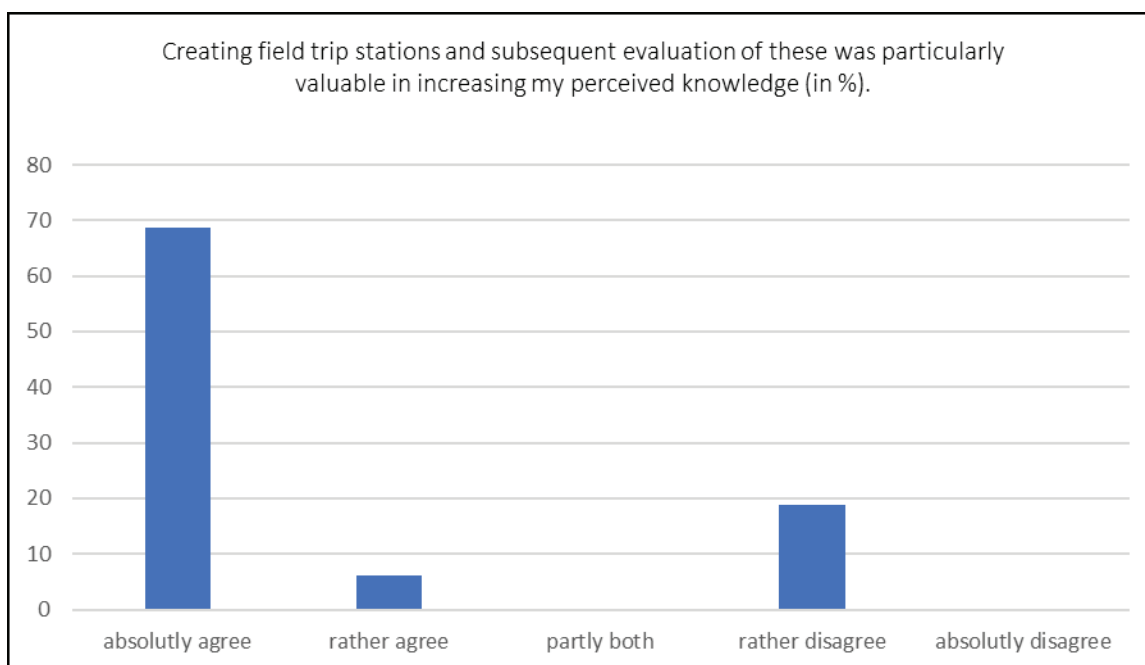
Figure 6. Results of Student Evaluation of a Seminar (n =20) – Author's Graph.

In summary, this discussion does not necessarily imply a dramatic change in traditional teaching practices is needed regarding field trips. Instead, it highlights that there may be new and helpful methodological and technical options available to teacher educators to enable student teachers to progress their competence in designing and delivering field trips more effectively. Additionally, the research suggests that a hybrid approach of combining digital and on-site offerings for field trips to student teachers provides the most viable approach for such teaching methods, although some methods of field trip delivery are more suited to on-site or digital field trips. Furthermore, by integrating the development of digital field trips into contemporary academic teaching it would not only be beneficial to student teachers' pedagogical understanding but may also to the in-service teaching they will undertake in their future careers (Hüttermann, 2006; Seckelmann, 2020b).

WHAT YOU SHOULD READ

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