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Articulating Design Principles for Productive Use of Video in Preservice Education

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Journal

Journal of Teacher Education, 70(3)

ISSN

0022-4871

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Publication Date

2019-05-01

DOI

10.1177/0022487118778549

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Peer reviewed

Title: Articulating Design Principles for Productive Use of Video in Preservice Education

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This article was accepted by Journal of Teacher Education on April 11, 2018

Articulating Design Principles for Productive Use of Video in Preservice Education

Abstract

Despite the potential of video for professional learning, the field lacks an integrated framework to inform teacher educators' pedagogical decision-making, particularly in the context of preservice teacher education. This article aims to make a conceptual argument about productive ways of using video in preservice education contexts. Drawing upon situative and sociocultural perspectives, we theorize how and under what conditions video can be used productively. We discuss existing frameworks and tools that guide the design of video-embedded learning environments. We then present an integrated framework, *The Principled Use of Video* (PUV) to specify principles, processes and key considerations for creating a system of video-embedded activities. The merits and potential pitfalls of the PUV framework are discussed using an illustrative case. We argue that productive use of video that facilitates the desired learning of preservice teachers involves attention to both the learning ecology and underlying theories of preservice teacher learning.

Key words: video, pedagogy of teacher education, teacher preparation, preservice teachers

Introduction

Video is widely used in preservice teacher education to facilitate novice teacher learning of instructional practices. Research suggests that video can be a useful tool to facilitate professional learning (Bill & Melinda Gates Foundation, 2013; Hatch & Grossman, 2009). Despite this increased interest and the potential of video, the field lacks an integrated framework for situating video within the learning ecology of teacher preparation. Like others (Blomberg et al. 2013; Goldsmith & Seago, 2011), we see video as a tool that is situated within a broader system of activity where multiple elements play out together to shape preservice teachers' learning experiences. The existing body of video-related literature provides guidance on various parts of that system – how to capture and select a clip (Author, 2009, 2015b), how to structure viewing (Author, 2002, 2017; Brouwer & Robijns, 2015; Santagata & Gaurino, 2011), how to facilitate conversations with video (Author, 2014; Borko, Jacobs, Seago, & Mangram, 2014), and how to design learning activities for particular aims (Author, 2010; Hatch & Grossman, 2009). Yet, facilitating preservice teachers' learning necessitates the coordination of these various aspects that operate inside the system of video-embedded activities, beyond attending to particular aspects of the system of activities.

The purpose of this article is to make a conceptual argument about productive use of video in preservice teacher education contexts. We first theorize what makes the use of video productive in teacher preparation. Next, we review existing tools and frameworks focusing on their affordances and limitations for guiding teacher educators' use of video. We then propose an integrated framework that specifies the procedures, processes, and key considerations for using

video in teacher education. We provide one case to unpack the complexity of creating a productive video-embedded learning environment in preservice teacher education and show how the framework guides teacher educators' decision-making. The following research questions guide our inquiry: a) What makes video use “productive” in preservice education?; b) What are the affordances and constraints of the existing frameworks for video use?; and c) What are guiding principles and procedures for using video productively to support preservice teacher learning?

Theorizing Productive Use of Video in Preservice Teacher Education

What makes video use productive in preservice education? Defining the meaning of “productive” involves establishing the link between video use and preservice teachers' learning. We come from the perspective that if the use of video is productive, it will lead preservice teachers to get better at the work of teaching. At first glance, this idea sounds rather straightforward. But when it comes to the actual work of designing or analyzing a video-embedded learning activity to support preservice teacher learning, the complexity is unveiled. What constitutes preservice teacher learning? What kind of changes should we look for either immediately upon the completion of a video-embedded activity or down the road? What is the role and affordance of video in the process of preparing preservice teachers to engage in the work of teaching? In this section, we unpack the notion of “productive” use of video before we turn to the discussion of frameworks and tools for video use.

Sociocultural Perspective, Novice Teacher Learning, and Trajectories of Participation

We draw on situative and sociocultural perspectives (Greeno, 2006; Greeno & Gresalfi, 2008; Lave, 1988; Lave & Wenger, 1991) to understand preservice teacher learning in a video-embedded learning environment. Situative and sociocultural theorists posit that the teacher and their activities are always situated in social, cultural, and historical contexts, and any learning can only be understood within a larger *system* (Greeno, 2006; Russ, Sherin, & Sherin, 2016). Instead of conceptualizing learning as changes in an individual's mental structure, sociocultural theorists view "learning by individual in a community as a trajectory of that person's participation in the community—a path with a past and present, shaping possibilities for future participation" (Greeno & Gresalfi, 2008, p. 170). In the context of preservice education, the trajectories of novice teachers' participation are interactively and dynamically shaped and re-shaped as novices travel through multiple communities of practice in both their credential program and school contexts, and over time (Author, 2017). Moreover, what preservice teachers come to know and be able to do is shaped by their participation and interactions with others and with material artifacts in these different settings where their preparation takes place.

To explain how and why novices shift or maintain their trajectories of participation in the communities of practice, situative and sociocultural theorists attend to the dynamics of the activity systems. Activity systems refer to complex social organizations containing learners (i.e., preservice teachers), facilitators (e.g., teacher educator), curriculum materials, tools, and the physical environment (Greeno, 2006). While engaging in activities, novices interact with people and informational resources to deepen their understandings about teaching and learning, and to develop complex practices. The type and nature of *interactions* that are coordinated in a system

are related to changes in novices' trajectories of participation. The key then for supporting novices' learning is to create a system of activities that facilitates *desirable interactions*—the interactions that result in novices increasing their capabilities for participation in the work of teaching in ways that are valued in the community.

Video as a Tool That Mediates the Social and Intellectual Interactions in a System

Video has a variety of features that make it a promising tool to mediate preservice teachers' learning (Calandra & Rich, 2015; Gaudin & Chaliès, 2015; Hatch & Grossman, 2009; Sherin, 2004). Video captures the authenticity of classroom practice, bringing to life the work of teaching for careful study (Brophy, 2004). It enables teacher educators to slow down and zoom in the work of teaching, thereby helping novices see the concrete ways that teachers enact particular teaching moves and the consequences for student' opportunities to learn (Author, 2017; Stürmer, Könings, & Seidel, 2013; Santagata & Gaurino, 2011). Because the genre of video captures the specificity of the classroom experience, it affords novices the opportunity to see the detailed ways that classroom life unfolds, what is often difficult to see in actual classroom settings. In addition, video can capture images of possibilities in teaching. It is well documented that field placements do not typically represent the image of teaching advocated by recent policy and reform initiatives (Author, 2018; CCSS, 2010; NGSS lead states, 2013). With video, teacher educators can provide novices with representations of ambitious instructional practice so they can develop a vision of student-centered, responsive teaching in practice. Video can also capture and represent the work of teaching in different grain sizes - small group interactions, whole class discussions, an entire lesson, or a collection of lessons over the course

of a year (Author, 2009; Boaler & Humphreys, 2005; Lampert & Ball, 1999) - with each of these representations providing novice teachers opportunities to see the multiple layers of the work of teaching. Finally, with recent advances in technology, video capture and sharing has become relatively seamless. As such, novices can easily share images of their own practice for collaborative analysis (Sherin & Dyer, 2017; Stockero, Rupnow, & Pascoe, 2017). The use of novices' videos brings individualized experiences from local classrooms into a collective learning space, thereby enabling teacher educators to help novices generate new meanings about their personal teaching experiences through professional conversations with others. Therefore, when video is strategically located inside the teacher preparation activity system, teacher educators can facilitate novices' individual and collective interaction that is difficult to coordinate otherwise.

Productive Use of Video *Contributes* to Moving Novices' Learning Forward.

We start with the premise that if the use of video is productive, it will lead preservice teachers to get better at the work of teaching. In fact, there is substantial evidence from the literature that viewing video records of teaching can cultivate knowledge and practices for “good beginning teaching” (e.g., Author, 2002, 2017; Gaudin & Chaliès, 2015; Calandra & Rich, 2015; Santagata & Yeh, 2014; Stockero et al., 2017; Sturmer et al. 2013). For example, Author's studies (2002, 2017) show that participating teachers in a video-based teacher preparation course increased their ability to attend to components of teaching and to systematically analyze their teaching toward developing a vision of a more student-centered, responsive approach to mathematics teaching. Situative and sociocultural perspectives teach us that novices' learning to

teach depends on the type and nature of novices' interactions that are set up and coordinated by a video-embedded activity system, not the video itself. The type and nature of interactions in a video-embedded learning environment are dynamically and interactively shaped through the coordination of multiple aspects of the system, such as the tools and frameworks that guide conversations, the norms and practices for video observation and analysis, and the nature of facilitation before, during, and after video observation (Blomberg et al., 2013). The productive use of video, then, hinges upon the coordination of the multiple components of a video-embedded activity system and its consequence—whether and to what extent the video-mediated interactions increase novices' participation in ways that are valued in the community.

In Search for the Guidelines of Video Use in Preservice Education

Prior research on video use in teacher preparation and professional development provides useful guidelines for incorporating video. To understand the affordances and constraints of existing tools and frameworks for leveraging video for teacher preparation, we reviewed two recent literature reviews on the use of video for teacher learning and a collection of essays on video use in teacher education (Brouwer, 2011; Calandra & Rich, 2015; Gaudin & Chaliès, 2015). This literature highlighted particular aspects for further inquiry, related to the objectives and nature of activity for using video and the types of videos viewed. We then reviewed relevant literature related to these aspects for guidelines - with a focus on those studies that offered frameworks and tools - for using video in teacher preparation. Two themes emerged from this review. First, existing frameworks or tools focus on one or the other aspect of using videos, such as selecting clips or scaffolding observations (see for exception Blomberg et al., 2013). Second,

little research explores how the affordances of these tools and frameworks may be realized or limited based on the use of video interfacing with novices' developing knowledge and skills as they travel through the preparation program and schools over time (see for exception Zhang, Koehler, & Lundeberg, 2015). In what follows, we discuss what research documents about using video through analysis of the existing frameworks and tools. Specifically, we begin by addressing the affordances of existing tools and frameworks for providing guidelines in using video in teacher preparation (See Table 1 for example frameworks). We then consider constraints of the existing guidelines, as they relate to achieving the broad aims of teacher preparation. From this analysis, we then present an integrated framework to inform the productive use of video in teacher preparation.

--Insert Table 1 About here--

Affordances of Existing Frameworks

One of the main contributions on research on video use in teacher preparation includes frameworks for structuring teachers' observations and reflections on teaching (Author, 2002, 2017; Brouwer & Robijns, 2015; Calandra & Rich, 2015; Gaudin & Chaliès, 2015; McDonald & Rook, 2015; Roth McDuffie et al, 2014; Santagata & Guarino, 2011; Stockero, Peterson, Leatham, & Van Zoest, 2014). There is much to be seen in a classroom episode and preservice teachers need guidance about what to observe and how to make sense of what they see. Observation tools and frameworks help narrow the observational field to help preservice teachers focus on particular features of interest. For example, the *Learning to Notice* framework (Author, 2002) provides a tool for shaping what teachers attend to in their analysis, as well as how they

analyze classroom interactions, with much of this work focusing on directing teachers' attention to student thinking and developing an interpretive, inquiry stance to these observations (see for example, Author, 2008). Building on the construct of noticing, researchers have constructed a variety of frameworks to focus novice teachers' noticing on particular aspects of teaching, such as important student disciplinary ideas or cultural forms of knowing tied to the discipline (McDonald & Rook, 2015; Roth McDuffie et al., 2014; Stockero et al., 2014; Walkoe, 2015). The overarching aim is to hone novice teachers' attention to features of instruction that are consequential for student learning and access in classrooms.

Similarly, the *Lesson Analysis Framework* (Hiebert et al., 2007; Santagata & Guarino, 2011) scaffolds preservice teachers to analyze the influence of teaching moves on student thinking and learning at the level of a lesson. Analysis begins by identifying the learning goal of a lesson and then using video to identify evidence of students making progress toward the learning goal and to highlight specific teaching moves that influenced students' progress. Novice teachers use what they learn to identify specific next steps in teaching that are hypothesized to improve student learning. Taken together, the affordance of these frameworks are many - they help preservice teachers: (a) learn to highlight what is important in the complexity of a classroom interaction; (b) construct a shared language to more precisely characterize instruction; (c) experiment with enacting instructional practices focused on students and their ideas; and (d) develop dispositions focused on students and their learning (Author, 2002, 2015a, 2017; Calandra & Rich, 2015; Santagata & Yeh, 2014; Stockero, 2008; Stockero et al., 2017).

The literature also provides guidance for selecting clips and facilitating conversations with video. One study offers a framework that presents features of clips that can lead to more productive discussions about student thinking, including multiple entry points to see worthwhile student ideas, sufficient depth of content, and some ambiguity such that viewers want to *figure out* what students are thinking and understanding (Author, 2009). Research suggests that camera placement and sound quality influence how features of effective clips are captured and thus the access viewers have to noteworthy interactions (Author, 2015b; Fadde & Rich, 2010). Other research provides guidance on whose video should be viewed - one's own or others' video (Seidel, Stürmer, Blomberg, Kobarg, & Schwindt, 2011; Zhang et al., 2015). The findings of this research suggest that videos of self and others both have affordances and their utility for teacher learning largely depends on the learning goals for preservice teachers.

Recent research also provides guidance on leading video-based tasks, with much of this work generating frameworks for leading productive discussions with video (Author, 2014; Borko et al. 2014; Lesseig et al., 2016; Tekkumru-Kisa & Stein, 2017). These frameworks offer guidance on structuring tasks and orchestrating conversations to ensure that worthwhile ideas represented in the videos become the objects of analysis, that the conversation is distributed and inclusive of the multiple perspectives participants bring to the analysis, and that the conversation is anchored in evidence generated from the video. Notably, much of this work has documented facilitation with inservice teachers. Few frameworks document teacher educators' practices for leading productive conversations with video with preservice in teacher preparation.

Constraints of Existing Frameworks

While the frameworks discussed above provide useful guidance for using video, we found that, for the most part, they are treated in isolation of other features of the video-based system. With the exception of Blomberg et al. (2013), the frameworks focus largely on one facet of the system of activity in which video is situated, without providing insight on the relationship between them. As a result, these dimensions remain compartmentalized and teacher educators are provided little guidance on how to think about these dimensions together. As discussed above, we identified frameworks for capturing high quality clips, structuring the video analysis task, and facilitating discussions. What is less understood, however, is how the type of the clip *interacts* with the nature of the task or how conversations facilitating in particular ways with different types of clips in the context of specific tasks *coordinate* to advance preservice teacher learning. Moreover, though Blomberg et al. (2013) offer a comprehensive model to guide decision-making with video, this model does not unveil the complex relationship among key features of the video-based activity system that need to be considered to use video productively in particular moments and over time in the preservice education context.

In addition, the frameworks we reviewed offer limited guidance on how to consider each feature of the video-based activity system at different points in the trajectory of learning to teach. For example, in relation to clip selection, Seidel, Stürmer, Blomberg, Kobarg, and Schwindt (2011) found that analyzing one's own teaching resulted in seeing more significant events tied to relevant components of teaching; whereas, viewing others' video afforded teachers to adopt a more critical stance in the analysis. We suspect, however, that the affordances of whose videos are viewed is contingent upon the aims of viewing video for preparing beginning teachers and

when they are viewed in the preservice teachers' learning trajectory. It may be that viewing others' videos is particularly beneficial early on in one's learning for seeing possibilities in teaching, while viewing one's own video at the later stage of the program becomes necessary for moving toward that vision in practice. And of course, how the video is situated in a learning activity and what frameworks are used at each point in time will influence the extent to which video is leveraged to move novices' learning forward. This suggests then that important research questions remain about how to integrate video productively for preservice teacher learning. We see our integrated framework as elucidating the complexity of using video and can guide future inquiry around the use of this powerful tool in teacher preparation. We now turn to present the framework with an illustrative case to exemplify how we use it to guide our instructional decision-making to integrate video in teacher preparation.

An Integrated Approach for Using Video to Move Novice Learning Forward:

The Principled Use of Video (PUV) Framework

Principles, Procedures, and Key Considerations

The Principled Use of Video (PUV) framework illustrates various pedagogical decision points in the process of designing video-embedded learning activities (see Table 2). The first two processes have to do with setting goals. Specifically, they are: (a) articulate worthy goals of preservice education, and (b) frame one or two specific learning objective(s) of a particular video-embedded activity. During these goal-setting processes, teacher educators locate novices on their learning trajectories in relation to developing deep understanding or complex performances, and specify the progress that novices are expected to make with a particular

video-embedded learning activity. The next processes have to do with setting up and coordinating novices' interactions in a video-embedded activity. During these processes, teacher educators specify the key features of the video-embedded learning environment that affect novices' interactions. It includes: (c) selecting a clip, (d) designing a task, (e) selecting a tool, and (f) facilitating conversations (see Table 2).

--Insert Table 2 about here--

Although the framework is presented in a linear form, it is unlikely that the actual decision-making processes are either linear or follow the suggested order. Instead, we speculate that the actual work of designing a video-embedded learning environment can begin at various decision points and one decision will inform the others. Regardless of the entry point, however, each of the processes specified in this framework needs to be considered to set up and facilitate productive interactions using video. In what follows, we describe each of the key decisions highlighting suggestions from relevant studies. We draw on findings from the affordances of existing frameworks and tools to inform these decisions as they arise in the goal setting, planning and enactment stages of working with video.

Articulating the worthy goals of preservice education. The first step for productive use of video is articulating broadly stated understandings or complex performances that preservice teachers are expected to master at the end of the program. We refer to these broadly stated understandings or complex performance as *the worthy goals of preservice education*. Preservice teachers are expected to make progress toward the worthy goals over time by continuously revising their ideas or improving their performance with support of teacher

educators. Prior studies on teacher preparation and professional learning identify a few worthy goals that lay a strong foundation for beginning teachers' career-long learning (Feiman-Nemser, 2001; Kennedy, 1999; Davis, Petish & Smithey, 2006). Those goals include: (a) forming a shared vision of teaching that supports all students in engaging deeply with the discipline in an equitable way (Kang, 2017; Hatch & Grossman, 2009; Windschitl & Calabrese-Barton, 2016); (b) developing deeper understandings about the discipline, learning and learners (Ball, Thames, & Phelps, 2008); (c) developing a basic repertoire of teaching for creating strong learning contexts for diverse learners, particularly for students from historically underserved communities (McDonald et al, 2013; Gay, 2010; Ladson-Billing, 2014); and (d) developing the practice to learn in and from practice while teaching (Hiebert, Morris, Berk, & Jansen, 2007; Lampert, 2010).

It is crucial for teacher educators to articulate the broad learning goal that a particular video-embedded activity intends to address for several reasons. First, it helps teacher educators move from an atheoretical approach of using video in preservice education to principled and purposeful use grounded in theories of preservice teacher learning. When worthy goals are articulated, two questions come to be the key part of planning: where are novices in relation to the worthy goals? And what will it take for them to achieve the goals? Therefore, the decisions around how to design and implement a particular video-embedded activity are driven and justified by both assessment of novices' learning trajectories and a theory of preservice teacher learning—how and under which conditions novices make progress toward the worthy goals. Articulating worthy goals also helps provide coherent and inter-related experiences for

preservice teachers that are coordinated with other curriculum activities, instead of experiencing a video-embedded activity as an isolated event. It is unlikely that novices grasp the full understanding about teaching and learning or become fully competent at a complex practice with a single activity. A well-designed video-embedded activity that is seamlessly coordinated with other curricula activities that can continue to build on each other can facilitate novice teachers to make progress toward the desirable learning goals over time.

Setting specific learning objectives for a video-embedded activity. The second process in our framework is setting specific learning objectives that can be accomplished with a particular video-embedded activity (see Hiebert et al., 2007). During this process, teacher educators establish the link between a video-embedded activity and the broad worthy goals, forming their theory of action—how this video-embedded activity might move novices’ learning forward. The following questions guide the process: (a) Who are the preservice teachers and where are they in their learning trajectories in relation to the defined goals? (b) What are possible pathways that novices can take to achieve the defined goals? (c) What kind of practice-based experiences and interactions might facilitate novices to make progress with these goals? and (d) What are novices’ practices, experiences or assets that can be leveraged? One or two specific learning objectives can be defined based on the best conjecture about those questions.

Selecting video clips: What should be viewed and why? Selecting the right video is essential to designing a productive learning environment (Author et al, 2009; Goldsmith & Seago, 2011). But identifying the right video is challenging because what is “right” largely depends on situations and the learners (preservice teachers). There are two key considerations in

clip selection. One is the novices' learning trajectories (i.e., where preservice teachers are in their learning trajectories now?), and the other is the type and nature of interactions teacher educators intend to set up with video in light of the intended learning goals. Video comes in various grain sizes - from brief clips that focus on particular features of a lesson, to longer segments that represent the unfolding of a lesson, to video libraries that capture many instances of teaching that can be studied to examine the development of teaching and learning over time (Author, 2009; Hatch & Grossman, 2009; Lampert & Ball, 1999). Each of these video representations affords preservice teachers to see teaching differently - such as learning to see the nuanced ways that students engage with content (e.g., Walkoe, 2015); capturing the evolution of learning as it is mediated by teaching decisions (e.g., Boaler & Humphreys, 2005); and seeing how norms are established and taken up and become routine forms of participation (Lampert & Ball, 1999).

Another consideration is whose video will be viewed (i.e., preservice teachers' video vs. others' video). As discussed in the prior section, each video offers different affordances for learning and these decisions are driven by the learning goals at particular points in the preservice teachers' preparation. Of course, the quality of the clip matters as well, so that observers have multiple entry points to see and hear the variety of ideas that emerge and the exchange between teachers and learners in the lesson.

Designing a task. With a selected clip, teacher educators specify a video-embedded task. It involves determining what to ask preservice teachers to do and/or produce before, during, and after viewing the video, and in what way (e.g., individual work or group work) for the purpose of achieving learning objectives. The task is a key component because it sets up the type and nature of video-mediated interactions among the members of the community, and therefore determines

opportunities to learn (Greeno & Grasalfi, 2008). Questions related to task design include: What kind of *pre-tasks* might increase the likelihood of novices seeing what they need to see in the video? What task might assist novices' noticing *while* viewing the video? What kind of *post-task* might help novices' sense-making either individually or collectively? What might be the best strategy for grouping learners to do the task, given various characteristics of novice teachers, the objectives, and various constraints of the situation (e.g., time, physical set-up of the space)?

Prior studies suggest a few potentially effective tasks with video that can be implemented before, during and after viewing activities. They include: (a) engaging novices in the content presented in the video, (b) highlighting and annotating the transcript of the video, and (c) annotating and comparing video using software analysis tools to generate shared frameworks of instruction (Author, 2015b; McDonald & Rook, 2015; Stockero et al., 2017). Though individual studies provide guidance for designing tasks with video, there are few studies that compare affordances and limitations of different tasks for achieving similar learning goals (Gaudin & Chaliès, 2015).

Designing and selecting instructional tools. A video-embedded activity, such as attending to and noticing a particular aspect of classroom interactions or analyzing diverse students' unfolding thinking, is complex and challenging. It is inherently complex because this task is designed around an artifact that shows real classroom situations where teachers and students interact with one another over disciplinary ideas. It is challenging to novices who have yet to learn how to see, notice, analyze and talk to others about complex classroom situations

(Author, 2002). It is even more challenging to the novices who do not have strong disciplinary understanding addressed in the video-recorded lesson (McDonald & Rook 2015).

A well-designed instructional tool can scaffold novices' video-mediated interactions, therefore helping them to successfully complete the complex task with high quality. By instructional tools, we mean “material artifacts provided for [novice teachers] to mediate social and intellectual interaction during task implementation” (Kang, Windschitl, Stroupe, & Thompson, 2016, p. 1321). Instructional tools, such as a conversation protocol, rubric or observation framework, can help novices to achieve learning objectives by improving conditions of their work, especially when novices engage in a complex activity. For example, a conversation protocol can prompt specific aspects of instruction to attend to, scaffold how to use the video as a source of evidence for observation, and supply linguistic resources such as sentence stems or examples of questions. The following questions guide the selection or design of instructional tools: (a) Given the knowledge and skills of preservice teachers at various points in their learning trajectory, what kind of support or scaffolds will they need to leverage video for their learning? What would be the nature of the difficulties? (b) Which tools or frameworks exist that might assist them in achieving the learning goals given where they are in their preparation?

Facilitating conversation. The final critical process of productive video use is facilitating conversations among people who have different perspectives and expertise. Professional conversations can facilitate novice teachers developing new perspectives and understandings about classroom situations, thereby shifting their instructional practices. Researchers characterize the productive talk as critical or analytic – speech that is highly

descriptive and interpretive and withholds oversimplified judgments; is rooted in data; and affords consideration of multiple points of view (Rodgers, 2002; Timperley, 2008). The goal is to move conversations from oversimplified judgments to identifying noteworthy features of classroom interactions, describing those events in detail for the purposes of understanding them, and using new understandings to make informed decisions about what to do next.

With much of the research on orchestrating video-based conversations emerging from in-service learning environments, we conjecture that facilitation practices in preservice education may require alternative approaches. Preservice teachers are in the unique position in that they have to participate in multiple communities of practices simultaneously while being positioned as novices (Kang, 2017). Therefore, facilitating preservice teachers' conversation involves careful positioning of cooperating teachers' practices, especially when the practices need to be problematized. In addition, early in their learning with video, when they have limited experiences in their field placements, conversations may initially aim to draw out what stands out to preservice teachers and why. When they take on increased responsibilities in the classroom, facilitators will likely manage these conversations differently, shifting to progressively highlight alternative aspects of focus and press preservice teachers to consider alternative points of view as they increase their interactions with students.

PUV Framework in Action: An Illustrative Case

We present one case to illustrate how the proposed framework guides a teacher educator's decision-making around video. We then use this case to reveal both merits and potential pitfalls of the proposed framework, which will be discussed later.

Context and situation. The case comes from a disciplinary-specific methods course offered for secondary science teacher preservice teachers in a 15-month graduate, certificate-plus-master's teacher preparation program in the United States. The secondary science preservice teachers attend a total of 20 sessions of 3-hour long discipline specific methods classes from September to June. The focal lesson is the very first session of the methods class in late September where the instructor and a group of preservice teachers first met.

Consistent with challenges experienced in most teacher preparation programs in the United States, the program had difficulties placing preservice teachers in classrooms where preservice teachers could see and experience the complex practices advocated by the program in action. Before coming to this session, the preservice teachers already spent about a month in their field sites while building relationships with school professionals and students. During this 'honeymoon' phase of fieldwork, they were exposed to their mentor teachers' instructional practices that typically presented science as 'the final answer.' Accordingly, one big challenge facing the methods course instructor was to help novices to problematize conventional forms of science instruction that had been normalized for most preservice teachers, and in turn begin to develop a new vision of teaching focused on students' sense-making, as advocated by science education communities (NGSS lead states, 2013; NRC, 2012).

Articulating the worthy goals of preservice teacher learning: Developing a shared image of good science teaching. Informed by research on preservice teacher learning and teacher preparation (e.g., Ball & Cohen, 1999; Feiman-Nemser, 2001; Windschitl & Calabrese-Barton, 2016), the four broad goals were identified: (a) develop a new vision of science teaching

that supports diverse students in engaging deeply with the discipline in an equitable way, (b) develop a set of initial teaching repertoires, (c) deepen understandings about discipline and learners and (d) learn practices to continuously learn from practice. For the video-embedded activity in the very first meeting, the teacher educator decided to focus on the first goal—developing a new vision of science teaching.

Setting specific learning objectives. The next step suggested with the PUV framework is setting learning objectives. The teacher educator struggled to determine specific learning objectives and had to revise them while designing the video-embedded learning activities. To set specific learning objectives, the teacher educator asked, “What would be the first step to develop the shared vision? How do I know if preservice teachers make a progress toward developing a new vision of science teaching after viewing a video? What might they perform or produce at the end of the activity if they master the goals?” The learning objectives were settled finally as the video clip was selected and the actual task was specified.

The framework suggested the teacher educator establish the link between this video-embedded activity and the targeted learning goal (i.e., develop a new vision of teaching) by considering situations relevant to preservice teachers’ learning trajectories. Because it took place in the early stage of the program the teacher educator conjectured: (a) most preservice teachers had yet to see complex practices in action, (b) most preservice teachers likely had simple, unproblematic views of teaching and learning, (c) if preservice teachers see how young children makes sense of a complex phenomenon in a well-supported instructional environment through a video, and also if preservice teachers have opportunities to discuss ‘what is possible’ even with

young children, they will begin to raise questions about conventional teaching practices, question assumptions about learners and how students of colors from historically underserved communities have been positioned at schools, and actively inquire about a new form of practices. Notably, this ‘theory of action’ guided the following decisions for specifying a video-embedded activity system, which in turn led to refine the learning objectives. The final version of the learning objectives was the following: preservice teachers can (a) develop and use a scientific model that explains causal mechanisms of the focal phenomenon presented in the video-taped lesson, and (b) describe young children’s various ideas and language use surfaced through their discussion of the focal phenomenon as valuable assets. Both learning objectives were foundational to develop the new vision of science teaching that promotes deep disciplinary engagement and equity.

Selecting a clip. With a set of conjectures about preservice teacher learning trajectories and the broad goal in mind, a video clip was selected. The selected clip was a 7-minute long edited video from a fourth-grade elementary classroom taught by an experienced teacher (see Colley, 2012). The clip captured highlights of a two-week long science unit on sound. The video began with a teacher’s presentation of a complex and puzzling phenomenon to the fourth graders. Specifically, the teacher showed a YouTube video and invited students to consider, “How can a singer shatter the glass?” A group of children engaged in various activities, such as individual tasks, small group conversation, modeling, and presenting their ideas to the class. With the teacher’s narration, the video illustrated students’ initial ideas elicited through talk and drawing (model) at the beginning, and how those ideas were revised as the children collected and

discussed evidence from various activities. Both the audio and video quality were sufficient for preservice teachers to see and listen to children's interesting ideas and use of language.

This video clip was selected for three reasons. First, it vividly showed students' rich ideas about this complex phenomenon and various ways of making sense of it while drawing on their everyday experiences—the image close to the new vision of science teaching. The clip featured student-to-student conversation, class presentation and student produced drawings along with captions. With this video, the preservice teachers had multiple entry points to see how students express and revise their ideas through the conversation with one another and the discussion of evidence collected from class activities over time. This clip was also selected because the students in the video were young children, demonstrating how fourth graders can make sense of a complex phenomenon collectively in a supported and discourse-rich learning environment. Lastly, the clip was selected because of the accessibility to teaching materials and artifacts of student work featured in the video. Those artifacts made it possible for the instructor to engage preservice teachers in a similar kind of sense-making work using the same focal phenomenon in a university setting. The instructor could also provide preservice teachers a glimpse into practices advocated by the science education community, and therefore had them experience those practices as students of science.

Designing a task and selecting tools. The teacher educator had to decide what to ask preservice teachers to do or produce before, during, and after viewing the clip. This task would set up the type and nature of interactions surrounding video, thereby greatly influencing the extent to which a group of novices could make progress with this particular video-embedded

activity. The actual work of designing tasks was guided by the teacher educator's 'theory of action' that was formed during the goal setting process. In short, the teacher educator thought that preservice teachers would begin to develop a shared vision of good science teaching if they attend to and notice children's rich ideas, various ways of thinking, and language use. She also thought that preservice teachers would problematize the conventional form of teaching and begin to build a new vision of teaching if they see and discuss "what is possible" even with young children. The teacher educator anticipated that it would be challenging for many preservice teachers to see and notice children's sense-making if preservice teachers struggled with the content. In other words, preservice teachers would more likely notice children's diverse ways of making sense of the complex phenomenon if preservice teachers themselves had experience struggling and making sense of the same phenomenon.

A set of tasks and tools were designed or selected for shaping preservice teachers' interactions. The pre-viewing task was essentially going through the same sense-making work as the fourth graders in the video. The preservice teachers in small groups constructed a model to explain what might cause the singer to shatter the glass. This pre-viewing task was intended to provide opportunities for preservice teachers to engage in scientific practices and to make sense of the same complex phenomenon using the same curriculum materials. With purposeful grouping, this task also provided opportunities to supply relevant disciplinary ideas while working with peers who had expertise in physical sciences. The other task was the post-viewing discussion, which we address in the following section related to a central process for video use, facilitating productive conversation.

Facilitating conversation. Given the goal and the theory of action (i.e., teacher educator’s conjecture of how novices might make progress in the moment), two kinds of interactions appeared to be crucial. One was noticing children’s rich sense-making repertoires and the other was discussing “what is possible” in relation to conventional forms of teaching that presents science as the final form of answer. Prior studies on non-dominant students’ learning suggest that positioning students as capable sense-makers is foundational for creating strong learning contexts for students from historically underserved communities (Gay, 2010; Ladson-Billing, 2014). Therefore, the post-viewing conversation needed to be set up to focus the interactions among preservice teachers on these two issues. Informed by studies on facilitation (Author, 2014; Borko et al., 2014), the teacher educator came up with four strategies to facilitate productive conversation. The first involved eliciting from preservice teachers what stood out them (e.g., “what did you notice?”). The second directed attention to specific children’s ideas or language if they were not surfaced by the preservice teachers. For example, the teacher educator might say, “Did you hear...?” The third strategy included pressing preservice teachers to describe and juxtapose the images of science teaching and learning in the video with what preservice teachers experienced or observed in their field sites, without making any judgment. For example, the teacher educator might ask, “You have been in the classroom about a month. How many of you have heard language like “evidence” in your classroom?”; “Think of the most recent lesson that you observed. Who was talking in the lesson? Who didn’t talk? Who was or was not invited to talk?”; “What ideas did you hear from students in that lesson?” Lastly, to facilitate discussion of “what is possible,” the instructor prepared and presented the slides that summarized what research has documented from the last several decades of research on what

students *can* do. The instructor also presented additional case that illustrated the successes of a student of color who the classroom teacher identified as ‘normally struggling,’ and then opened up the conversation, “what is possible?”

Summary. This case unpacks the complex decision-making that goes into the design and enactment of a video-embedded learning activity with a particular group of preservice teachers in a particular time and place, illustrating how the PUV framework can guide a teacher educator’s complex and interconnected decision-making. It should be noted that this case was situated at the very beginning of the program where preservice teachers had yet to reflect and problematize their own vision of teaching. Changes in preservice teachers’ experiences later in the program, such as preservice teachers taking on more responsibilities in their field site, enable teacher educators to foreground different learning goals. For example, the teacher educator may foreground the goal of developing initial repertoires of teaching, such as designing and launching complex tasks. With the shift of the foregrounded learning goal and some progress made by a group of preservice teachers over time, it may be an appropriate time to shift to selecting and using video from preservice teachers’ own teaching to facilitate the interactions that preservice teachers need at that stage of their learning trajectories. The PUV framework makes the complex and connected decision-points explicit.

Merits and Potential Pitfalls of the PUV Framework

This study set off with the question of what tool or framework might help teacher educators better use video in preservice education. We proposed a framework to guide the principled use of video in preservice teacher education grounded in situative and sociocultural

perspectives on learning. The PUV framework embodies our claim that productive use of video involves attention to the learning ecology in which video is situated and the theories of preservice teacher learning that inform pedagogical decision-making. One merit of this work is the explicit attention to the situated nature of video in the preservice education. Expanding prior studies (Blomberg et al., 2013), we position video within a broader activity system consisting of participants with particular learning aims; frameworks that structure how video is integrated within a learning environment; and norms and practices for using artifacts of practice for teacher learning. The proposed framework illuminates how these facets connect in the learning ecology in which video is situated and unveils the complex decision-making behind teacher educators' deliberate efforts to create learning opportunities for preservice teachers.

The illustrative case reveals a few potential pitfalls of the PUV framework. First, the framework is limited in its ability to capture dialectic and interrelated processes of designing video-embedded learning environments. For example, the case demonstrates that on one hand setting up learning objectives are informed by the designed instructional task. On the other hand, the design of the instructional task is informed by the teacher educator's 'theory of action' that is formulated during the process of setting learning objectives. The actual processes of teacher educators' pedagogical decision-making are interdependent and iterative, which is not very well represented in the framework. Second, the framework points out a few important issues to consider in each process, such as "where a group of novices are in their learning trajectories?" or "what kinds of interactions might help novices to move forward in their learning?" However, currently the framework provides little guidance about how teacher educators might figure out

the answers, largely leaving the pedagogical decisions to teacher educators' personal choices or theories. In part, this issue reflects the struggles of a broader teacher education community that suffers from the under-developed theory of preservice teacher learning. Finally, it is certainly the case that many of the decisions for using video are driven by commitments to what it means to teach in the content areas. In some cases, learning content for teaching may be the primary goal, in which case the decisions about clip selection, facilitating productive discussions, and use of frameworks to guide analysis will be guided by this goal (Seago, Driscoll, & Jacobs, 2010). At the same time, it may be less central for other goals that the specific content drive decision-making. Understanding under what conditions the disciplinary focus of the videos matters for preservice teachers' learning about beginning teaching practice is another area for future inquiry.

Discussion & Conclusion

Research identifies the powerful role that teacher education has on beginning teacher practice and student learning, along with the challenges of leveraging the field site for teacher learning (see Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009). Video shows promise in addressing these challenges, bringing practice to life in a variety of settings throughout preservice teachers' learning trajectories. In this article, we unpack the notion of productive use of video in preservice teacher education, review the existing tools and frameworks for video use, and present an integrated framework. The PUV framework specifies the six processes and key considerations of each process to support teacher educators' principled use of video.

This article contributes to the field of teacher education by responding to recent calls to more clearly articulate pedagogies for teacher preparation (Grossman, Hammerness, &

McDonald, 2009; McDonald, Kazemi, & Kavanagh, 2013) and to develop a knowledge base for the teaching profession (Hiebert, Gallimore, & Stigler, 2002). It sheds light on the complex processes of designing video-embedded learning environments in preservice teacher education.

In addition, this article identified several areas where future research is needed to support productive use of video. First, important questions center on the various ways in which teacher educators' pedagogical decisions with video can be guided using this tool and its impact on preservice teacher learning. Also, research on preservice teacher learning that generates a well-grounded theory of how and under which conditions novices make progress toward complex practices through video analysis will further advance the knowledge base of the teacher preparation. Finally, research that elucidates how the PUV framework helps teacher educators to advance equity through analysis of video (or not) will be imperative. We hope the proposed framework generates conversation among teacher educators to advance research on the design of learning environments with video for preservice teachers to collectively advance the knowledge base for teacher preparation.

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