

Development of Proximal Formative Assessment Skills in Video-based Teacher Professional Development

Eleanor W. Close¹, Rachel E. Scherr², Hunter G. Close¹, and Sarah B. McKagan³

¹*Department of Physics, Texas State University – San Marcos, San Marcos, TX 78666*

²*Department of Physics, Seattle Pacific University, Seattle, WA 98119*

³*McKagan Enterprises, Seattle, WA 98144*

Abstract. Developing skills for proximal formative assessment is a primary goal of the academic-year professional development course offered by the Energy Project at SPU. We have adapted a video club model (Sherin & Han, 2004) in which groups of teachers watch and discuss video of classroom interactions. In this paper we use a framework developed by Sherin & Han to analyze teacher reasoning about student understanding in an episode of video from our course. Teachers in the video use evidence from student interactions to propose general models of student thinking about energy. Our analysis suggests that the video-based professional development supports teachers in developing their *professional vision for teaching*: practicing the selective attention to and reasoning about evidence of student understanding that is required for proximal formative assessment.

Keywords: Professional vision, proximal formative assessment, video club.

PACS: 01.40.Fk, 01.40.Ha, 01.40.jh

INTRODUCTION

The Energy Project at Seattle Pacific University offers academic-year professional development courses for teachers focusing on development of proximal formative assessment skills in the context of energy.

Proximal formative assessment (PFA) is teachers' continual, responsive attention to learners' developing understanding as it is expressed moment to moment [1,2]. This responsive attention is among the most subtle and challenging of formative assessment practices, yet is the one with perhaps the most potential impact on a teacher's ongoing activities in the classroom [3,5].

In our profession development course we have adapted a video club model [3] in which groups of teachers watch and discuss video of classroom interactions. This format allows teachers the opportunity to develop and practice the skills needed for PFA in an environment removed from the demands of classroom teaching. In this paper we analyze an episode of teacher discourse about student thinking using a framework described by Sherin & Han [3].

THEORETICAL PERSPECTIVE

We apply the concepts of PFA, as defined by Erickson [1]; and professional vision, as defined by Goodwin [4] and as applied to teaching by Sherin [5].

Proximal Formative Assessment (PFA)

Formative assessment broadly stated is any gathering of information by teachers or students that is then used to inform the teaching and learning process. The time scale of formative assessment on the classroom level can vary. For example, a teacher could use a mid-unit assessment to gather information about student learning over several weeks of instruction; assign a brief written reflection at the end of a lesson to provide feedback for planning the next lesson; or listen in on a small group discussion to understand students' current ideas. PFA is *proximal* in that it is assessment that is formative on a very short time scale, informing the moment-to-moment actions of teachers and students.

The *assessment* component of PFA requires close attention to what students say and do as they participate in classroom activities. Erickson [1] defines PFA as "careful attention focused upon specific aspects of a student's developing understanding and mastery of skills, as instruction is taking place in real time." Erickson distinguishes between PFA of student learning and other forms of PFA, e.g., PFA of student deployment or effort, and suggests that while PFA of student deployment and effort are common in K-12 classrooms, PFA of student understanding is not. If PFA of student understanding is uncommon, it may be because the relevant skills are not often taught.

Professional Vision

Professional vision is selective attention to and categorization of relevant events and objects, shaped by enculturation into a professional community. Goodwin [4] defines professional vision as “socially organized ways of seeing and understanding events that are answerable to the distinctive interests of a particular social group” (p. 606), and argues that the ability to see and interpret meaningful events in a domain of interest is not inherent to the events, but is specific to the community of practice to which the viewer belongs. For example, an area of bare dirt is potentially interesting for both a farmer and an archeologist, but would be seen differently by the two observers; the farmer recognizes signs relevant to growing crops (e.g., soil composition), where the archeologists recognizes signs of previous human habitation or use (e.g., local changes in soil color and texture). Enculturation into a way of seeing (e.g., receiving mentoring at an archeological dig) shapes what events are seen as objects of knowledge and how they are interpreted.

Enculturation into the teaching profession includes learning to interpret events relevant to categories such as classroom management, pedagogy, and student content learning. Professional vision is what enables teachers to engage in PFA: to selectively notice and interpret classroom interactions for evidence of student effort, attention, and developing understanding. Viewing and discussing video of K-12 classrooms provides a context for teachers to collaboratively examine classroom interactions for evidence of student understanding. This context allows teachers to engage in extended discussion about interpretation of evidence, without the pressures of classroom management and pedagogical decision-making. Previous studies have found that participation in discourse about classroom video has resulted in changes in what teachers notice and how they interpret what they see, both during the video discussions and in their classroom teaching [3,5,6].

Levels of Complexity in Teacher Discourse

In their analysis of mathematics teachers’ activity in a video club, Sherin & Han [3] develop a framework to characterize the changes in teachers’ attention to and reasoning about different kinds of classroom events. They identify three levels of complexity in teachers’ discourse about student thinking.

In Level 1 discourse, teachers draw attention to student statements. For example, teachers may read one or two lines from the video transcript. Level 1

discourse does not include any explicit interpretation of students’ words.

Level 2 discourse consists of working to understand the meaning of student statements. For example, when viewing a video of students discussing a worksheet that includes two sets of data, teachers may work to establish meaning by trying to figure out which data a student is referring to. Restating student words in other terms is also Level 2 discourse.

In Level 3 discourse, teachers generalize and synthesize evidence in order to characterize the nature of student understanding. For example, teachers trying to characterize the different ways a concept was discussed in a group of students, and whether the students reached consensus, are engaged in Level 3 discourse. This level of discourse includes attention to and interpretation of individual student statements as evidence that is then synthesized into a broader characterization of student thinking.

Effective PFA in a physics classroom depends on the ability to characterize student understanding of physics concepts and their relationships to physical phenomena. Thus, PFA requires the same kind of attention and reasoning as Level 3 discourse.

CONTEXT FOR ANALYSIS

The video episode described below is of teachers in our professional development course discussing a three-minute video excerpt of students in an eighth-grade physical science class. There are two videos relevant to this analysis; we will refer to them as the T video and the S video. The students in the S video are discussing energy concepts; the teachers in the T video are watching the S video and discussing what the students say and might be thinking.

Professional Development Context

Teachers participated in a 2010-2011 academic-year professional development course offered through the Energy Project at Seattle Pacific University. Professional development sessions were held on weekday evenings every 2 to 3 weeks, with a total of 15 meetings. Teachers were invited to attend as many or as few sessions as they were able. Attendance ranged from three to 21 teachers with an average of 11 teachers per class session, and from two to six members of the research team.

The course followed a modified video club format. In the video club format described by Sherin and colleagues [3,5,6], small groups of teachers from a single school meet regularly to view and discuss video of their own classrooms. In our course, a varying number of teachers from multiple schools attended

sessions. Most, but not all, sessions focused on video episodes of students discussing energy ideas. Initially the video discussed was of university students in introductory physics courses; later in the year, teachers discussed video from some of their own classrooms.

The T video analyzed here is from late January 2011. This was the eighth professional development session of the year and the fifth that focused on viewing and discussing video of people learning. In this episode, five teachers (Donna, Mark, Owen, John, and Ann) and one researcher are seated at a table; another researcher is standing next to the table.

Student Video Excerpt

The students in the S video are eighth-graders beginning their study of energy. They have seen a movie showing various phenomena: a bus driving, a bicyclist pedaling, leaves blowing in the street, etc. The worksheet they are discussing asks how energy is involved in each of the phenomena in the movie.

The T video begins with a question posed by the researcher leading the whole-class discussion, who asks the teachers how they interpret the students' use of the term *perpetual motion*. Transcript of this section of S video is given below. The student group in the S video has five members, named Student 1 (S1) through Student 5 (S5) in the transcript.

S2: The leaves in the street, do they have energy.

S3: They are *pushed* by energy.

S2: They have *energy*. But they do not have energy, like, to *move*. [...pause...] Like, perpetual motion. You'd have to have wind to do that.

S5: True, but are we... I mean... uh, a *bus* doesn't have perpetual motion.

The students continue to discuss the leaves in the street for the remainder of the S video, including comparisons to the bus and the bicycle. The term *perpetual motion* is not used again. Note that although the worksheet does not prompt students to discuss the wind and its relationship to energy, in the movie the students watched prior to starting the worksheet the leaves in the street are being blown by the wind, and the wind plays an important role in the students' subsequent discussion.

IDENTIFYING AN EPISODE OF HIGH-LEVEL TEACHER DISCOURSE

In the T video, teachers alternate between discussing what the students mean by *perpetual motion* (Level 2 discourse) and attempting to characterize student understanding(s) of the

relationship between motion and energy (Level 3 discourse). They describe three possible understandings of this relationship (abstracted by the authors).

One possible way in which students understand the relationship between motion and energy is that **energy is fuel for motion**. Like gasoline in a bus, energy gets used up in the process of making things move:

Donna: It seems like the idea that it can always move, maybe? Not necessarily constantly moving? or has a period of time where it constantly moves...

Mark: More like it has a source, it always has a source of energy.

Donna: Yeah...

Owen: Yeah, that's how I think that they were using it also.

John: So if you take that away you would have [hand gesture indicating *nothing*]

This exchange takes place immediately following the initial question by the researcher. Mark's proposal that students think perpetual motion is motion with a constant source of energy, combined with John's indication that removing the energy source would leave you with nothing (i.e., with no motion), describe a student model for the relationship between motion and energy in which energy is a source of motion in general in the same way that gasoline is a source of motion for a bus.

A second possible student understanding characterized by the teachers is that **motion generates energy**; energy is created by (certain kinds of) motion:

Mark: (Shaking finger no) I don't know if it they [actually mean] *self-generated*...

Ann: ...To have perpetual motion you'd have to have *wind* to do that, so in order to have perpetual motion...you'd have to have *wind*?

Donna: In other words, [making windmill gesture] to always get the turbine to blow, for example...to create electricity.

Here Donna and Ann are describing a possible student model in which the motion of the wind creates energy, for example by making a wind turbine turn to generate electrical energy. With her use of the phrase *create electricity*, Donna suggests a student model in which energy is not conserved; rather, the motion of the wind causes energy to be created in the interaction between the wind and other objects (e.g., leaves, or a wind turbine). Numerous other interactions with Donna suggest that, in relation to her peers, she has a sophisticated understanding of energy concepts. We interpret her use of *create* here to characterize her understanding of the students' thinking.

The third possible student model described by teachers is that **motion has two distinct relationships to energy**, depending on the motion or on the thing moving; students think the motion of wind is inherently different from motions that require fuel:

Ann: I think she's saying, in order for it to be perpetual motion, it has to have the wind.

Donna: It has to have wind (nodding). Not... a fuel source.

Ann: And that's what *she's* saying perpetual motion is. So of course the bus doesn't have perpetual motion, because it doesn't need wind. To move.

Donna: Or it doesn't *use* wind.

Ann: It doesn't *use* wind.

This characterization of possible student thinking is a hybrid of the previous two; at this point, the teachers are considering whether students might be intending to use one or the other relationship between motion and energy in different physical scenarios. This division of scenarios into two categories is restated by another teacher later in the discussion:

Mark: And, the bus *doesn't* have perpetual motion, because it will run out of gas.

As with Donna's statements above, Mark's statement is characterizing student thinking, not describing his own. This characterization is consistent with the one described by Donna and Ann; rather than proposing a new model here, Mark is applying the model described by Donna and Ann to further interpret the meaning of student statements.

The students in the video do not explain what they mean by perpetual motion, or why they believe the bus does not have it. In each of these excerpts of teacher discourse, the teachers are synthesizing evidence from a number of classroom interactions to develop a model of student thinking. This model can then be used both to interpret student statements (e.g., what does the student mean when she says the bus does not have perpetual motion?) and to predict what students might say in response to new questions (e.g., *why* doesn't a bus have perpetual motion?).

While we understand teachers to be proposing models of student understanding based on evidence in the video, neither the teachers nor the participating researchers explicitly identified creation of models of student thinking as a goal at the time; the segment of discussion recorded in the T video was initiated by a researcher posing a Level 2 question about the meaning of a specific student statement. Because of this lack of alignment between discussion prompt and observed activity, it is not clear whether teachers are trying out different models for the group consensus understanding (if there was consensus), or

characterizing different understandings of individual students.

DISCUSSION

We find evidence in the T video that teachers viewing video of students are engaging in sophisticated discourse about student thinking, which supports development of PFA skills by allowing teachers opportunities to selectively attend to and reason about evidence of student understanding. If it is true, as Erickson [1] suggests, that PFA of student learning is both under-supported and under-researched, then video-based professional development is a promising context for providing both support for teachers and data for researchers.

Previous studies of one-year video clubs for mathematics teachers have reported a significant shift in teacher discourse about student thinking, from primarily Level 1 to majority Level 3 by the end of the year [3,6]. While we have not yet analyzed the video of many of our professional development sessions, our initial impression is that we are not seeing as high a percentage of Level 3 discourse as is reported in these studies. This could be influenced by the more removed nature of the video viewed in our professional development sessions: most teachers in our course did not observe video of their own classrooms. We wonder if explicitly introducing teachers to Sherin and Han's framework for discourse about student thinking [3] would support more extensive engagement in complex high-level discussion about student understanding.

ACKNOWLEDGMENTS

This work was supported in part by the National Science Foundation (Grant No. DRL 0822342).

REFERENCES

1. F. Erickson, "Some Thoughts on 'Proximal' Formative Assessment of Student Learning," in *Evidence and Decision Making*, edited by P. Moss, pp. 186-216 (2007).
2. M. Heritage, "Formative Assessment and Next-Generation Assessment Systems," Washington, DC: Council of Chief State School Officers (2010).
1. M. Sherin & S. Han, *Teaching and Teacher Education*, **20**, 163-183 (2004).
2. C. Goodwin, *Am. Anthropologist* **96**(3), 606-633 (1994).
5. M. Sherin, "Developing a Professional Vision of Classroom Events," in *Beyond Classical Pedagogy: Teaching Elementary School Mathematics*, edited by T. Wood, B. S. Nelson, & J. Warfield, pp. 75-93 (2001).
6. M. Sherin & E. van Es, *Journal of Teacher Education*, **60**(1), 20-37 (2009).