How Immersive Should Virtual Field Experiences Be?

A Comparison of Single and Multi-Perspective 360 Video

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Abstract: We examined preservice teachers (PSTs) immersive experiences comparing single and multi-perspective 360 videos together with two variables of pedagogical content knowledge (PCK) and perceptual load. The purpose of this research was to analyze how teacher virtual field experiences can be enhanced and to investigate whether using multi-perspective 360 increases PSTs' duration of focus for their field of view (FOV). Data were collected from early childhood (PreKindergarten-3) education majors and was analyzed using a quantitative approach with multiple regression analysis. The preliminary results indicate that the multi-perspective field experiences led to a higher perceptual capacity in PSTs noticing and are similar to face-to-face assignments. Overall, results indicate that the duration of focus doesn't warrant PSTs being better at noticing. While PCK was found to have a negative effect on focus, the multi-perspective videos were found to reinforce longer duration focus. Finally, a useable interface that is currently in Beta has been shown to facilitate teacher viewing in multi-perspective 360 and gives feedback on where teachers tend to focus.

Historical Review

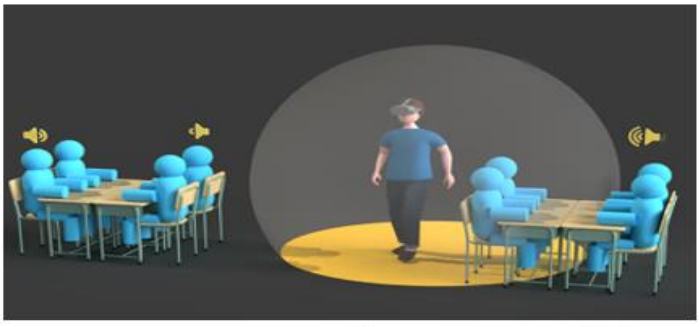
Field experiences with students in K-12 classrooms are an essential component of preservice teachers' (PSTs) professional development. Such experiences are also tied to assignments in PSTs' methods courses to help align theory learned in a college classroom with practice engaged in a K-12 classroom. Beginning in March 2020, face-to-face field experiences

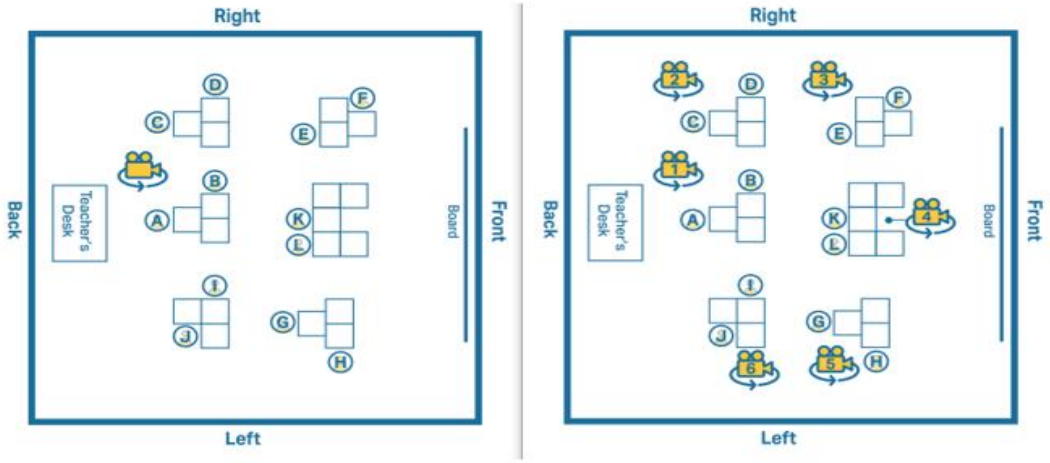
ceased due to the COVID Pandemic, and this pressed us to adapt PST's field-based assignments to a virtual field experience (Zolfaghari et al., 2020). Specifically, we used multi-perspective 360 video to engage PSTs in observing students' mathematical reasoning in previously recorded elementary mathematics lessons. Single-perspective 360 video records a classroom omnidirectionally (a spherical video) that allows the viewer to look in any direction from a fixed location, whereas multi-perspective provides this affordance with multiple vantage points in a classroom (see Figure 1).

Figure 1.

On the top view: Illustration of a teacher with a VR headset immersed in a single perspective recorded 360 video.

*On the bottom View: Illustration of single perspective classroom map (left) and mu*lti *perspective classroom map (right).*





Our use of multi-perspective 360 video to create an asynchronous field experience was based on lessons from research. First, scholars had found that single-perspective 360 video supported PSTs' professional development more than standard video (Kosko et al.,2021a; Walshe & Driver, 2019). Particularly, 360 video has a higher degree of perceptual capacity, or "a medium's capacity for aspects of the scenario to be perceivable" (Kosko et al., 2021a, p. 286). This perceptual capacity allows PSTs the potential to observe more children in a recorded classroom, which, in turn, increases PSTs' focus on children's mathematical reasoning (Kosko et al., 2021a). In spring 2020, we piloted multi-perspective 360 videos as a virtual field experience. Although these video-based experiences "were created to supplement, not replace face-to-face field experiences…we found PSTs engaged in authentic observation when assessing students" (Zolfaghari et al., 2020, pp. 318-319).

Since the events of spring 2020, we and others have continued studying 360 video while circumstances continuously evolved with the changing world. At our institution, face-to-face field experiences returned slowly. In the following academic year, only our seniors received field placements, with many having a placement where they taught students online. Face-to-face placements began returning in fall 2021. As we continued to integrate both single and multi-perspective 360 videos, we learned that "merely providing 360 videos allows for more student actions to be observed by PSTs. However, PSTs may not necessarily take up such observations" (Kosko et al., 2021b, p. 245). Many PSTs need to be scaffolded in how to attend to students, what to look for, and why specific student actions matter (Buchbinder et al., 2021; Weston & Amador, 2021). In attempting to measure the effects of such scaffolding, we developed pedagogical content knowledge (PCK) measures like the PCK-Fraction assessment that examines teachers' knowledge of students' reasoning (Zolfaghari et al., 2021a). We also sought a

means of assessing teachers' physical ability to identify things visually; a construct described by Eayrs and Lavie (2018) as *perceptual load*. Rather, when teachers watch 360 video, they turn the camera perspective to look at different locations. Although an affordance, some teachers overuse it to the degree they attempt to see everything in general rather than anything in particular. This has led to findings that longer durations of focus (i.e., looking in the same place for longer periods) are associated with more sophisticated professional noticing (Heisler & Kosko, 2021; Kosko et al., 2022; Zolfaghari et al., 2021b). In this chapter, we sought to examine whether the duration PSTs tended to focus was different in single and multi-perspective 360 videos and whether accompanying factors such as their PCK and perceptual load affected such tendencies.

Methods and Procedure

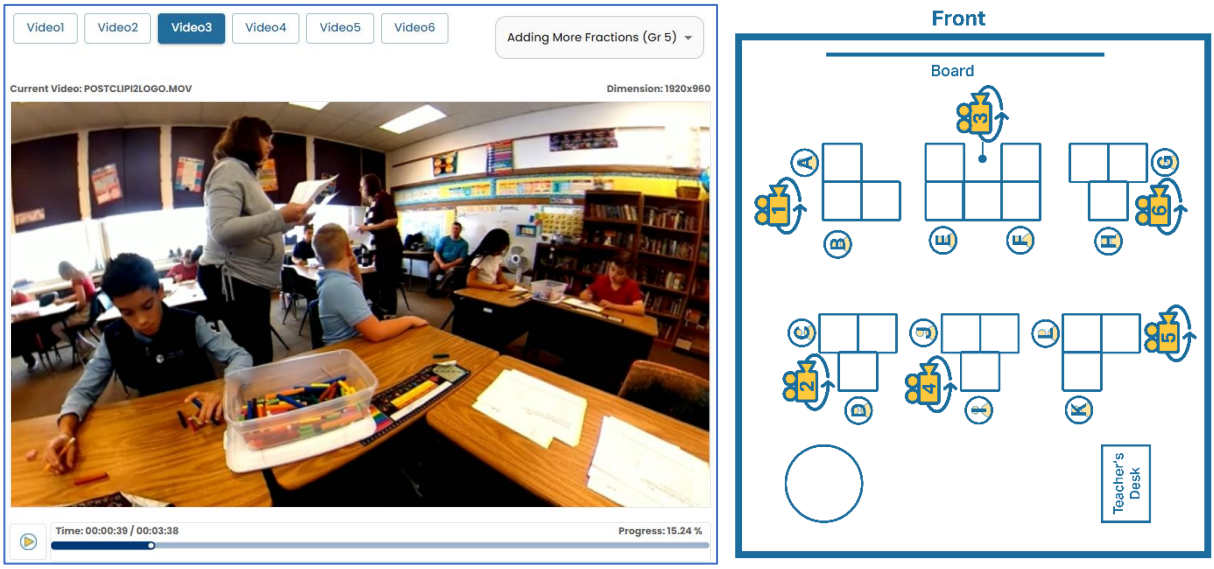
Data were collected from 42 PSTs majoring in early childhood education (preK-3) at a Midwest U.S. university in fall 2020. The participants primarily identified as white (97.6%) and female (95.1%). Participants were at varying points in their professional education, with 26.2% not having taken any of the three mathematics pedagogy courses in the program, 26.2% having taken the first course, 4.7% having taken the third, and 42.9% having taken all three courses. Participating PSTs completed the PCK-Fractions assessment (Zolfaghari et al., 2021), which was estimated with a Rasch model ($\bar{\theta}$ = 3.483, *SD* = 2.199, *Range* = -4.57 to 6.41). PSTs were also assessed on their perceptual load (Eayrs & Lavie, 2018), which was also estimated with a Rasch model ($\bar{\theta}$ = 0.564, *SD* = .906, *Range* = -1.16 to 3.04). Rasch modeling transforms ordinal data (i.e., 0 = incorrect, 1 = correct) into continuous data using logarithmic transformation; thereby providing a more specified

statistic for analysis (Bond et al., 2021). Following these measures, PSTs viewed a 360 video of a fifth-grade class reviewing fraction addition with like denominators.

Participants either viewed a single-perspective or multi-perspective version of the scenario using the Praxi platform for viewing 360 videos (Miller et al., 2020) and a map of the recorded classroom for reference. Multi-perspective participants' maps included the different camera perspectives such that they were able to click on the location in the classroom they wanted to view the video (see Figure 2). Single-perspective participants viewed the video from Camera 4 and were not provided information regarding the other camera locations. Participants in both conditions watched the 360 video before describing, in writing, what they noticed regarding students' mathematical thinking.

Figure 2.

Screenshot of Praxi viewing interface (left) with a map of the recorded classroom scenario (right). For the multi-perspective 360 video version. The single perspective included only Camera 4 as an option.



Participants' viewing sessions were recorded with the Praxi system and reassembled for analysis (i.e., Praxi produced video files of what and where participants looked). This allowed us to calculate the number of times participants changed their field of view (FOV) and for how long they maintained their FOV. We used multiple regression to examine the effect of being placed in the multi-perspective condition, accounting for participants' PCK and duration of focus for their FOV. This is represented in the equation below:

$$FocusDuration = B_0 + B_1 \cdot (d\_MultiPerspective) + B_2 \cdot (PCK - Fractions) + B_3 \cdot (Perceptual\ Load) + e$$

Results

Results indicate the regression model accounts for 20.6% of the variance in the duration of FOV focus and is statistically significant ($F(df=3) = 3.285$, $p = .031$). Being placed in the multi-perspective condition had a positive and statistically significant effect on focus duration ($B_1 = 10.406$, $p = .031$). However, PCK-Fractions had a negative and statistically significant effect ($B_2 = -7.390$, $p = .007$) and perceptual load had a positive but not statistically significant effect ($B_3 = 1.495$, $p = .163$). The results shown in Table 1 suggest that when accounting for participants' assessed PCK and perceptual capacity, viewing a multi-perspective 360 video increased the duration of focus by about 10.4 seconds over viewing a single-perspective 360 video. Although having a higher PCK score had a negative effect on the duration of focus, the size of the coefficient suggests a participant needed a score of about 1.41 or higher to overcome the potential benefit if placed in the multi-perspective condition; which only 16.7% of the sample achieved. Descriptive statistics do suggest multi-perspective participants had a higher average duration ($M = 17.18$) than single-perspective participants ($M = 11.81$). However, multi-

perspective participants also had higher PCK scores (M = .858) than their single-perspective peers (M = .343). We suspect there is a more complicated interplay between professional knowledge and perception than is possible to be modeled with these data. However, the trends observed here suggest both the potential for multi-perspective 360 video and areas for further study.

Table 1.

Results from the Multiple Regression Analysis.

	B	S.E.	β	*t*	*p*
Intercept, B_0	8.610	4.725		1.822	.076
Multi-Perspective, B_1	10.406	4.632	.353	2.247	.031
PCK, B_2	-7.390	2.610	-.454	-2.831	.007
Subitizing, B_3	1.495	1.049	.223	1.424	.163

Implications

Following an abrupt cessation of face-to-face field experiences in spring 2020, we incorporated multi-perspective 360 video as a means of engaging PSTs in attending to children's reasoning in a realistic context (Zolfaghari et al., 2020). An implicit assumption, and one our 2020 results supported, was that a more immersive representation would lead to the potential for more specificity of focus on children's actions. In this chapter, we sought to examine whether this assumption was justified with empirical data. Results support early findings from Zolfaghari et al. (2020) and expand upon them. First, PSTs viewing the multi-perspective 360 video had an average duration of focus of 10.406 seconds longer than their peers viewing the single-perspective 360 video. While statistically significant, the magnitude of this effect size is large,

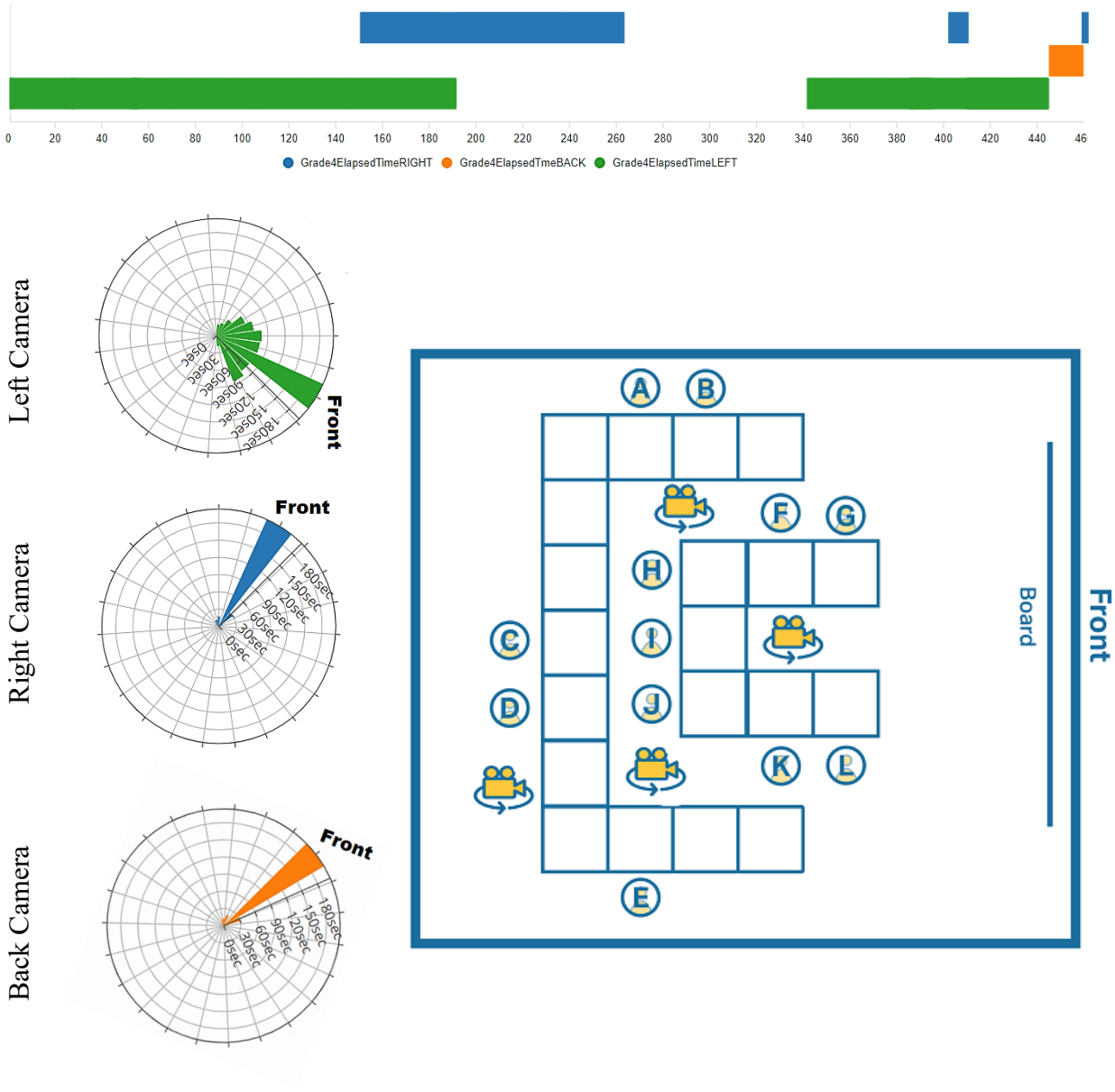
suggesting a more focused viewing pattern with less variance (i.e., less 'looking all around'). Results here suggest that multi-perspective 360 videos may provide a means of scaffolding more focused attending. So, there is a general increase in focused behavior despite more aspects of a classroom being perceivable. We contend this happens because once a teacher finds the particular locations they wish to focus, they do not feel a need to constantly move about. Rather, if their attending is purposeful, their focus is less varied, and most teachers (novice or expert) have a purpose in how they look around.

Earlier in this chapter, we noted scholarship supporting the need to scaffold PSTs' engagement with 360 video (Buchbinder et al., 2021; Kosko et al., 2021b; Weston & Amador, 2021). To scaffold engagement in the technology, Kosko et al. (2021b) suggest using standard video and single-perspective video before introducing multi-perspective. Yet, even with this scaffolded engagement, there is a need for decomposing practice, generally (Grossman et al., 2009). Over the course of the pandemic, we created a tool to support PSTs' and teacher educators' viewing of multi-perspective 360 videos. Praxi is a web-based platform that allows for viewing single and multi-perspective 360 videos and provides users with summary viewing reports (see Figure 3) for how much of a 360 video they viewed, from which camera perspective, and from which direction they viewed (Miller et al., 2020). Those interested in testing both the viewer and the summary report can do so as a guest at the Beta version of the platform (https://praxi.guans.cs.kent.edu/). By discussing directional views with PSTs, a teacher educator can initiate discussions about events at locations and times in the recorded scenario, and prompt PSTs to describe children's actions at those locations. In our experience, teachers will tend to focus on events at specific locations and times, but this often results in multiple groups focusing on different locations in the classroom. Such situations provide rich opportunities for

pedagogical discussions surrounding different students' reasoning, choices for attending to certain students over others, and so forth.

Figure 3.

Example summary report for one PSTs' viewing in Praxi.



This chapter presented additional results that we believe warrant further study. First, we found higher PCK scores had a negative statistical effect on PSTs' average duration of focus. The literature on the relationship between professional knowledge and noticing is complex; suggesting at times either no or a negative relationship (Jong et al., 2021; Yang et al., 2021) or a positive association (Simpson & Haltiwanger, 2017; Voutsina et al., in press). Thus, this is an area in need of further study to better understand the nuances in how professional knowledge affects how and where one looks. Additionally, the varying professional experiences PSTs engage across coursework and field experiences is also worth further study. Results presented here also point towards the potential for studying perceptual load in more detail. We used an adapted version of Eayrs and Lavie's (2018) subitizing assessment to assess PSTs' ability to deal with perceptual load. However, the effect in our regression equation was not statistically significant. Rather, the majority of our sample had scores above 0.0, which is considered 'average' on a Rasch scale. This suggests a heavy skew and may indicate that those entering into the teaching profession have a higher ability to deal with perceptual load. Regardless, future study is warranted to better understand this construct. Lastly, our study focused on viewing 360 video on a flatscreen display. It is possible that PSTs would have benefited more from viewing with a dedicated VR headset, as found by Kosko et al. (2021b). Evaluation of the benefits of using dedicated VR headsets versus access to 360 video on a standard screen is a pragmatic and important topic for future research.

At the height of the COVID pandemic, amidst a lack of face-to-face field experiences, Zolfaghari et al. (2020) suggested multi-perspective 360 video can help "fill part of the gap" (p. 319) when no such face-to-face field placements are available. Two years later, we believe multi-perspective 360 fills a gap even when such placements are in use. Results presented in this

chapter, and in prior work on the topic (Kosko et al., 2021b; Zolfaghari et al., 2020) support the continued use of multi-perspective 360 videos to support PSTs in their professional development.

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