TEACHER NOTICING OF STUDENTS' MATHEMATICS AS STUDENT CENTERED

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Attending to students' actions and mathematical thinking is an important aspect of professional teacher noticing. In this paper, we used 360 videos as a medium to examine the relationship between preservice teachers'(PSTs) observed attending behaviors and their written noticing. Findings suggest that PSTs focusing on students, instead of the teacher, during class discussions provide more specified descriptions of children's mathematical thinking.

Keywords: Teacher Noticing; Technology; Preservice Teacher Education

Professional teacher noticing involves "honing in on a key aspect of or instance that occurs during a lesson and engaging in reasoning to make sense of it" (Stockero & Rupnow, 2017). Experienced and knowledgeable teachers generally make sense of such instances by unpacking the mathematics that students engage in detail (Jacobs et al., 2010; Mason, 2017). By contrast, more novice teachers, such as many preservice teachers (PSTs), initially focus on the teacher's actions or on students' non-content related behaviors (Barnhart & van Es, 2015; Huang & Li, 2012). The differences in content-specificity of teachers' noticing corresponds with how and where teachers look when viewing a classroom scenario (Cortina et al., 2015; Dessus et al., 2016; Kosko et al., 2021). Scholars using eye-tracking have found that teachers with more specific descriptions of content focus on fewer students in a recorded classroom, whereas teachers with less specific descriptions of their noticings attempt to focus on multiple students (Dessus et al., 2016). Examining PSTs' teacher noticing while viewing a 360 video with a VR headset, Kosko et al. (2020) found that where and how PSTs turned their head and focused corresponded with how they described events within the recorded scenario. Such findings provide useful evidence of how teachers' physical actions of attending correspond with their verbal and written descriptions of what is noticed.

In this paper, we use the 360 video medium to study PSTs' tacit choices of where and what to attend with a focus on how such choice informs their articulated professional noticing. Contrasting standard video recorded from camcorders and Swivel cameras, 360 video records omnidirectionally so that the viewer can choose where to look within the classroom. This facilitates a sense of being in the classroom, as it more closely approximates standing in the classroom (Ferdig & Kosko, 2020; Walshe & Driver, 2019). Recording PSTs' 360 video viewing sessions provides useful data to examine their tacit choices of what, where, and when to attend (Gold & Windscheid, 2020; Kosko et al., 2020). We used such data to examine the nature of PSTs' attending in relation to the specificity of students' mathematics described in their noticing.

Classrooms where such student-centered actions can be observed are sometimes perceived as chaotic. Often, students are engaged in different content-specific actions that are happening simultaneously. Teachers must be able to make sense of what they notice in the moment and respond accordingly (Luna, 2018; Sherin, 2011). Less sophisticated noticing is evidenced by attending to superficial aspects of the classroom environment such as class management rather than focusing on student learning (Mitchell, 2015). More nuanced professional noticing is evidenced by attending to more specific student actions (Huang & Li, 2012; Jacobs et al., 2010).

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Sherin (2007) describes two interrelated subprocesses of professional noticing: selective attention and knowledge-based reasoning. Selective attention, what we have referred to as attending, is when the teacher "selects certain stimuli of a perceived scene for detailed analysis" (Scheiner, 2016, p. 231), where knowledge-based reasoning, or interpreting, is the act of using one's professional knowledge and prior experience to unpack what was attended (Sherin & van Es, 2009). Studying the interrelationship between these subprocesses is complex, and video has traditionally been used in examining this phenomenon (Rosaen et al., 2008; van Es, 2002).

The use of video can help PSTs to refine their descriptions of students' actions to be more content-specific reflections that shift from more general, to procedural, and then to conceptual descriptions of children's actions (Barnhart & van Es, 2015). Early evidence suggests that 360 videos provides a more immersive viewing experience to study teacher noticing (Kosko et al., 2021; Walshe & Driver, 2019). Particularly, different scholars have begun to record where PSTs attend in a 360 video and relate those attending behaviors to their pedagogical decisions and reasonings (Huang et al., 2021; Ferdig et al., 2020; Gold & Windscheid, 2020). Examining where and how PSTs look *at* a scenario, such as with eye-tracking data with standard video (Dessus et al., 2016), is useful. However, examining where and how they look *within* a scenario provides an added dimension of data regarding what Sherin (2007) describes as PSTs' selective attention. In this paper, we present a preliminary analysis of PSTs' attending behaviors (via recorded 360 video sessions) in relation to their interpreting acts of the recorded scenario.

Therefore, the purpose of this paper is to examine the relationship between where PSTs chose to attend in a 360 video and the specificity of their descriptions of children's mathematics.

Method

Sample and procedure

Participants included 21 preservice teachers enrolled at a Midwestern U.S. teacher education institute in Spring 2020. Most participants identified as white (91.7%), and female (76.1%). After completing consent and basic demographic questions, participants engaged in a brief tutorial describing how to watch 360 videos on a laptop and how to screen record their 360 video viewing sessions. Analysis of participants' screen recordings enabled us to identify their field of view (FOV) (Huang et al., 2021), where FOV includes the *location* and *time* a viewer looked at a specific point. After the tutorial, PSTs watched a 360 video (5 minutes and 49 seconds) of fourth grade students explored equivalent fractions using fraction strips. Within the video, students were asked to use their fraction strips to find an equivalent fraction to 5/6. Midway through the video, the teacher engages students in a brief class discussion where two students describe not being able to reduce the fraction because 5 is a prime. Students are then asked to find an equivalent fraction to 3/8. The video ends after a brief discussion of how students needed to use an algorithmic approach, instead of fraction strips, to find an equivalent fraction. After viewing the 360 video, PSTs were asked to describe all pivotal moments they had noticed in their viewing (i.e., any moment you (PSTs) believe is important for the teaching and/or learning of mathematics). Then, PSTs selected one of these moments as the "most informative for them for teaching and/or learning of mathematics" and describe it in further detail.

Analysis and findings

In order to analyze participants' written noticing, Systemic Functional Linguistics (SFL) was used (Halliday & Matthiessen, 2014; Eggins, 2004). SFL is an approach to linguistics that examines how grammar functions to convey meaning. This method allows "the detailed and systematic description of language patterns" (Egging, 2004, p.21).

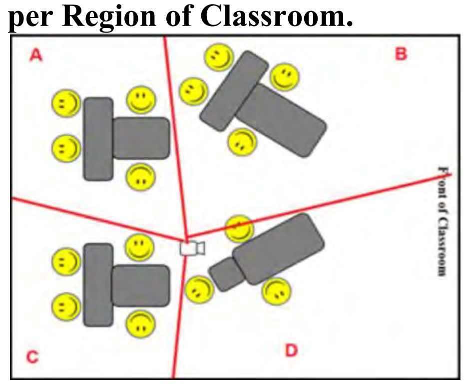
PST's math-specific written noticing	PST's generic written noticing
The teacher **challenged** her students **to use** the fraction strips for the second fraction (3/8). I noticed// the students closest to the 360 camera quickly **realized** that // the second problem (3/8) *could not be* **demonstrated** using the fraction strips.	When the students **shared** what answers they got // and [students] **worked** together, [students] **talking** through the problem. *Sometimes* it is helpful for students **to discuss** their thought process // and [students] **work** with their peers to come to a conclusion.

Figure 1: Examples of a specific (left) and nonspecific (right) written noticing.

In the current study, we examined the grammatical resource of reference. *Reference* refers to "how participants are introduced and 'managed' 's the text unfolds" (Mehler and Clarke, 2002, p. 160). The repeated patterns of referencing builds reference chains, which can also convey how a particular referent is operationalized by an individual. Figure 1 illustrates two participants' excerpts with coded reference chains. The PST on the left introduces the referent "fraction strips" which is then connected to "the second fraction (3/8)." As the text continues, these two referents are conveyed as not being the same, since "(3/8) could not be demonstrated using fraction strips." By contrast, the student on the right references "answers" and builds a reference chain that identifies students conveying their answers along with their "thought process" to come to a "conclusion." Although this PST incorporates discourse in how the referents are conveyed, the reference chain clearly ends with a focus on a final answer (i.e. "conclusion"). After examining PSTs' written noticing using reference chains, reliability of whether the theme was observed or not was examined by the first and second author (0=fractions not referenced; 1=referenced fractions). The Kappa coefficient (.857) indicated near perfect agreement, with 52.3 % of PSTs attending to fractions in their written noticing and 47.7% not doing so.

Table 1: Contingency Table for Seconds Focusing per Region of Classroom.

	A	B	C	D	n/a*	Total
Not Attend	**166** **219.9**	**1157** **1092.3**	**460** **440.7**	**1622** **1655.3**	**47** **43.8**	**3452**
Attend	**296** **242.1**	**1138** **1202.7**	**466** **485.3**	**1856** **1822.7**	**45** **48.2**	**3801**
Total	**462**	**2295**	**926**	**3478**	**92**	**7253**



**Indicates a region could not be identified (i.e., scanning or moving back-and-forth).*

To examine variations in PSTs' specificity of noticing equivalent fractions across four regions of classroom we analyzed their recording videos second-by-second. A total of 7253 seconds across 21 participants were examined for which region of the classroom PSTs' FOV included at any given second (see Table 1). We estimated a chi-square statistic to determine whether where PSTs focused during the video was independent from whether they attended to fractions in their written noticing. Results indicated a statically significant chi-square statistic (χ^2 (*df*=4)=35.85, *p*<.001), suggesting PSTs' written noticings and where they attended in the video were not independent from chance. To better understand this finding, we conducted a post hoc chi-square analysis using z-scores to compare observed and expected counts within cells of Table 1. In particular, PSTs who attended differently in mathematical noticing, spent different amount of time in region A and B. Next, we created graphical representations of each individual PSTs' viewing patterns across the length of the 360 video (see Figure 1 for a cumulative example). Based on the chi-square analysis, we focused our attention on variations between participants' attending for regions A and B. Notably, a specific time frame [2:28-2:44], indicated in Figure 2 by a yellow rectangle, illustrates considerable traffic in the fraction-specific group (blue) for region A. This prompted a review of PSTs' screen recordings to better understand what was happening in this 16 second interval. Essentially, PSTs who attended to students' fractions in their written noticing were looking back-and-forth between one student in region A describing their math and the teacher in Region B writing on the board. By contrast, PSTs who did not attend to fractions in their written noticing focused almost exclusively on the teacher during this timeframe (only one PST looked at the student, and did so for 1 second).

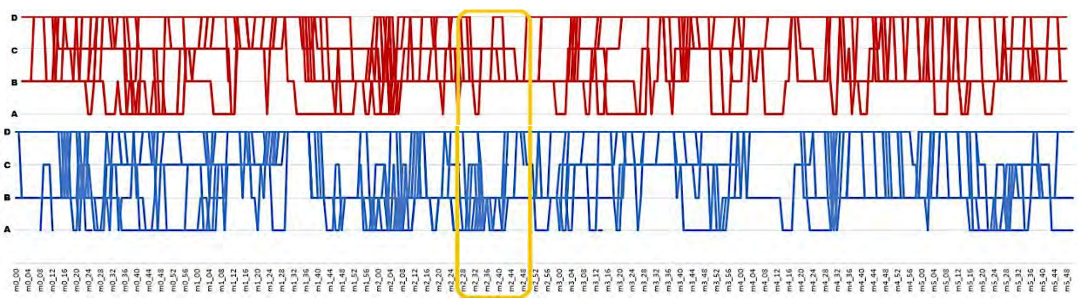


Figure 2: Region PSTs focused by second for not specific (top) & specific (bottom) noticing.

Discussion

The study described the relationship between PSTs' attending within their FOV and the specificity of their written noticing. PSTs selective attending as well as their reflection on what they attend are considered as key elements of professional noticing (Sherin, 2007). Using 360 videos allowed us to understand how PSTs' content-specific descriptions of students' thinking related to their FOV being, literally, student-centered. Thus, PSTs with student-centered attending behaviors provide more specific descriptions of students' mathematical thinking. This corresponds with prior research on teacher noticing (Jacobs et al., 2010). Future study is needed to confirm trends observed in this paper, as well as applied to different contexts to provide additional empirical evidence of how PSTs' develop their professional noticing.

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