Video of Children as Anchors in an Online Forum for Elementary School Teachers: A Tool for Positioning Oneself as Knowledgeable About Physics

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Abstract

The authors investigated how prospective teachers enrolled in an undergraduate physical science course participated in an online forum in which they posted reactions to video episodes of children talking about science. Using Positioning Theory (Harré & Van Langenhove, 1991) as a lens, the authors analyzed 108 online posts from 26 prospective teachers as they completed six prompts from a Unit Task about force. Prospective teachers compared their own current ideas about physics topics to their prior understandings as well as to ideas articulated by the children in the video clips. Additionally, within these posts the prospective teachers positioned themselves as knowledgeable about how physics ideas develop, an important aspect of teaching science. As the prospective teachers wrote about the videos in their online posts, the videos may have served as a point of comparison with which they could document their understanding of physics concepts as well as the process of learning physics.

Elementary teachers report lacking content knowledge and confidence when teaching science (President's Council of Advisors on Science and Technology, 2010). An unfortunate outcome is that science is too seldom taught in elementary schools. Indeed, in California, 80% of elementary school teachers report spending 1 hour a week or less on science, and 16% of teachers report spending no time on science at all (Dorph, Shields, Tiffany-Morales, Hartry, & McCaffrey, 2011).

It is vital that future elementary school teachers see themselves as teachers of science and that those who prepare future elementary school teachers provide instruction that prepares them to do so. Although the development of attitudes and self-efficacy has traditionally been seen as a responsibility outside the domain of disciplinary content education, it is a responsibility that should be shared between teacher education programs and the disciplinary departments in which teachers learn content knowledge.

Researchers in teacher education have long argued for the integration of content and pedagogical knowledge when preparing future teachers (e.g., Ball & Cohen, 1999; Munby, Russell, & Martin, 2001) and for situating content knowledge in the problems of teacher practice. Mikeska, Anderson, and Schwarz (2009) articulated three broad problems that elementary teachers must grapple with prior to beginning to teach:

> 1) *Engaging in science*: Finding ways to teach content that is meaningful and engaging to students,
>
> 2) *Organizing instruction and resources*: Making use of curriculum materials and other available resources to organize productive instruction,
>
> 3) *Understanding students*: Learning about students as people and as reasoners about science (p. 679; emphasis in original).

Our study addressed special activities within a physical science curriculum focused on this third problem of practice—understanding students. We found that by considering the ideas of children, prospective elementary school teachers reflected on their own ideas and developed a sense of themselves as science teachers.

This study builds on an earlier study (Harlow, Swanson, & Otero, 2012), in which we investigated prospective teachers in an undergraduate physics course designed for an audience of future elementary school teachers. This course used the Physics and Everyday Thinking (Goldberg, Robinson, & Otero, 2007) curriculum, which included special activities that provided undergraduate students the opportunity to view video of children learning science and discuss the children's ideas.

In this earlier work, the discussion of these videos occurred in class in face-to-face conversations during class. Like research focused on other types of teacher education and professional development, Harlow et al. (2012) demonstrated that analyzing video of children learning science can facilitate teachers' ability to develop useful science knowledge for teaching (see also Brophy, 2004; Santaga, Zannoni, & Stigler, 2007; Yerrick, Ross, & Molebash, 2005).

This paper describes a study that continued a similar line of inquiry in a new context. In the undergraduate physics course that constituted the context of the present study, prospective teachers also engaged in activities built around similar video clips of children talking about science. As was the case with Harlow et al. (2012), this course was intended for undergraduates interested in pursuing a career in elementary teaching. However, unlike the earlier course, the videos and related activities were moved to an online context, a forum in which prospective teachers responded to guiding prompts (see appendix) and were able to read posts from their peers. These activities also included videos of other undergraduates (i.e., students who enrolled in the course the previous year) to increase opportunities for prospective teachers to consider the reasoning of their peers; however, our study focused only on the online responses that discussed the videos of children.

The nature of these online responses (longer individual narratives) allowed us to probe more deeply into the role of video in the prospective teachers' views of themselves as teachers. As more undergraduate institutions move to online formats or integrate online activities into face-to-face courses, it is important to understand how the technology facilitates the types of conversations in which students engage.

In this study we asked the follow research questions:

- How did prospective teachers position themselves as knowledgeable in relation to the content material in an online post using videos of children as anchors?
- How did the prospective teachers position themselves as knowledgeable about how physics ideas develop?

Literature Review

The conceptual framework guiding our earlier work centered on two ideas, (a) developing subject matter is developing a discourse (e.g., Gee, 1990), and (b) teacher learning is both constructed and situated (e.g., Brown, Collins, & Duguid, 1989; Driver, Asoko, Leach, Mortimer, & Scott, 1994). The present study investigated the role video played in prospective teachers' views of themselves as teachers of science, as evidenced by their online posts. This work was guided by the notion that learning cannot be separated from the context in which it occurred and that learning science discourse is an essential aspect of learning science. Further, Positioning Theory (Harré & Van Langenhove, 1999) supplemented our conceptual framework and informed our work identifying the role video analysis played in the prospective teachers' views of themselves as physics learners.

Positioning Theory

To increase the amount of time and quality of elementary school science instruction, new elementary school teachers must see themselves as individuals capable of learning and thinking about science. Unfortunately, the majority of individuals preparing to be elementary school teachers have experienced failure in their attempts to learn science (Palmer, 2001), placing the burden of developing their confidence in learning and teaching science in their methods or science content courses. Using Positioning Theory (Harré & Van Langenhove, 1999) allowed us to look at how the prospective teachers used discourse to position themselves in an online forum. Harré and colleagues (Davies & Harré, 1990; Harré & Van Langenhove, 1991) opted for the term *positioning* to capture the notion that one is "constituted and reconstituted through the various discursive practices in which they participate" (Davies & Harré, p. 46). The term positioning, therefore, implies that this process can happen multiple times within a given interaction.

In this way, positioning is tied to identity (Bucholtz & Hall, 2005).

> Deliberate self-positioning occurs in every conversation where one wants to express his/her identity. This can be done in at least three different ways: by stressing one's agency (that is presenting one's course of action as one from among various possibilities), by referring to one's unique points of view, or by referring to events in one's biography. (Harré & Van Langenhove, 1991, p. 400)

For the purposes of this study, we were most interested in this third avenue (recounting one's biography) through which individuals position themselves and express a certain identity. A biography is one's account of what one saw, did, and thought, in addition to a description of what happened. In particular, we were interested in the ways the

prospective teachers incorporated descriptions of learning experiences and previously held science ideas in their written conversations with peers.

Wortham (2001) claimed that individuals create and reinforce particular identities when they position themselves during autobiographical narratives. In order to achieve this reinforcement of a particular identity, "any autobiographical narrative involves a *doubling of roles* for the narrator's self—the narrator has at least one role in the represented content of the story and one role in the ongoing interaction between the narrator and audience" (p. 13).

For example, prospective teachers might recount a story in which they describe learning a particular science concept. Through this autobiographical narrative, the teachers would not only be positioning themselves as more knowledgeable about science than they were prior to the learning experience, but they would simultaneously be positioning themselves to their audience as understanding that particular science concept.

We viewed the online posts of prospective elementary science teachers as similar to the types of autobiographical narratives Wortham described. For example, the questions that guided the online postings prompted the prospective teachers to talk about themselves, their learning, their experiences, and their science ideas. Additionally, the prospective teachers' posted responses contained several narrative-like features: They had a clearly defined teller, tale, and audience; a trajectory that led the audience to some form of conclusion; and the postings incorporated displacement (descriptions of events removed in time from either the teller or audience)—all salient features of narratives (Toolan, 2001).

Online Asynchronous Forums

In this study, we investigated how prospective teachers positioned themselves in relation to the content materials when posting responses in an online forum. All online contributions were asynchronous and threaded. This meant that individuals did not have to be online at the same time to post a response. All posts were accessible to all prospective teachers and the course instructor. Any contribution could be replied to, and a reply would be nested with the initial contribution.

The intention behind having posts visible to all members of the forum, and the ability to reply to individual posts was to engage prospective teachers in asynchronous online conversations about physics content material, children's ideas, and how one learns science. As such, we drew from literature on asynchronous discussion boards to guide our understanding of this type of instructional tool.

Asynchronous discussion boards are becoming increasingly common in teacher education and professional development. Gomez, Sherin, Griesdorn, and Finn (2008) suggested that teacher educators tap into the potential of this technology to provide opportunities for all educators to contextualize theoretical knowledge in their daily activities of teaching and to become reflective about their practice. One example of this type of use of asynchronous discussion boards can be seen in Schwartz and Szabo's work (2011). These authors studied preservice elementary teachers' use of reflective thinking when analyzing videos of classroom teachers.

Barnett (2006) provided another example with his description of how preservice and practicing elementary teachers deepened their understanding of planning and implementing inquiry-based science instruction through participation in the Inquiry

Learning Forum (ILF). Through this forum, teachers engaged in online discussions centered on how children learn science, what it meant to teach science using inquiry, and how to identify such practices in a classroom setting. ILF helped frame teachers' thinking about ideas consistent with the three problems of practice described by Mikeska and colleagues (2009).

Although the teachers in Barnett's (2006) study found asynchronous discussion forums to be useful in discussing reform-based science in elementary settings, other research has shown varied levels of participant satisfaction with this form of technology. For example, Thomas (2011) found that preservice elementary science teachers enjoyed participating in online learning, yet they wanted to continue to engage in the types of face-to-face conversations that occur in traditional methods courses.

Ocker and Yaverbaum (1999) found that graduate student working groups using an asynchronous discussion board to analyze case studies and complete a group report were less satisfied with their experience than were those who worked face-to-face with peers. Interestingly, the authors found no differences in terms of the quality of learning among the two types of student groups. Similarly, Wang and Woo (2007) noted that students found face-to-face discussions as more authentic than those online using an asynchronous platform.

As with any other type of instructional practice, there are many considerations for using asynchronous discussion forums, including the time allotted for student response, the structure of online questions, and a discussion anchor. In responding to a discussion, students need additional time to read, reflect, and formulate posts in an asynchronous discussion forum, compared to having the same conversation face to face (Wang & Woo, 2007).

The questions guiding the online discussion must also be carefully considered. Bradley, Thom, Hayes, and Hay (2008) classified online questions into one of six types, ranging from those asking students to respond to specific aspects of an assigned article to those asking students to justify a particular position on a given issue. Bradley and colleagues investigated student responses by word count, the degree to which the question was answered, and which question types elicited higher order thinking. They found that, although some question types resulted in longer student responses, were more on topic, and were more likely to evoke higher order thinking, the vast majority of student responses indicated lower level thinking.

Finally, Guzdial and Turns (2001) argued that the goals for online discussions are similar to those of in-class discussions: Conversation is sustained, relates to class topics, and is shared by multiple active participants (i.e., students in the class). They recommended using an anchor to motivate students' participation and focus online discussions. An anchor is "a topic that students find worthy of discussion, and a successful anchor is one that engenders a sustained discussion in the collaboration forum" (p. 443). The authors found that successful anchors included review pages with sample exam questions and other students' work to critique.

Anchors are also distinct from the discussion forum, so that students can easily look at the anchor and responses simultaneously. That is, students do not have to scroll up to read the anchor when reading the responses, but instead can access the anchor in another window. In their work comparing anchored and unanchored discussions among undergraduates in a computer science course, Guzdial and Turns found that online discussions including an anchor remained focused on course topics more often, contained more posts (i.e., the conversations were sustained), and involved a greater number of

students than did unanchored discussions. In the activities discussed in this paper, the online discussions were anchored by videos of children discussing their science ideas.

Video in Teacher Education

Classroom videos are used in traditional face-to-face as well as online methods courses. In fact, several of the studies previously discussed involved the use of videos in teacher education (e.g., Barnett, 2006; Schwartz & Szabo, 2011; Thomas, 2011). Analyzing videos of children presents prospective and practicing teachers with the opportunity to apply theoretical knowledge learned in their methods courses and content knowledge learned in their disciplinary courses to the practices of teaching (Hough, Bill, Moon, Guzman, & Lager, 2010; Petrosino & Koehler, 2007). However, the video alone does not produce effective learning: Videos must be integrated thoughtfully into course activities with particular attention paid to how they will promote discussion (Borko, Jacobs, Eiteljorg, & Pittman, 2008).

Our study investigated the use of videos in an undergraduate physical science course, in which prospective elementary school teachers analyzing the children's ideas as an application of their content learning rather than analyze teaching practice. Specifically, the prospective teachers responded to prompts about the children's ideas seen in the videos.

Study Context and Methods

The study context was a semester-long introductory undergraduate physical science course at a large state school in California. Again, participants were upper division undergraduates considering careers in elementary education. We refer to these undergraduates as prospective teachers even though they had not yet formally entered a teacher education program. The activities were adapted from Learning about Learning (LAL) activities included in Physics and Everyday Thinking (PET; Goldberg et al., 2006) and Physical Science and Everyday Thinking (PSET; Goldberg, Robinson, Kruse, Thompson, & Otero, 2008), content courses designed for undergraduate audiences of prospective elementary school teachers.

In PET and PSET, instruction occurs through guided inquiry activities, and both curricula include special LAL activities that provide opportunities for learners to reflect on their own learning, the learning of children, and the nature of science. All activities (physics content and LAL) follow a similar pattern: Undergraduates discuss their initial ideas, engage in a hands-on or computer-based activity, and finally discuss their observations and interpretations as a whole class. In all cases, the prospective teachers are expected to support claims with evidence.

For those activities focused on physics content, the evidence came from experimentation; for those that focused on learning, the evidence was from video episodes of children talking about science. Key to this study was the LAL activities focused on children's ideas. In PET and PSET, two such activities focused on force and motion (see Harlow et al., 2012, for a detailed description of these activities). Videos can be found at http://petpset.its-about-time.com/htm/pet.htm (see Activity 5 Movies under Chapter 2).

The interactive nature of PET and PSET requires equipment and a classroom set up to facilitate discussion in small groups. Such requirements preclude many institutions from offering this course or similar courses. To meet the space and equipment constraints of such institutions, a new curriculum was developed using technology such as student

response systems ("clickers"), videos of experiments, and online discussions to maintain many of the inquiry aspects and allow for instruction in a traditional lecture hall (Goldberg, Price, Robinson, Boyd-Harlow, & McKean, 2012).

For the LAL activities, the first field test of the new course included activities in which the prospective teachers watched videos of elementary school students and other undergraduates (i.e., students who were not enrolled in the course) outside the classroom and responded to prompts in an online discussion format. The videos of elementary school students included in the online force and motion activities were edited versions of those used in the PET force and motion activities about children's ideas and reported on in Harlow et al. (2012). In the version of the course studied here, the online discussions of the videos were part of activities called Unit Tasks, which were completed over the duration of each unit. (The final version of the curriculum does not include Unit Tasks. Instead, the activity format is more similar to the content activities and includes an online context but not a forum.)

The videos of undergraduates talking about science were not included in PET and PSET. They were added to the new course, because in the lecture format prospective teachers had fewer opportunities to consider the reasoning of their peers. As our focus was to gain insight into the ways prospective elementary school teachers positioned themselves as knowledgeable about physics content material and about how physics ideas developed, we did not analyze their comments regarding the video clips depicting other undergraduate students.

We viewed these comments as more indicative of how the prospective teachers positioned themselves in relation to other physics learners at the college level—a separate research question beyond the scope of this paper. However, the prompts surrounding all videos are provided in their entirety in the appendix.

Two important aspects of the online discussions should be considered when thinking about how the prospective teachers positioned themselves with respect to the content material. First, watching the videos constituted a shared experience among the prospective teachers. As such, they could be confident that their peers would understand references to the videos' content in their posts.

Second, prospective teachers may have considered this type of online forum more public than face-to-face conversation. This is because participants' names were attached to the responses, the responses were more permanent than a vocalized statement in a small group or whole class discussion, and everyone in the class, including the instructor, had access to the postings. Therefore, prospective teachers may have been more mindful of their words when posting responses (when compared to discussing the same ideas in a classroom discussion).

Description of Anchoring Videos

Three videos were included in the unit task, two of children and one of undergraduates. The video clips of children were selected from longer videos that are part of the activities about children's ideas in the PET curriculum. The first video (3 minutes long) shows an interviewer asking a group of fifth graders what will happen after a ball is kicked. The children in the video are specifically directed to consider what forces, if any, act on the ball after the ball has left the foot.

A physicist would claim that while the foot is in contact with the ball it exerts a force on the ball. The ball then moves across the grass at a constant speed until another force (friction between the grass and the ball in this case) acts on the ball in the opposite direction to slow it down. This means that after the ball has left the foot the only forces acting on the ball are friction and gravity. The children in the video, however, expressed ideas that are common among novice physics learners, including that the ball moves because the foot transfers a force to it and that the ball slows down because a force "runs out."

In the second video (48 seconds), a third grader talked about why a toy car slows down after being pushed across a surface. The elementary student suggested that the toy car will slow down because it does not have batteries and "because of gravity."

Data Collection

Online responses were collected from 50 prospective elementary teachers enrolled in the undergraduate physics course. At this university, the teacher-credentialing program is a postbaccalaureate program; therefore, participants had not yet taken any education courses at the time of data collection.

The prospective teachers watched videos of children discussing their ideas about force and friction and then responded to prompts online. The prospective teachers were asked to provide individual responses to each prompt during the unit and then work together to write a final summary essay. In order to respond to the summary essay prompts, they were expected to review both their own and their classmates' previous posts. Beyond the summary questions, they were not explicitly told to respond to or incorporate their classmates' posts, though the discussion forum had this capability.

The lack of explicit requirements to respond to each other's posts may have decreased the likelihood that the prospective teachers engaged in back-and-forth conversations online. In fact, our analysis of the online posts indicated that the prospective teachers rarely engaged in extended discussion. However, this forum was public and resulted in peer collaboration.

First, the prospective teachers were expected to use their peers' posts when collaborating on the summary responses; therefore, these posts became part of a conversation between individuals. Second, the prospective teachers' posts were not anonymous nor were their posts to a board populated by strangers. These prospective teachers were all enrolled in the same course and met face to face on a regular basis. Finally, all posts were viewable by all members of the forum, including the course instructor.

A total of 146 online postings (from 50 participants) were collected during the unit; however, many prospective teachers did not complete all parts of the assignment. We analyzed work only from prospective teachers who completed at least two thirds (four) of the six prompts related to the unit. As a result, 26 prospective teachers' work (108 online postings) was used for analysis. Participants included 6 males and 20 females, all college age (18-23). Using the 26 prospective teachers as participants, response rates for each of the prompts were as follows: Prompt 1 (54%), Prompt 2 (88%), Prompt 3 (96%), Prompt 4 (96%), Prompt 5 (96%), and Summarizing Questions (92%).

Data Analysis

An earlier study on face-to-face interactions about videos of children found that the prospective elementary teachers connected the physics subject matter of the course to the children's discourse in two ways: (a) reflecting on their own learning and (b) identifying and restating the ideas of children (see Harlow et al., 2012, for full details). We used these findings to inform our initial coding of the discussion board postings and, as such, began with an a priori coding scheme of two codes, reflecting on learning and analyzing children's ideas.

Through iterative coding and discussion of codes, we recognized that this scheme was insufficient for our data and modified it to better represent the data. We converged on four codes:

- Analyzing children's ideas (AC)
- Stating own ideas – current (OI-C)
- Stating own ideas – prior (OI-P)
- Discussing the learning process (DLP)

See Table 1 for final codes and examples. The online posts were independently coded by both authors.

Table 1
Codes and Example Text

Code	Example
Analyze other's ideas-children (AC)	The children understand that the foot is a force acting on the ball.
State own ideas-prior (OI-P)	Before this class...I used to think that some force was transferred to the ball...
State own ideas-current (OI-C)	However, now I know...The minute contact is lost the force is no longer working on the object.
Describe the learning process (DLP)	Group opinions are very important, they introduce ideas that someone may not think of. They influence your thinking and challenge your ideas.

Any discrepancies in coding were discussed until agreement was reached. Our unit of analysis was a prospective teacher's post in response to one of the six prompts (Prompts 1-5 and the Summary Questions). Each post was assigned one or more of the four codes in Table 1. When a prospective teacher responded to more than one of the six prompts in a given post, we separated the post by prompt and coded the responses to each prompt separately. Table 2 provides an overview of the frequency of occurrences for each code among the 108 online postings.

Table 2
Frequency of Codes for Each Prompt of Unit Task

Unit Prompts	AC	OI-P	OI-C	DLP
Part 1	100%	14%	64%	0%
Part 2	96%	9%	78%	0%
Part 3	76%	68%	32%	4%
Part 4	36%	8%	4%	92%
Part 5	88%	4%	68%	8%
Summarizing Questions	8%	8%	8%	100%

Specific co-occurrences of codes allowed us to identify analytically interesting postings that highlighted the ways prospective teachers talked about their own physics understandings and experiences learning science, as well as the videos of children. Table 3 details how often codes co-occurred with one another.

Table 3
Overview of Co-Occurrences of Codes

Code	Total	Number of Co-Occurrences			
		AC	OI-P	OI-C	DLP
AC	88	-	20	53	8
OI-P	26	20	-	8	2
OI-C	70	53	8	-	6
DLP	50	8	2	6	-

To investigate whether these prospective teachers used the children's talk to position themselves in specific ways, we first identified the co-occurrence of the following codes within a given posting: AC and one of the codes about participants own ideas (OI-P or OI-C).

We selected this combination of codes to further investigate, because it indicated that the participants were talking about the children's ideas and their own ideas at the same time. We found that when prospective teachers discussed both the children's ideas and their own ideas, they positioned themselves and their ideas about physics as similar to or different from the children's, providing insight into how they were identifying with physics.

Findings

Finding 1: Positioning Themselves to Highlight Their Physics Understanding

Prospective teachers used videos of children to position themselves as knowledgeable about force in two ways: First they used the videos to help

articulate their own preinstructional ideas about force and motion and how their ideas changed. Second, they used the videos as a way to showcase their understanding of the content material. These two findings resulted from analyzing combinations of the codes OI-P,OI-C, and AC.

Of the 26 times the OI-P code was used in the online posts, 20 of those codes (77%) co-occurred with AC. Two examples follow:

> A lot of kids...thought that the force was transferred and would run out, making the object go slower. *I also used to think* that constant motion requires constant force before I took this class. [emphasis added] (Unit 2, Prompt 3 – Alicia)

> I think 'Common Idea 1: Impetus Theory- Internal Force' and 'Common Idea 2: Impetus Theory- Force Runs Out' [from the assigned reading] are very similar to the children's ideas about force and why the soccer ball stops. I think these are very realistic common ideas. *Before taking this class I thought* that constant force was required to keep an object at constant speed, but it actually makes the object speed up. [emphasis added] (Unit 2, Prompt 3 – Brian)

In her post, Alicia compared her initial ideas to those of a child—indicating that her ideas had since changed, as evidenced by her final statement: "I also used to think that constant motion requires constant force before I took this class."

Brian also acknowledged that he shared common misconceptions about force with the children. In fact, Brian argued that his previous ideas are commonly held among people ("I think these are very realistic common ideas"). In his post, Brian indicated that his ideas changed as a result of the course, positioning himself as more knowledgeable about the content than when he began the course.

In other posts, undergraduate students were more explicit in comparing their current understandings (coded OI-C) to the children's ideas (coded AC). For example, Nicole wrote,

> These children know what force is. The first kid knew that the force is from the foot but that it didn't transfer to the ball. The third kid with the huge soccer ball picture thought that there was still force acting on the ball after it was kicked. *Personally, I would have thought* that force transferred. Force is just the motion of one object affecting another, but it doesn't transfer. *After learning about energy, I know that* energy is transferred. Force is just the motion of one object affecting another, but it doesn't transfer. I know that once the foot and soccer ball are not interacting, there is no longer a force acting on the ball. [emphasis added] (Unit 2, Prompt 1 – Nicole)

In her post, Nicole began by discussing the children's ideas about force. She then indicated that she held different ideas about force and motion at an earlier time and described her current understanding that force did not transfer from one object to another. Further, Nicole related her understanding of force to that of energy explaining that, unlike force, energy was transferred during an interaction. By contrasting force and energy, Nicole highlighted that she had learned what the two concepts mean and how they explain a rolling ball coming to a stop. Nicole's posts represent the type of responses that were coded with the codes of AC and OI-C. These codes co-occurred 53 times.

Finding 2: Positioning Themselves as Knowledgeable About How Physics Ideas Develop

The posts described in Finding 1 are evidence that the prospective teachers articulated what content (e.g., force, friction, energy) they learned in the physics course as they talked about the videos of children. In their online posts, the prospective teachers also discussed aspects that impacted the learning process: namely, how prior knowledge influences learning and the importance of talking about one's ideas with peers. We coded these posts as DLP.

The code DLP occurred most frequently in posts responding to Prompt 4 (92% of these posts contained the DLP code) of the unit task as well as the summarizing questions (100% contained the DLP code). In both these sections, prospective teachers were asked to discuss the role of social interaction in developing science ideas. Prompt 4 asked prospective teachers to watch a video prior to constructing their posts. For the summarizing questions, prospective teachers were asked to draw from their class readings, previous posts (both their own posts and their peers' posts), and the videos of children.

In their posts, the prospective teachers wrote that people, including children, form explanations of phenomena based on everyday experiences. For example Crystal wrote, "Especially if you have not taken many science classes or been exposed to different theories….if you have no science knowledge, your only choice is to draw from your own personal experiences." With this post, Crystal distinguished everyday knowledge from scientific knowledge.

Alicia similarly separated everyday and scientific knowledge: "At least for me, I just make assumptions based on what I experience everyday, then I learn the actual reasons from class."

Another student wrote,

> …I think that most people base their knowledge of science on their daily life because we have nothing else to base it on, or relate it too. We learn through our daily life and coming to scientific conclusions based on our daily life makes the most sense to us. (Unit 2, Summary Questions - Stephanie)

Like Crystal, Stephanie stated that people develop ideas during everyday experiences. However, unlike Crystal, Stephanie referred to this knowledge as "scientific conclusions" and learning knowledge in this manner as a reasonable process. Like Stephanie, Thomas indicated that he thought everyday experiences were a reasonable way to learn about science,

> …My first ideas could only have come from my everyday experiences because I had no formal teaching on the matter prior. My experiences were the only reasonable explanations I had. I could not have guessed out of thin air my explanations without having had evidence from previous, everyday experiences. I think we as students think very much like scientists, even elementary school students. Using, roughly, the scientific methods of observation and experimentation we come up with hypotheses that correspond to our everyday experiences. Us, [sic] like scientists, are constantly disproving theories we thought for sure were right! (Unit 2, Summary Questions – Thomas)

Thomas likened the process used to formulate explanations based on everyday experiences to that of the "scientific methods" of observation and experimentation. Like Stephanie, Thomas thought his explanations based on daily life were reasonable ones.

In addition to acknowledging that people develop understandings of phenomenon based on everyday experiences, the prospective teachers explained that these understandings influence future learning. Melissa posted,

> You could learn about a topic and already have some basic knowledge about it from everyday life but hearing more information about it will enrich your brain and cause you to make more sense about the topic and understand the way it works and how it is. (Unit 2, Summary Questions – Melissa)

> At the beginning of the semester, I found myself among the many students that often find their initial expectations of phenomenon different from that of scientists....I had ideas that were consistent with my everyday experiences, which is why they seemed reasonable to me, even though my ideas were not scientifically correct. While at first it was hard to separate the misconceptions I had held for years, I then began to use the same previous experiences to support the scientific explanations of that same phenomenon. (Unit 2, Summary Questions – Maria)

For Melissa, new knowledge (learned from class) is integrated with prior understandings (from "everyday life"). Maria explained that observations from her everyday experiences led to strongly held ideas. Further experiences in class led her to understand that her preinstructional ideas were not aligned with scientific ideas. Yet, as she developed new ideas in class, she was able to use these new ideas to explain the same phenomenon that led to her earlier ideas, thereby aligning her prior experiences with her new knowledge.

The prospective teachers' posts also indicated that they saw value in talking with their peers (prospective teachers regularly met face-to-face with their peers during class sessions). Responses included the following:

> "When we discuss ideas [about physics content] with our peers we eliminate off ideas by challenging them and proving others." (Nicole)

> "Conversing with other classmates creates a sense of accomplishment because more heads together are better than just your own. Talking with other classmates will help you solidify your own reasoning." (Sandy)

> "You will most likely come up with a better answer if you come up with your own and build on it with other people's suggestions and ideas." (Alicia)

> "I think it's very important to discuss your final decisions with your classmates because you become open to new perspectives that could be correct also." (Jennie)

> "It is important because everyone can put their input and see what fits for the right answer. When you listen to other people it gives a person more facts to choose either answer." (Frank)

Other students focused on a relationship between talking and learning. For example, Hannah suggested that talking improves learning: "It is very important to talk about your ideas and listen to others because you learn better when you realize things while talking it out rather than being told without thinking at all."

Discussion

In the online forum, the prospective teachers who completed four of the prompts positioned themselves as knowledgeable about physics and knowledgeable about the process of developing physics knowledge. The anchor videos of children talking about physics ideas most likely played an important role in this process (particularly for positioning themselves as knowledgeable about physics) by providing a point of comparison. Figure 1 depicts a continuum of novice to expert ideas. Because the children's ideas were known, the prospective teachers could locate their prior (grey circle) and current (black circle) selves along the continuum by describing this as a distance from the children's ideas (white circle). This comparison facilitated a description of their development of physics expertise. Providing referents (in this case, videos of children) may have resulted in even better estimations of how much the prospective teachers had learned.
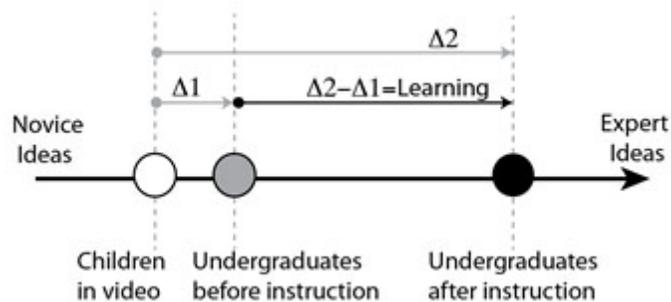

Figure 1. *Using video to anchor a comparison of ideas.*

A physics expert can look at the prospective teachers' ideas before and after instruction and notice that the ideas are becoming more sophisticated. Novices, however, would have difficulty making such an assessment, because they do not have a larger framework against which to base their ideas. In other words, if one does not know what there is to know, it is difficult to assess whether one has learned a lot or a little. However, comparing to a known value (a child's idea as articulated in a video, in this case) may make that assessment easier. The prospective teachers could position themselves with respect to the child's idea, thereby making comparisons between their own preinstructional and postinstructional ideas clearer.

The prospective teachers compared their ideas to those of the children since the prompts directed them to do so. The prompts, however, did not ask the prospective teachers to use the children's ideas as a way of comparing their own pre- and postinstructional ideas, which many of the participants did.

The online forum was semipermanent (it was available for the duration of the course) and viewable to all those enrolled in the course. Indeed, prospective teachers were expected to review and use their peers' posts for the summary activity. Thus, when teachers posted about how their ideas had developed or how their ideas were different than the children's, they were publically positioning themselves as knowledgeable of physics. Our analysis, particularly thinking about how the prospective teachers positioned themselves and their ideas with respect to the children in the video, made visible the discursive practices (e.g., using videos of children as a marker to indicate how much had been learned) used in the online posts that allowed the prospective teachers to position themselves as knowledgeable about physics to their classmates and course instructor.

Using the online forum to document their developing physics expertise may help prospective teachers think of themselves as people who are capable of learning science. This component is vital in thinking about themselves as capable science teachers. Many elementary teachers have struggled through science (Palmer, 2001) and feel insecure about their ability to teach science (President's Council of Advisors on Science and Technology, 2010). In contrast, many prospective teachers have experienced success working with children, and working with children and children's ideas is part of their identity as elementary school teachers. Allowing prospective teachers the opportunity to document their own physics learning process and showcase their physics knowledge in the context of making sense of children's ideas may help them see themselves as capable of teaching science to elementary school children. In this way, our work aligns with Sutherland, Howard, and Markauskaite's (2010) assertion that through the process of documenting their ideas on an asynchronous discussion board teachers can create a "teacher's voice" and, thus, construct an identity of a education professional.

Such online activities may have allowed the prospective teachers to make progress in addressing the problems of practice facing elementary teachers described by Mikeska and colleagues (2009). The online posts showed the prospective teachers acknowledging that children have ideas about science phenomena, an important part of learning about students as "reasoners of science" (p. 679). As the prospective teachers discussed children's ideas about science, they also talked about where ideas come from, how they are constructed, and the role social interaction plays in learning.

Our analysis also points to ways that the online forum may have been limiting. Students who completed the assignments all referred to the videos in their posts. Clearly to these students, the videos were "a topic that students find worthy of discussion" (Gudzial & Turn, 2001, p. 443). Yet, we found these anchors failed to meet this definition of success in two ways: Not all prospective teachers fully participated, and even among those who did, the posts did not generate back-and-forth conversation.

Of the 50 prospective teachers enrolled in the course, only 26 completed at least four of the six prompts. Only half the class fully participated in the activity. Possibly, if the discussions had occurred face to face in class, all students who were present would have participated. At the very least, even those who did not speak would have heard the comments of their peers. Further, the prospective teachers rarely participated in a back-and-forth online conversation regarding the videos. While the prospective teachers collaborated with one another to complete the summary activity, other postings rarely included any references to classmates' contributions to the forum.

One way to increase student participation is to require (through the assigning of a course grade) all participants to post and respond to their peers' comments. Yet, the research literature provided other suggestions for fostering sustained discussion on an online asynchronous platform. For example, drawing from Bradley and colleagues' work (2008),

the online prompts could be revised to evoke more higher order thinking among undergraduates. Additionally, Lee-Baldwin (2005) suggested attending to the social dynamics of the students groups who use the online forums. A related suggestion stems from research (e.g., Hew & Cheung, 2008) on asynchronous discussion that documented the potential benefits of assigning students to the role of facilitator. Finally, just as is commonplace in traditional face-to-face classroom activities, the role of the course instructor in facilitating online discussions should be considered (Mazzolini & Maddison, 2007).

Our work extends the use of Positioning Theory to interpret teacher education contexts. Researchers have previously used Positioning Theory to explain how teachers position themselves in relation to their students in face-to-face (e.g., Yoon, 2008) and online (e.g., Dennen, 2007) classroom contexts, as well as in relation to other educators (e.g., Bullough & Draper, 2004). Dennen (2007) investigated the ways in which instructors positioned themselves, as well as the ways their students positioned them, on asynchronous discussion boards. Similar to our study, Dennen applied Positioning Theory to written, asynchronous exchanges and used transcripts of online posts as her primary data source.

Dennen's study highlighted the ways instructors' positioning of themselves impacts the ways in which they and their students negotiate online interactions. Our study differs in that we used Positioning Theory to help explain how prospective teachers used videos of children to position themselves with respect to learning content material. The focus of our analysis of the online posts was to understand the prospective teachers' learning process rather than to highlight a specific dynamic between themselves and their peers or instructor.

Limitations

Our study highlights how prospective teachers in an undergraduate physics course discussed their physics content knowledge as well as their ideas about learning physics using an online forum. However, our study is limited in that our data do not allow a more nuanced analysis of how individuals positioned and repositioned themselves as knowledgeable about physics teaching and learning in an online context when faced with the response and feedback from their peers.

Furthermore, data collected did not allow us to investigate potential reasons why some prospective teachers participated in a more limited capacity with the online discussion forum (i.e., they completed three or fewer of the five individual tasks). In particular, we do not know if these individuals did not complete the assignments due to (a) the nature of the online discussion forum; (b) the nature of the task (i.e., analyzing children's ideas); (c) another aspect of the assignment (e.g., worth in terms of grading); or (d) some outside factor (e.g., limited time).

Triangulating prospective teacher's online activity with interview data that specifically targeted their views toward the online activities, the undergraduate physics course, and their strengths or reservations regarding a career in elementary education or teaching science would have assisted our analysis of the written data (i.e., online posts).

Implications for Teacher Education

In our study, videos were used as a tool to help prospective teachers develop deeper understanding of content material. This activity was done out of class in an online

asynchronous discussion board. The data presented here show that great potential exists for using videos of children talking about science ideas as anchors for online discussions. Using such videos simulates the pedagogical task of listening to and interpreting children's ideas. Therefore, using video of children talking about science to deepen prospective teachers' conceptual understanding of content material may be a useful practice in teacher education (see also Harlow et al., 2012). Yet, instructors need to carefully consider the structure and requirements of the assignment to foster sustained discussion equivalent to what would be expected in an in-class assignment.

Changes to the prompts, the requirements of the assignment, or assigning group moderators may have changed the nature of the online discussions. This speculation echoes Borko and colleagues' (2008) recommendation that video be thoughtfully integrated into the curriculum. In our study, the videos were selected so that (a) children and undergraduates talked about the same physics concepts (e.g., force) as the participants in the undergraduate physics course; (b) specific prompts were answered regarding each video; and (c) participants in the undergraduate physics course were expected to support any claims made regarding the videos with evidence (as was the expectation for all course activities).

Conclusion

As technology advances, it enables new ways of interacting with content. One such innovation is the moving of course material to online contexts. In this study, prospective teachers posted responses to guiding questions regarding video clips of children to an online forum. This replaced in-class activities and freed up in-class instructional time. Further, the online context allowed the prospective teachers to participate at their convenience within the bounds of assigned deadlines.

Moving some parts of a traditionally face-to-face course to an online context is one type of hybrid instruction. The U.S. Department of Education reported on a meta-analysis of studies about online and hybrid instruction in higher education (Means, Toyama, Murphy, Bakie, & Jones, 2010). They found that students in courses with both face-to-face and online elements reported larger learning gains compared to both purely online and purely face-to-face learning contexts. This result indicates that moving parts of the course to an online format is not likely to be detrimental to students' learning. Our study demonstrates one way that online discussions about videos of children's thinking might complement content training of prospective elementary school teachers. This work is particularly important, because it may help address the concern that elementary teachers do not see themselves as science teachers. This reason is one used to explain the lack of science instruction that aligns with authentic science inquiry at the elementary school level (Duschl, Schweingruber, & Shouse, 2007).

Helping teachers establish identities as science learners is an important function of the science courses that prospective elementary teachers enroll in. Integrating this type of activity into science courses may help elementary teachers establish such identities and increase their willingness to teach science through inquiry.

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Appendix
Prompts for Unit Task (Paraphrased)

Unit Task Prompts
Key Questions:

1) How does prior knowledge influence our learning of science?

2) How is knowledge developed through social interactions?

For parts 1-5, you should post your response for the group to read and you should read the responses posted by your group members. You do not need to come to agreement on these parts, only discuss your ideas.

For the final part (Summarizing Questions), you do need to come to an agreement on a response and submit one final group answer.

Part 1: Children's ideas about slowing down. (To be done at the beginning of unit)

Watch the following two clips of elementary children talking about their ideas about force.

1) What ideas about force do these children have?

2) How are these ideas similar and different to your ideas?

Part 2: Undergraduates ideas about slowing down (to be done after lesson 5)

Watch the following clip of undergraduates discussing why they think a cart slows down after being given a quick push.

1) How are these ideas about friction expressed by the undergraduates in the video similar to those of the elementary students?

2) How are your ideas about why things slow down compare to the ideas expressed by the elementary students and to the undergraduates?

Part 3: Common ideas about force and motion. (To be done after lesson 7)

Educational researchers have found that there are some ideas about forces that are common among learners. Before answering the following questions, read the article *Common Ideas about Forces* [a short paper describing common misconceptions and naive ideas about forces] and review your responses to part 1 of this task.

1) Are any of the ideas in the article similar to the ideas you recognized in the children's and undergraduates ideas in part 1?

2) Are any of these ideas that you recognize from your own thinking – either now or earlier in the course?

Part 4: Development of ideas through talking with peers. (To be done after lesson 8)

Watch the following video of a small group discussion their ideas with one another.

1) Consider the idea developed in the group. How did talking about the different ideas that lead to agreement among the group on a single idea?

2) How important to learning are talking about your own ideas and listening to the ideas of others?

Part 5: Models in science. (To be done after lesson 10)

You have likely noticed that in your everyday experiences, moving objects (like soccer balls rolling across the grass or books sliding across a table) tend to slow down and eventually stop. People develop *models* to explain such regularly occurring phenomenon. After reading about two different models that explain why objects tend to slow down (provided), answer the following questions.

1) Which of these models do you think was most evident in the video of the children?

2) Which of these models is most like the ideas you developed throughout Unit 2?

Summarizing Questions (To be done following end of Unit 2)

Building on your responses to parts 1-5 of this activity and evidence from the videos, come up with a group answer to the following questions.

1) Students often find that their initial expectations of phenomenon differ from that of scientists. After reading three students' explanations (provided), who do you agree most with and why?

2) What role does social interaction (talking to peers about your ideas) play in the development of science ideas?