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 COVID, 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 INTRODUCTION TO 360 MEDIA 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.

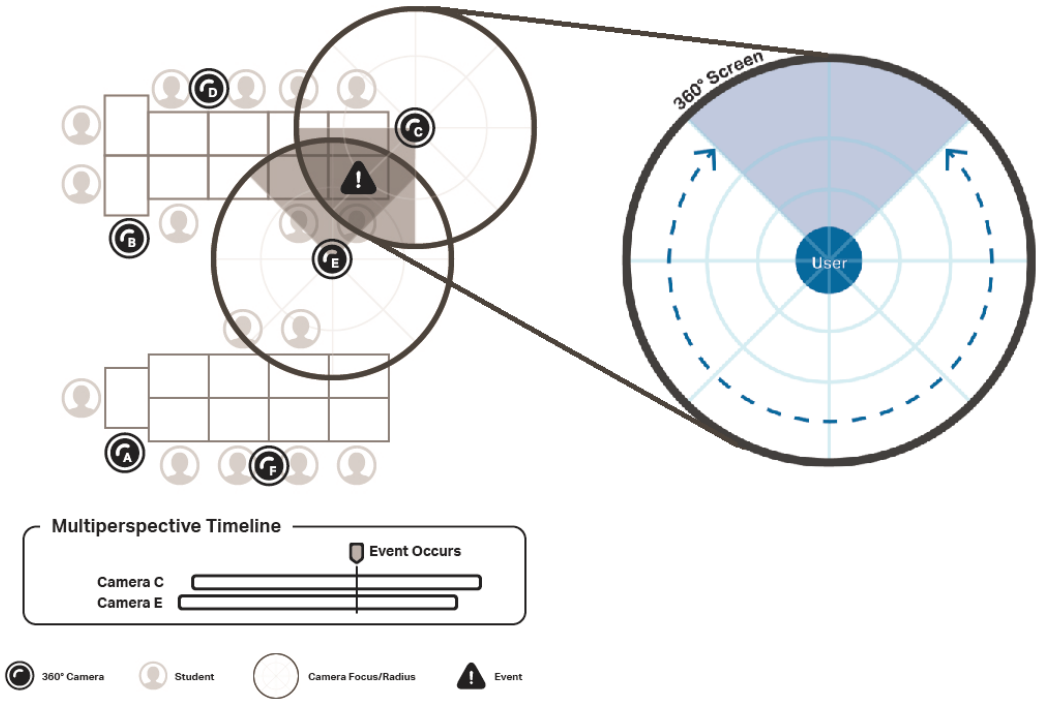

Figure 1. Illustration of how a PST may view a multi-perspective 360 video. Different camera positions are denoted by letters, with a PST able to switch from one 360 camera perspective to another.

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.

360 Video in Mathematics 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).

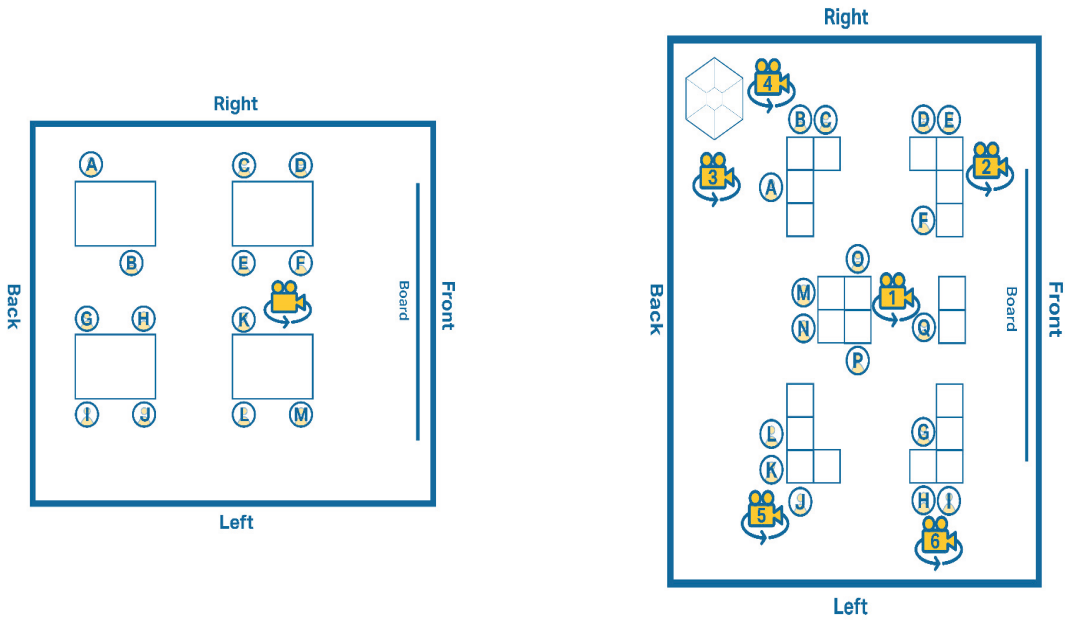

Figure 2. Example classroom maps for a single-perspective 360 video (left) and multi-perspective 360 video (right).

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.

[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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