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Mathematics teachers learning with video: the role, for the didactician, of a heightened listening

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Abstract This article addresses two main questions, how do mathematics teachers learn from using video? and, what is the role of the didactician? A common problem is reported in the difficulty of keeping teacher discussion of video away from judgment and evaluation. A review of mathematics education literature revealed four existing models for the use of video with teachers. Drawing on enactivist ideas (Rosch 1999), there are reasons why these models are likely to be productive and therefore suggestions for how teachers can learn from video. However, little is known about the role of the didactician in supporting learning. From empirical data, there is evidence that didacticians need to engage in a particular form of attention that I label a 'heightened listening' since there are simultaneous foci (on the content of teachers' contributions and what kind of a comment is being made), in order to establish discussion norms and to support the development of new ways of seeing and acting in the classroom.

1 Introduction

Although there has been substantial research into the use of video to support mathematics teacher learning, little is known about the skills needed to support such learning. The focus of this article is on the role of the didactician and how discussion amongst teachers about video recordings of lessons can become effective. Following Jaworski (2004), a didactician is defined as anyone who is involved in theorizing the learning and teaching of mathematics, developing awareness in these areas. In particular, didacticians include anyone involved in working with teachers to support learning about teaching mathematics.

2 Research on using video with mathematics teachers

There have been a significant number of studies into the use of video or multi-media resources to support teacher learning, since the 1990s. Many studies report positive effects of such resources (Lampert and Ball 1990; Bitter and Hatfield 1994; Sullivan and Mousley 1996; Herrington, Herrington, Sparrow and Oliver 1998; Kim, Sharp and Thompson 1998; Goldman 2001; Skiera and Stirling 2004). However, few studies have looked into the detail of discussions amongst teachers nor the role of a didactician. For example, in some of the studies above, the teachers involved made private use of multi-media materials. Sherin (2007) conducted a review of different uses of video, noting mixed findings about the benefit and suggesting more empirical work is needed to understand the role of

video in supporting teacher learning. A similar conclusion is reached by a more recent review of research done in the context of using video with prospective teachers:

> the use of video is mostly described in quite general terms; when in fact, it is the details of how video is integrated into instruction that seem to determine its effectiveness (Blomberg et al., 2013, p.94)

The authors continue: 'there is little research on how to use video in order to systematically support the learning of [prospective] teachers' (ibid). Again, confirming the importance of how video is used, Borko et al. (2011) conclude:

> [o]ne key component of planning, in addition to selecting the video clip, is deciding how to engage teachers with the video—how to guide their explorations of the mathematics, instructional practices, and student thinking; and how to establish community and orchestrate productive conversations (p.185)

There is a need therefore to address two questions that are the main focus of this article: how can mathematics teachers learn from using video? and, what is the role of the didactician in facilitating learning from video? Blomberg et al. (2013) have begun to address these questions. They propose five heuristics for using video with prospective teachers, which are: (1) identify learning goals; (2) choose instructional approach; (3) choose video material; (4) address limitations; (5) align assessment to instruction/goals (from p.95). The focus of this literature review is on the second heuristic, choice of instructional approach, and what can be said about different approaches, independent of their specific learning goals.

2.1 A common problem

There is some consensus that, to make effective use of video with teachers, the didactician needs to establish discussion norms to try and ensure that talk is reflective and questioning (Brophy 2007; van Es and Sherin 2002). However, an issue reported as far back as 1990, is that it can be hard to shift discussion out of evaluations and judgments of what is on the video recording (Jaworski 1990; Nemirovsky, Dimattia, Ribeiro, and Lara-Meloy 2005; van Es and Sherin 2008). In other words, establishing reflective and questioning discussion norms can be problematic. Drawing on an empirical study of teacher talk, Nemirovsky et al. distinguish: 'Grounded Narrative whose aim is to articulate descriptions of classroom events', from: 'Evaluative Discourse' which 'centers on the values, virtues and commitments in play' (2005, p.365). They conclude: 'Evaluative Discourse is in our experience, by far, the most prevalent mode used in conversation about videotaped teaching episodes' (Nemirovsky et al. 2005 p.388). Jaworski (1990) gives examples of the kinds of comment that constitute barriers to valuable discussion:

> 'He was railroading them — they didn't have a chance to think for themselves.'
>
> 'I couldn't do that with my pupils, they can't work quietly enough;' 'they're not intelligent enough;' 'they don't wear uniform;' 'we can't arrange the classroom like that;' etc.

'I could never do that — I just don't have the right sort of personality.' (1990, p.63)

All these comments are examples of 'evaluative discourse'. As Jaworski (1990) reported, the problem is that if comments such as those above are made by the first speaker in discussion of a video clip, then those comments can influence the rest of the discussion and result in little of value taking place for the participants.

2.2 Four models for using video

Given the findings above, it was important to conduct a review of mathematics education literature on the use of video in working with prospective or in-service teachers, to look into instructional approaches that offer ways through the problem of evaluative talk. This review involved searching six major journals within mathematics education: ZDM – The International Journal on Mathematics Education, the Journal of Mathematics Teacher Education, Educational Studies in Mathematics, For the Learning of Mathematics, the Journal for Research in Mathematics Education and the Mathematics Education Research Journal. Using their online archives, a search on all articles with 'video' in the title gave 25 matches, of which 14 were about using video with teachers. After reviewing these articles, common references were followed up, in order to broaden the review to books and journals outside mathematics education. From this search, which is not claimed to be exhaustive, there were four explicit models for using video with teachers (see Table 1). These models will now be described, in turn, and compared and contrasted.

Table 1 Four models for using video with mathematics teachers

Open University (OU)	Learning to Notice	Videos as Tools	Lesson Analysis
Jaworski 1990	van Es and Sherin 2002, 2008, 2010; Star and Strickland 2008; Alsawaie and Alghazo 2010	Maher 2008; Maher, Landis and Palius 2010	Santagata and Angelici 2010; Santagata and Guarino 2011

A particular practice was developed at the OU to overcome the difficulty of evaluative talk raised by Jaworski (1990). The theoretical basis of this practice was rooted in Mason's (1996, 2002) distinction between 'accounts of' and 'accounts for' data. Mason himself (personal communication) developed the OU method by adapting the pioneering work done with mathematical film for the learning of mathematics by Gattegno (1965). Accounts *of* phenomena aim to report on them as directly as possible, avoiding interpretations, judgments or evaluations. Accounts *for* phenomena aim to explain what is perceived or interpret it, for example by classifying. Nemirovsky et al.'s (2005) 'grounded narrative' appears to be equivalent to accounts *of*, and their 'evaluative discourse' as one type of account *for*.

With the OU method, the didactician selects a 3-minute continuous clip of video. Having watched the clip, the first task for teachers is to try and reconstruct what took place on this clip, giving an account of what was observed. The teachers work together to try and agree the detail of what was said or done. This reconstruction will, at some point, involve re-watching the video clip, for example to resolve a disagreement in what participants heard. The didactician may need to keep discussion focused on accounts *of*, and cut short any straying into accounts *for*. Only after the reconstruction phase does the didactician move discussion on to an interpretation of what occurred on the clip, for example identifying what teaching strategies were being used, or some other focus such as students' mathematical thinking. The OU method is therefore essentially a two-stage process, starting discussion with accounts of and only later moving to accounts for. There is evidence (Coles 2013a) that this practice is effective in ensuring that teacher discussion does not become evaluative.

In the Learning to Notice framework, van Es and Sherin (2008) describe a three-stage process they use to promote learning from watching video that centres around the development of the skill of 'noticing'. In this framework, the skill of 'noticing' consists of three main aspects, '(a) identifying what is important in a teaching situation; (b) using what one knows about the context to reason about a situation; and (c) making connections between specific events and broader principles of teaching and learning' (van Es and Sherin 2008, p.245). In keeping with the OU method of using video, van Es and Sherin suggest:

> While teaching certainly involves making judgments about what went well or poorly in a lesson, we believe it is critical for teachers to first notice what is significant in a classroom interaction, then interpret that event, and then use those interpretations to inform their pedagogical decisions. (2008, p.247)

Star and Strickland (2008) developed the Learning to Notice framework and introduced a first task, having shown a video, which was to engage teachers in a 'what did you notice' questionnaire, before re-playing the clip. Star and Srickland's work brings this framework into close alignment with the OU method, in beginning work on video with a focus on the detail of events, to aid noticing, before moving to interpretation.

In both the Videos as Tools method and Lesson Analysis framework, there is no explicit mention of didacticians focusing teachers on the detail of events in the video clip, but both share a similar pre-watching process. In the Lesson Analysis framework, before any video watching, the teachers who will do the viewing and the didactician work on the mathematics the students in the video are using. The didactician models some of the teaching strategies that can be seen on the clip, for example, getting someone to the board to demonstrate an idea to the others. The discussion then proceeds via a variety of prompts (Santagata and Guarino 2011, p.133).

The Videos as Tools method is part of a year long professional development programme with teachers, involving repeated intervention cycles each with four components: '(1) *teachers doing mathematics*,

(2) *teachers studying videos of children doing mathematics*, (3) *teachers implementing in their classrooms*, and (4) *teachers analysing their students' work*.' (Maher et al. 2010, p.4)

Of relevance to this article, is component (2) of the model, when using video with teachers. The similarity here to the Lesson Analysis framework, is a pre-watching activity of working on the same mathematics the students are engaged in on the video recording. With the Videos as Tools and Lesson Analysis models, although there is no specific mention of a strategy of getting teachers to focus on a reconstruction of events, the pre-watching activities are likely to have the effect of sensitising teachers to be able to make more detailed distinctions in their viewing than would otherwise have been possible. So, it could be argued that all four models, in different ways, encourage teachers to avoid evaluative discourse via supporting perception of the detail of events on any video clip being viewed.

Following this brief summary of research, the next section sets out the theoretical perspective of the article, that is used initially to offer a lighting on the review above, and then to analyse the results of an empirical study into the use of video for teacher learning.

3 Theoretical perspective

I bring an enactivist stance (Varela, Thompson and Rosch 1991; Reid 1996; Brown and Coles 2012) towards research, which has implications for my view of the learning process. One strand behind the emergence of enactivism as an epistemology was the biological insight of Maturana and Varela (1987), who argued against the common sense notion that our brains operate via representations of the world. When we perceive, they claim we do not create an internal model in our brains, operate mentally on this model and then act. Rather, in the vast majority of our lives, we have developed automated behaviours that require no conscious deliberation (examples might range from managing our heart beat, to driving a car, to solving a linear equation). Our perception links directly to action In fact, it is true to an enactivist perspective to say that our perception is a *form* of action. The inseparability of perception and action is perhaps obvious in the case of touch, on the enactive view, such inseparability is true for all the other modes. We move our eyes and head in choosing where to look and make active choices about whether to place our attention. Such choices are mostly unconscious and it is only when our smooth perception-action-in-the-world breaks down for some reason (the car ahead moves erratically, the equation does not fall out easily) that we employ conscious deliberation. The aim of this conscious deliberation, however, is to return us to a state of unconscious competence. In other words, the aim of cognition (whether conscious or not) is to maintain smooth functioning in our environment. Hence, Maturana and Varela (1987) state, 'cognition is effective action**,** an action that will enable a living being to continue its existence in a definite environment' (1987, p. 29). An action is effective if it allows me to continue operating in a specific context. Knowing, which requires cognition, is therefore also equated with effective action. We credit someone with knowing what they are doing if we see them acting smoothly and effectively, maintaining whatever relationships are important in that context (keeping the car on the road, finding the solutions to equations). Knowing cannot be separated from the

knower nor the context in which the knower acts, hence, '[a]ll doing is knowing and all knowing is doing' (Maturana and Varela 1987, p.27). Since other people are usually a major element of the context in which we act, enactivism is a profoundly social theory. The enactivist view of knowledge has implications for the carrying out of research.

The aim of enactivist research is to arrive at theories that are 'good enough for' (Reid 1996, p.208) the purposes of their users, supporting the development of new awarenesses or distinctions and supporting effective actions. From an enactivist perspective, learning is equated with the development of new distinctions, new ways of seeing and hence new ways of acting (effectively) in a given context. The aim of research, therefore, is to support or 'occasion' (i.e., make possible the emergence of) learning (see Brown and Coles 2011). A key mechanism for arriving at theory is the search for pattern, or the 'pattern which connects' (Bateson 1979, p.8). For enactivist research, the start of any interrogation of data is to dwell in its detail (Coles 2009), trying to avoid interpretation and allowing for the noticing of pattern from this detail (for example, the repetition of a word, phrase, or response). We cannot separate ourselves from what we notice, and two people will not perceive the same event in the same way, as a result of their different histories of acting in the world; but, through seeking multiple views of the data (e.g., collaborating with different researchers, or interrogating data with a different focus) we always return to what is observable, in deriving interpretations.

For the purposes of this article, the key idea used to analyse research findings comes from the work of the enactivist author, Rosch (1999), on categories. Rosch (1999) distinguished three kinds of categories that we, as humans, use to talk (with acknowledgement to David Reid for the animal examples!).

Table 2 Rosch's categories

Layer of abstraction	Example	Example in the context of working on video with teachers
Detail/behaviour layer	my pet 'Chino'	A detailed description of an observation e.g., 'I think Teacher A said ... then a student said …'.
Basic level category	dog	An easily stated label, linked to action. This could be a familiar category linked to familiar ways of acting (e.g., 'students were disengaged'), or potentially a new label/issue, arising from detailed observation.
Superordinate category	animal	A 'philosophical' concept or interpretation, not directly observable e.g., 'The teacher seems to respect the students' autonomy'. Discussion at this level is unlikely to impinge on practice.

One of Rosch's insights is that, as humans, we tend to pitch our discourse at the basic level. It is usually easier to talk about 'dogs', 'tables', 'students', rather than either the more abstract labels

'animal', 'furniture', 'humans', or the more detailed particular examples. Words at the basic level are the most abstract words that are still associated with similar actions. We tend to do the same things with 'tables' (eat or work off them) but not with the more abstract 'furniture'. I work with prospective teachers as they learn about teaching. After a lesson, prospective teachers often talk about the 'students' as a group. At the start of their journey into the profession, they may have performed similar actions in relation to all students, in some cases not aware of individual differences. Over time, as they become more skilled, they become more able to notice details and specifics about individuals and their responses to students become more attuned to differences between individuals. The word 'student' might then start shifting from a basic level to a superordinate category as prospective teachers develop new basic level categories, noticing common features and developing common responses in relation to, for example, categories such as: 'highly engaged student' or 'off task student' or 'student operating with a misconception'. Rosch's categories are not fixed and, over time, as we become more expert in any field we able to make finer and finer distinctions and develop categories that novices do not have (Brown and Coles 2011). A student new to algebra may see "$x + y = 3$" as a puzzle with two solutions (x=1, y=2 or x=2, y=1). A slightly more experienced student may be aware of an infinity of solutions (e.g., including negative numbers). A mathematician might see in this simple statement: an operation; a gradient; a vector; a graph, and more. What gets called forth depends on the context and what question is being asked. There are distinctions a mathematician is able to make (e.g., the relationship between x and y is 'linear') that are not available to others. Rosch's enactive view of categories has important theoretical implications for working with video, which will now be drawn on to analyse the results of the literature review and then to analyse the results of an empirical study into the use of video.

4 An enactivist analysis of how mathematics teachers learn from video

The review of literature in section 2 pointed to a common research finding that teachers learn from video by engaging in a process that makes evaluative discourse unlikely. This process either involves an explicit focus by the didactician on getting teachers to discuss the detail of events after watching the clip, or else engaging in pre-watching activities that sensitise teachers to noticing the detail of events. The enactivist category theory of Rosch helps makes sense of why these practices are likely to be successful in terms of supporting teachers to develop new actions in their own classrooms.

Rosch suggests that, by default, as humans we will pitch our discourse at the basic level category layer. What Jaworski (1990, p.63), Nemirovsky et al. (2005, p.388) and van Es and Sherin (2008, p.264) can be interpreted as reporting, in the difficulties of working with teachers on video, is that evaluative discourse is so common because it tends to be at the basic level. Looking again at Jaworski's (1990) description of typical responses to video, the labels are at this basic level, invoking 'my pupils' as a group and ideas such as 'intelligence' with the implication that certain levels of intelligence allow certain kinds of action. These basic level categories are the easiest words to use; but, if we begin our descriptions at this layer, the words we use are strongly linked to ways of seeing and actions we *already* perform in the classroom, and the possibilities for learning are limited. Other examples of basic

level (and evaluative) comments about a lesson might be: 'the students seemed lively'; or 'there was a lot of confusion'. Labels such as 'lively' and 'confusion' will be linked, for experienced teachers, to well-established patterns of behaviour in a classroom, yet by interpreting events at this level of generality there is little scope for noticing anything that may allow new distinctions to be made, or an extension to established patterns of acting. An absence of new distinctions being made is exactly the kind of behaviour reported by Jaworski (1990), when teachers 'invest all of their energy in interpretation and judgment of the acts and intentions of the particular teacher of the video' (1990, p.63). Concepts such as 'railroading', 'intelligence' or 'personality' cannot be observed directly on video, they are interpretations that may tell us more about the speaker than anything they observed.

The discipline of beginning with a reconstruction of events (used by the OU and Learning to Notice methods) forces discourse into the detail layer, which will be 'grounded', to use Nemirovsky et al.'s (2005) label. From there, generalisations have the possibility of identifying *new* labels, concepts or categories and there is the possibility that these new labels (which will be at the basic level) can become associated with *new* actions in the classroom. It is the arising of possibilities for new or different ways of acting that, from an enactivist perspective, is the mark of learning.

When the didactician, using the OU method, moves discussion from a reconstruction of events, to accounting *for* events, there is the possibility of making new connections. One element of Rosch's work is that basic level categories are the *most* abstract words that are still associated with similar actions. Therefore, if discussion has begun at the detail layer and allowed the identification of new basic level categories, it would not help if there were another shift in abstraction to Rosch's superordinate layer, since superordinate categories are not linked strongly to the detail/behaviour layer. In other words, if discussion of video moves into the realm of the philosophy of teaching, or of mathematics, it is likely that teachers will not be left with practical strategies to try out. However, if there has been an identification of basic level categories, these words can get linked directly to a range of actions in the classrooms and hence can support teachers in acting differently in their classrooms.

It is therefore possible to answer, from a theoretical perspective, the first question in this article of how mathematics teachers learn from video. Teachers can learn from video if there is a discussion norm that ensures they firstly focus on the detail of behaviours/events, and then generalise from that detail to arrive at new labels or descriptions, at a more abstract, basic level (but not at the superordinate level). This description is easier said than done and there are considerable demands on the facilitator of discussion, the didactician, if work on video is to result in the development of new distinctions. The second question addressed in this article is the role of the didactician in supporting teacher learning from video.

5. An enactivist analysis of the role of the didactician in facilitating learning

There is a research gap in that the four models quoted in section 2.2 have little detail to offer about the role of the didactician, while at the same time acknowledging the centrality of the role if discussion is to be productive. My own practice of working with teachers on video was strongly influenced by consciously adopting the OU method. One reason for this choice was experience, as a teacher, working with students on the films of Nicolet (see Tahta 1980) and using Gattegno's (1965) method, on which the OU method was based. I was introduced to the mathematical films of Caleb Gattegno and Jean Nicolet through membership of a working group of the UK's Association of Teachers of Mathematics. Gattegno had developed a particular way of using mathematical film in which after watching a short animated sequence, the first task for students is to try and re-create in their minds the events of the film. Gattegno's and Nicolet's films typically deal with geometrical aspects of the curriculum (for example providing an introduction to trigonometry, or a treatment of circle theorems). Students try, communally, to re-create the images they have seen, with the teacher at some point re-playing the film, for example to resolve a difference of opinion that has arisen. Typically, the video viewing will raise questions that can then be pursued by students using pen and paper. This method was powerful in terms of student learning and so it was perhaps natural to adopt the OU method when working with teachers on video.

The remainder of Section 5 draws on an empirical study, which took place in one school in the UK, as part of which I collected audio data of teacher discussions of video clips (see Coles 2013b for a write up of the whole study). For this article, I returned to the audio data to re-analyse it in terms of the role of the didactician.

5.1 Research study methodology

The use of a single study to draw out more general themes is an example of Krainer's method of 'particularization' (2011, p.52). The study used an enactivist methodology (Coles 2013b). Data was taken over two academic years, 2007-08 and 2008-09 in a school where I was the head of the mathematics department, whilst at the same time undertaking research. A practice I encouraged was the taking and watching (amongst staff) of video recordings of lessons. On three occasions between 2007 and 2009, I gave over a department meeting to the watching of a clip from one of these videos (the lessons were given by three different teachers, one of whom was me). I would choose a small section of the lesson video as the focus of discussion. In selecting the clip, I looked out for times during a whole class discussion when the pattern of talk appeared to get disrupted for a while. There had been an agreement amongst the staff to focus our own development activities on 'ways of managing pupil talk'. However, in adopting the OU method, I was not concerned if what teachers noticed and discussed touched on different issues, which at times it did.

As part of the original study the three teacher discussions were transcribed, split into episodes and characterized, according to different kinds of either grounded or evaluative discourse. Ten different kinds of episode were identified, for example: 'reconstruction'; 'linking to own practice'; 'naming a strategy'; 'metacomment'. The purpose of this characterization was simply to aid the noticing of

pattern, for example it became apparent (and was not a surprise, given that I was using the OU method) that all the 'reconstruction' episodes happened at the start of the discussion.

Since the focus now is on the role of the didactician, I re-looked at the transcripts, searching for patterns in my own contributions across different episodes. What similarities or differences were there in my contributions, given the type of episode they were in? or, in relation to what had just been said? The focus here is on contributions during episodes of 'reconstruction' and then of 'metacomment', since these are the most relevant to the theoretical ideas from sections 2, 3 and 4. It is particularly in reconstruction episodes (at the start of discussion) that there can be a need to establish discussion norms, and metacommenting episodes give access to some of the complexity of the role of the didactician in using the OU method. What emerges from the analysis is a pattern in terms of the listening of the didactician. The issue of teacher listening has received attention within mathematics education (Davis 1996; Coles 2001; Mason and Houssart 2009) but there are no studies I know that problematize the issue of the listening of didacticians working with teachers.

5.2 Didactician responses when 'reconstructing'

During reconstruction episodes there were three patterns in the kinds of comment I would make: (1) 'supporting grounded narrative'; (2) 'asking a question' (which could be seen as a subset of supporting grounded narrative); and, (3) a pattern around ways of responding to evaluative discourse. No special claims are made about this characterisation, it is used here in order to allow an analysis of groups of my comments in relation to Rosch's categories. Each pattern will be exemplified and analysed in turn.

5.2.1 Supporting grounded narrative

In the transcript below, the group of teachers was discussing part of a video clip in which students had suggested a range of answers to a set of six questions. Students' answers had been written on a board by the teacher and, for each question, one answer had been 'agreed' and circled as the one favoured by the majority of the class, following a vote. The discussions have been edited to remove details that do not make sense without more of a context but hopefully retaining a sense of *how* the teachers were talking. In the transcription, punctuation is avoided and the following notation adopted: (.) pause of less that one second; (1) pause of 1 second; / / overlapping speech; […] section of talk removed; *italics* for words spoken as if in the voice of another; TK is Teacher K, etc; AC is Alf Coles. The date of the teacher discussion is given after all transcripts.

1 TK   […] the first thing I remember is the discussion you had (.) had about the things you should do if you don't get one of these answers and I wrote down three suggestions (.) the kids came up with three things […]

2 AC   yes (.) was there something about what are you going to do if you haven't got /one of

3 TG   /one of these

4 AC	one that's circled or something
5 TG	yes
6 TR	there was some sort of voting about […]
7 AC	that's right they voted and I think
8 TG	so if you don't get one of these (.) what can you do
9 TR	one was use a calculator to check it
10 TA	that was the third one (14/09/07)

In this small section, the talk is at Rosch's detail layer of description. In line 1, TK talks about what he remembered about where the class discussion on the video began, TK suggests there were three suggestions that had come from students. I respond (line 2) by agreeing with the suggestion that discussion began with: what to do if you have not got an agreed answer (these answers were circled on the board). More detail is elicited, TG (line 8) supplies a form of words that the teacher on the video may have used: 'so if you don't get one of these (.) what can you do'. TR (line 9) then offers one of the student ideas and TA (line 10) suggests this idea was the third of the suggestions. I do not interpret any of the talk in this transcript being at Rosch's basic or abstract layer, except perhaps in the use of the phrase 'the kids' by TK (line 1). The recording was such that it was not possible to distinguish who said what amongst the students, i.e., the use of this relatively general term was perhaps more of inevitability than an unwarranted abstraction.

I can be seen in this transcript to be offering positive responses in relation to the detailed comments of others 'yes' (line 2), 'that's right' (line 7) and also hedging my own contributions 'there was something about […]' (line 2), '[…] or something' (line 4), '[…] I think' (line 7). I express a lack of certainty in my own reconstruction.

5.2.2 Asking a question

The transcript below begins with TL referring to a section of video in which a student had been talking, and the teacher had been writing on the board. TL is musing on the way in which these parallel activities were synchronized.

1 TL	[…] when the first person was talking […] you wrote something up and I can't remember if that happens (.) you're doing that at the same time (.) or had they finished and then you put it up (.) because I got the sense of either it was you two working together and you put it up at the same time or (.) um you were kind of translating what she was saying
2 AC	it might be [something] we can go back and possibly look at that clip again I mean has anybody got a sense of that what happened next as she was talking (.) yeah she was talking […] and TA was writing in some kind of synchronization I'm not quite

sure what (.) what what's (.) where did it go from there (1) does anybody have a

sense about TL's question (.) were they in step or was TA translating (14/09/07)

As in the first example, discussion here is focused on the detail layer (the detail of the mathematics has again been omitted from the transcript). TL raises an issue that she is unsure about – did TA (the teacher on the video clip) write on the board as the student was talking or was there some translation by the teacher (and hence, the words on the board going up after the student stopped speaking). In line 2, I initially raise the possibility of re-watching the clip in order to answer TL's dilemma and ask 'has anybody else got a sense […]' then, as in the first transcript, hedge my own reconstruction 'I'm not quite sure'. In Coles (2013a) I discuss looking out for differences of opinion about the clip, or questions about what happened, in order to motivate re-watching the video clip. I can be seen here to be flagging up that what TL said in line 1 could provide such a motivation.

5.2.3 Dealing with evaluative discourse

Looking across the three teacher discussions, there are some examples of evaluative discourse interrupting a reconstruction episode. The following quotations exemplify the range of evaluative comment from the start of discussions.

I started writing it down but then I gave up (14/09/07)

what you said wasn't as clear as what she said (4/4/08)

you know she was actually quite (.) she was very fluent in her description of what she found (14/09/07)

like what they seem to be playing around with is different ways of working out the area (15/05/09)

student S's just thought *you've got to work out the area of these two triangle bits and take them away* and (.) because she's got in her mind you've got to make out the area of the whole square (4/4/08)

These quotations are not grounded narrative, at Rosch's detail layer, but for different reasons. The first two comments are evaluative (judgmental) of the task or the teacher on the clip. The first comment is not an offer of a reconstruction of an event on the video clip, but a comment *about* the speaker's engagement with the task of reconstruction, with an evaluation that the task is too hard: 'I gave up'. The second comment is an evaluation of the clarity of the words spoken in the video, not a reconstruction of what those words were.

The third and fourth comments stray from the detail of reconstruction by moving into basic level descriptions of events. The third comment includes the word 'fluent' and the fourth comment, the phrase 'playing around'. Unless these words are defined carefully in advance, it is impossible to know

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what these teachers are referring to in the clip. A word like 'fluent' implies an abstraction from the events of the video clip and a placing of some of these events within a basic level category.

The fifth and final comment is an example of over-interpreting the events on the video. We simply can have no idea what student S has in her mind, so when there is a suggestion of what S may have been thinking, discussion is being taken away from the detailed reconstruction of events.

The comments above avoid the detail in different ways, either through judgment, abstraction or interpretation. When such comments occur at the start of a discussion, there is a need for some response (either from the didactician, or another teacher in the group) in order to return discussion to the task of giving and account *of* events. One possibility is to re-direct discussion to a particular point in the video clip:

AC   could we go back to student S's first thing (.) because there are three explanations of the same thing (4/4/08)

Another possibility is to try and support an individual who has perhaps been interrupted, and re-state the task of reconstructing 'what happened' or what was said:

AC   so (.) go on TM (.) what did you hear TL saying (4/4/08)

In both these comments, discussion had begun straying away from the detail and I make an implicit invitation to return to the reconstruction task. A further possibility for response is to be explicit about the evaluative nature of what has just been said before re-directing discussion. My own practice as a didactician has developed since the audio recordings in the study. I cannot be seen making explicit comments that someone has strayed from the task of reconstruction and there are occasions (particularly the fifth of the comments above) when I think I would now respond differently, for example, saying:

I want to interrupt you there (.) you are beginning to stray into your interpretation of events and we will come on to that later (.) can we stay for now with the detail of what happened

It might be argued that I would be responding to an evaluation, with another evaluation. However, there is a difference. The five non-grounded comments above were all examples of evaluations of the video (in different ways). What I offer in response is an evaluation not of the video, but of the comment. Part of the role of the didactician is to take responsibility for the type of discussion that is had about video and in order to keep this discussion away from evaluation of the video, there may need to be some evaluation of the discussion itself.

One reason for the absence of my own evaluative statements about other teacher's comments across the three transcripts may have been that the group of teachers were used to working with video and were generally aware of the discipline of beginning with a reconstruction of events. On several occasions, following an evaluative comment, a member of the group simply responds by returning discussion to the detail, or the group laughs and then returns to reconstruction. I am aware that it is when working with a group on video for the first time that my own explicit comments are most needed, in order to highlight a contribution that has moved away from reconstruction into interpretation and to establish the discussion norm.

5.3 Discussion

Across the three sets of examples concerning didactician responses I can be seen to act differently depending on the *kind* of comment said by a teacher. In the first, reconstruction, stage of discussion when a teacher offers a comment that is in the detail of events, I can be seen to encourage with positive statements, inviting further elaboration. When a teacher raises a question, I can be seen to flag the issue raised as a possible reason to re-watch the video before again inviting further elaboration. When evaluative comments are made, I re-focus the discussion back onto the detail of events.

In order to be able to respond in the ways detailed above, my listening and attention must *simultaneously* be on what teachers are saying and what *kind* of a thing they are saying. The evidence from the transcripts is that I am sensitive to when comments made by teachers are at Rosch's detail layer and when they stray into evaluation. I am aware of part of my attention being taken by a monitoring of the way discussion is going. I know I am alert to any comment that moves into judgment, abstraction or interpretation at the start of discussion of video. I also know that I am prepared to act on the awareness of these differences, in order to provide a boundary for the discussion norm. This is not, for me anyway, a normal form of listening, and I propose the label 'heightened listening' to try and capture the sense of needing to consciously work on paying attention in a different manner.

My own practice using video and the sensitivity of my own listening continues to develop – as mentioned above, there are comments on the transcript that I would now respond to differently. 'Heightened listening' does not capture a fixed or stable capacity but more, an attitude of the didactician becoming vulnerable to what is said. Through reflection on discussions (for example, via audio recordings) it is possible to make distinctions in retrospect that were not made at the time. I now hear some evaluative comments in the transcripts of discussion of video that I did not notice at the time. Such work of reflecting supports the making of distinctions in the future and hence supports the development of my own capacity for heightened listening.

The next section looks at didactician responses during episodes of 'metacommenting', again analysed first in relation to Rosch's categories and then discussed.

5.4 Didactician responses when 'metacommenting'

As part of the OU method for working with video, mirrored in van Es and Sherin's (2008) work on noticing, there is a need in the later stages of discussion to move to an interpretation of events, to support possibilities for new actions, arising from working with video. I see the purpose of the move to interpretation as linked to arriving at new labels or categories, which can support teachers in new actions in the classroom. If discussion has been kept at the detail layer in the early stages, there is the possibility that, from this detail, *new* labels at the basic level may emerge (that Brown (2005) would call 'purposes'). I focus now, more briefly due to limitations of space, on my responses in a metacommenting episode from each of the three video discussions.

In the first discussion, one teacher had been talking about how the teacher of the video (TA) had managed to sort out a student dilemma but showing how the students themselves could resolve the issue.

> that's lovely (.) and it's a much more enabling sorting out (.) because if we just sort it out by answering the issue then the next time pupils come up with this issue they have no (.) they're in no better position to decide (.) the only resource they've got is to ask TA (.) but if you sort it out by making them aware this is an issue and making them aware there are consequences for each one and whatever (.) that is offering them a tool for next time they get into that situation (.) so yeah I love that (14/09/07)

My comment, in this turn, is *about* what had just been said and so is a *meta*-comment. I offer a label 'enabling sorting out' to summarise what I hear one teacher as saying. The teacher in the turn before this had been describing their interpretation of what TA had done on the video, using some basic level categories, what I do is to condense the insight I hear into a short label (or 'purpose'). This label is an abstraction from the detail of discussion and so is at the basic level. Such labels can allow a new interpretation or perception of events on the video clip and, hence, learning. To be useful longer term, such labels need to be worked on, for example, by consciously trying, as a teacher, to sort out difficulties of students in an 'enabling' manner. In the discussion below, I pick up on the issue of how such labels can support longer-term development.

In the second video discussion, several teachers discuss an image that was used with the students and how it somehow already contained the 'answer' the students needed to know. After several comments, I say:

> […] I think that's a really interesting way of describing […] the image *having the answer* (.) and that could be something that people (.) that people work on (4/4/08)

This contribution is a metacomment because it is a comment about the discussion, identifying a (basic level) commonality in what is being discussed. The label ('the image having the answer') emerging from the detail of discussion provides a new category at the basic level (the idea had not arisen before in discussion). This new label provides a new way of seeing the image on the video clip and can

become linked to new ways of acting in the classroom (for example, as a teacher I might consciously plan to find and make use of images that 'have the answer' within them).

In the third discussion, following several teachers offering their interpretations of events on the video, I make the (meta)-comment:

> so there's a strategy there (.) what's the strategy there then (15/05/09)

In this instance, I do not offer a basic level category summarizing or condensing the discussion, but invite someone else to (which in fact someone does in the next turn), flagging up that I see a sameness in what is being discussed, without naming the strategy.

5.5 Discussion

In the three excerpts above, each from different video discussions, the fact I am metacommenting indicates I am sensitive to the *kind* of comment being said as well as to the content, since a metacomment is a comment about what kind of a thing has just been said. Hence, these comments are examples of a heightened listening, but of a different form. In the reconstruction episodes, the heightened listening took the form of differentiating between detailed and evaluative comments and responding differently to each category. In the metacommenting episodes, I appear to be attuned to noticing kinds of comments that could be linked to a *new* category. So whereas in the reconstruction phase, a heightened listening allows a distinction between an existing categorization (detailed versus evaluative), in the later episodes, the grouping or categorising is made in the moment. In the comments above, I elaborate on a single teacher's contribution, offer a label summarizing comments from several teachers and flag up that a common issue is being discussed without offering a label. In each case, there is attention to the content of what is said and to the fact that this content can be linked to a more abstract, basic level category. For this to happen not only must the didactician listen in such a way as to be aware of the content and the kind of comment being made, but also be aware of similarities in the kinds of comment being offered and be ready to provide a label to capture this similarity.

As with my own learning in relation to distinguishing detailed talk from evaluation, my capacity for heightened listening during reconstruction phases of discussion continues to develop. The form of listening required in this second phase is more sophisticated in that a new categorization is required if a new basic level category is to emerge from discussion. The didactician must be sensitive to potential categories and the potential similarities in what is said. In my own teaching, I recognize the power of having a 'purpose' in mind during planning or in the classroom (see Brown and Coles, 2008). Having worked with purposes (basic level categories) such as 'using silence' in my teaching (e.g., planning lesson starts when I would be deliberately silent and, say, offering images on the board), no doubt makes it easier to notice when a label such as 'an enabling sorting out' may be around. However, I would now respond differently in the first two teacher discussions. In the discussion of 14/09/07, rather than focus on the one form of 'sorting out' that was being described ('enabling'), having identified the

label 'an enabling sorting out', I would offer the more general (but still basic level) notion/question: 'how do we sort out student difficulties?'. From this label, it would be possible to gather a range of strategies (including the 'enabling' kind) that teachers may be able to try out in their classrooms, and plan for. Such work can support teachers in conceptualizing their own practice in new ways, for example, becoming aware of patterns in how they usually sort out difficulties and raising awareness of alternatives. Similarly, in the 4/4/08 discussion, having identified the label that the image in the clip was one that 'had the answer', I might now offer a prompt such as: 'what kinds of image can/do we offer students?' again, to support the gathering of a range of possibilities and the recognition of alternatives to current practices. My responses now would be at a more meta-level, extracting from the discussion to a question, still at the basic level, that could support the sharing and development of strategies. Supporting teachers to reflect on and categorise their own habitual behaviours supports new ways of perceiving the classroom, hence learning, and the informing of future actions.

6 Conclusion

This article set out to answer two main questions: how do mathematics teachers learn from working with video recordings of lessons? and, what is the role of the didactician in facilitating teacher learning? From a review of mathematics education literature, there is consensus that teachers can learn from video when supported to avoid an evaluative discourse about what they see, particularly at the start of discussion. The category theory of Rosch provided a theoretical explanation of why the practice of beginning discussion with the detail of events is likely to be necessary, if the aim of discussion is to allow the emergence of new labels and new ways of seeing/describing events in a classroom.

In answer to the second question, there was empirical evidence that in order to establish discussion norms, the didactician needs to listen in a particular manner where attention is placed not only in what teachers say but also in what *kind* of things teachers say. This mode of attention was labeled a 'heightened listening' and there was evidence that such a form of listening is necessary when establishing discussion norms or trying to support the learning of teachers by identifying new basic level categories from discussion.

While answering these questions, I have obliquely been considering my own learning as a didactician. My own learning continues every time I work with teachers on video, and I have indicated moments in discussion when I would now respond differently to how I did on the audio recordings. Whereas the teachers, I hope, will come to make new distinctions in relation to the video and their own practice, my learning is about supporting the process and, through reflecting on similarities and differences across discussions, developing the sensitivity to notice ever finer distinctions, and the skill of how and when to express my awareness of distinctions, to support the learning of others.

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