

As published in the *Journal of the Learning Sciences*, 17, 1, 33-59 (2008)

**The seeds of time: why classroom dialogue needs a temporal analysis**

Neil Mercer

*Faculty of Education*

*University of Cambridge, UK*

Neil Mercer  
Professor of Education  
Faculty of Education  
University of Cambridge  
184, Hills Rd  
CAMBRIDGE, UK  
CB2 8PQ

Tel. (0)1223 767592/01908 260452

[nmm31@cam.ac.uk](mailto:nmm31@cam.ac.uk)

## **Abstract**

The process of teaching-and-learning in school has a natural long-term trajectory and cannot be understood only as a series of discrete educational events. Classroom talk plays an important role in mediating this long-term process, and in this article I argue that more attention should be given to the temporal dimension of classroom dialogue, both empirically and theoretically, if we are to appreciate how children gain an education from their classroom experience. I explore this topic using data from recent applied, interventional research in UK primary schools, and examine how classroom talk is used to represent past shared experience, carry ideas forward from one occasion to another, approach future activities and achieve learning outcomes. The article ends with a discussion of the theoretical, methodological and educational implications of making this kind of temporal analysis.

In this article, I examine how the passage of time is embodied in classroom talk and how this embodiment contributes to the process of teaching-and-learning. I begin by elaborating this topic, arguing for its significance, discussing relevant prior research and considering some methodological and theoretical issues involved in studying it. I then present the first of several transcripts from a related series of events and use an analysis of the transcribed talk to begin to explore these issues and discuss what is involved in making a temporal analysis. Following the consideration of more examples of talk, involving both teacher-student and student-student dialogue, I draw conclusions about the importance of the temporal dimension for analysing the discursive process of teaching and learning and discuss what theoretical and methodological developments will be required if this topic is to be pursued.

Most of my research has been carried out in primary/elementary schools. In such schools, a teacher and the members of a class normally stay together for the whole of a school year. Their classroom life is organized into lessons, which may be as short as half an hour or as long as two hours; but any one lesson usually represents part of a series dealing with a topic or a set of related topics, taking place at quite regular intervals. Moreover, although the efforts of the learners (and the teacher) in each lesson may be focused on specific learning outcomes, there is a cumulative quality to the educational process. Particular tasks will be set in the context of an overarching curriculum, some topics will take more than one session to pursue and the achievement of some kinds of skills and understanding may be prerequisites for more advanced work. The treatment of topics and development of skills may be planned by teachers as a staged process.

As Douglas Barnes observed: “Most learning does not happen suddenly: we do not one moment fail to understand something and the next moment grasp it entirely.” (Barnes, 1992, p. 123.) It is widely accepted that becoming educated is not simply matter of accumulating information; it involves the gradual induction of students into new perspectives on the world, the development of new problem-solving skills and new ways of using language for representing knowledge and making sense of experience. In British schools, at least, some of the most important assessment is designed to test students’ cumulative, integrated understanding of a subject and not just their recall of specific items from discrete lessons. From a student’s perspective, school work should ideally have a cohesive, cumulative quality in which specific activities and their goals can be seen to form part of greater whole, as part of a purposeful educational journey.

The continuity of personnel and the linking of the content of lessons can be expected to provide some coherence to children’s experience of classroom education. However, for all students some discontinuity and incoherence will be inevitable, caused by such factors as absences of students from crucial lessons in a sequence, the use of inappropriate pedagogic strategies, students’ difficulties in keeping up with the pace of activities, and the effects of lack of concentration, boredom and distractions of many kinds. Bereiter (1997) has highlighted the problems which may be caused by teachers and students pursuing goals which are based on different implicit time frames. Alexander (2000), Crook (1999) and several other educational researchers have argued that coherent knowledge and purposeful understanding will not naturally emerge for students from their continuous immersion in classroom life: it has to be pursued actively as a pedagogic goal, through the use of appropriate teaching strategies. Language is our prime tool for making collective sense of experience, and

the extent to which students will perceive cohesion and coherence in their classroom work may be heavily dependent on how dialogue mediates that activity. Talk with a teacher, and with other students, is perhaps the most important means for ensuring that a student's engagement in a series of activities contributes to their developing understanding of science, mathematics or any other subject as a whole. In order to understand how classroom education succeeds and fails as a process for developing students' knowledge and understanding, we therefore need to understand the temporal relationship between the organization of teaching-and-learning as a series of lessons and activities and how it is enacted through talk. To put it another way: as learning is a process that happens over time, and learning is mediated through dialogue, we need to study dialogue over time to understand how learning happens and why certain learning outcomes result. We may then see more clearly how the precious resource of the time that a teacher and a class spend together can be used to good effect in the pursuit of children's education, or how it may be squandered.

The significance of the temporal dimension of discourse for the development of knowledge and understanding has been recognized by several researchers (see for example Erickson, 1996; Cobb, 1999; Crook, 1999; Issroff, 1999; Wells, 1999, Chapter 3; Alexander, 2000, Chapter 15; Lemke, 2001; Roth, 2001, 2005, 2006), but relatively few studies have expressly examined the relationship between time, talk and learning in classroom life. One possible reason, as Littleton (1999) suggests, is that studying the dialogues of teaching and learning over an extended period time poses serious methodological and theoretical challenges. As is apparent from one of the few studies of this topic (by Rasmussen, 2005, who analysed the talk over some months in a Norwegian primary classroom), just gathering the relevant data requires the

researcher's substantial commitment of their own time for continual recording and observation – and then some theoretical and methodological innovation is needed for the subsequent analysis.

Methodologically, there is little guidance available for studying the temporal development of talk, and not just within educational research. On consulting several excellent and well-regarded methodological texts, representing various approaches including sociolinguistics, discursive psychology, conversation analysis and systemic functional linguistics (Edwards and Westgate, 1994; Potter and Wetherell, 1994; Gee, 1999; ten Have, 1999; Christie, 2002), I found no substantial treatment of this topic. However, I found some useful advice in publications by Gee and Green (1998) and Scott, Mortimer and Aguiar (2006). Gee and Green describe one of the functions of talk as “connection building”, whereby intertextual links are made by speakers in their joint meaning-making. Following other researchers such as Bloome & Egan-Robertson (1993), they identify this as an important characteristic of classroom discourse and suggest that useful insights can be gained into how classroom talk functions by addressing such questions as:

What sorts of connections (intertextual ties) are proposed, recognized, acknowledged, and interactionally made to previous or future interactions (activity) and to texts, to other people, ideas, things, institutions and discourses outside the current interaction?

Which processes, practices and discourses do [speakers] draw on from previous events/situations to guide the actions in the current situation (e.g., text construction)? (Gee and Green, 1998, p. 141)

Scott et al. (2006), reporting a study of talk in school science lessons, offer the following advice:

To understand the purpose of a specific teaching activity in a sequence of lessons it is necessary to determine how this particular activity fits with the whole sequence...[Our] analysis of the discourse of science lessons involves an iterative process of moving backwards and forwards through time, trying to make sense of the episodes as linked chains of interactions. ( 2006, p. 610)

Also within an analysis of learning in science lessons, Roth (2006) offers the valuable insight that it is only by pursuing the trajectory of students' learning over time that an analyst can begin to recognize the potential significance of the apparent repetition of certain actions (such as procedures in a practical scientific investigation) as part of the learning process. The same act repeated cannot be assumed to be "the same" act in repetition, because it builds historically on the earlier event. This insight applies as much, of course, to the consideration of verbal acts – and so problematizes the use of atemporal coding schemes for studying the educational functions of discourse.

At a different level of analysis, Christie (1999) has shown how teachers use talk to manage the timing and sequencing of events in the classroom. My own earlier research has described discursive strategies commonly used by teachers to refer to

past events and so consolidate relevant experience being shared with their students. For example, they use *recaps* - summaries of what they consider to be the most salient features of a past event for the current activity (Edwards and Mercer, 1987; Mercer, 1995). Recaps can be *literal* or *reconstructive*, the latter being where the teacher “rewrites history”, presenting a modified version of events which fits his/her current pedagogic concerns. Teachers also frequently use *elicitations* to activate students’ recall about past events (for example “Who can tell me what they found out about the moon in the last lesson?”). It is common too for them to mark past shared experiences as significant and relevant by using *we statements* (as in “Remember when we looked at the map of Italy?”). In those ways teachers invoke common knowledge and highlight the continuities of educational experience, trying to draw students into a shared, cumulative and progressive understanding of the activities in which they are engaged. In his influential research on culture and pedagogy, Alexander (2000; 2004) suggests that one indicator that teacher-student talk deserves to be called “dialogic” is that the teacher uses talk to provide a cumulative, continuing, contextual frame to enable students’ involvement with the new knowledge they are encountering.

## **A THEORETICAL BASIS FOR THE TEMPORAL ANALYSIS OF EDUCATIONAL DIALOGUE**

Not only methodological development, but also some theoretical development is required if we are to use a temporal analysis of classroom dialogue to understand the process of teaching and learning. As Roth (2006) points out, despite the significance of time and temporality as constituent aspects of human experience, learning theories generally do not take them into account. He comments:



Learning theorists take an ...atemporal perspective of learning, by mapping prior knowledge and subsequent knowledge in an atemporal space, much like mathematicians conduct mathematics in a space that has no time. (2006, p. 234)

Within most psychological and educational research there is little recognition of how language really functions to allow the dialogic, temporal process of meaning-making which is at the heart of education. It is only in more linguistic research we find a clearer conceptualization of how meaning is carried through time by language users, using such concepts as *intertextual referencing* (Gee & Green, 1998.; Bloome & Egan-Robertson, 1993; Shuart-Faris & Bloome, 2005; Agha & Wortham, 2005), *textual cohesion* (e.g. Christie, 2000; Gibbons, 2002; Martin & Rose, 2003). There is also relevant work under the heading of *indexicality* (Hanks, 2001; Silverstein and Urban, 1996). However, such research has not been concerned with understanding cognitive development, learning processes, or measuring educational outcomes: so while it offers useful concepts, they are not embedded in an appropriate theoretical framework. There is a gap in contemporary educational theory where there should be a conceptual framework for explaining “becoming educated” as a temporal, discursive, dialogic process.

An appropriate base for developing a theory of school-based learning as a temporal, dialogic process might be provided by the sociocultural perspective built upon the foundations of the work of Vygotsky (e.g. Vygotsky, 1978; Wertsch, 1984, 1985; Daniels, 2001; Wells & Claxton, 2002). Not only does this perspective recognize language as a key psychological and cultural tool, but also, as Lemke explains: “Sociocultural approaches to learning and development are not just about social

interaction...They are more significantly about the role of longer time-scale constancies and how they constrain, afford and intrude into moment-by-moment activity.” (2001, p. 19). Within sociocultural theory, the Vygotskian concept of the zone of Proximal Development (ZPD) figures prominently as a means for describing the way a child’s intellectual capacity changes over time to reach new levels with the dialogic support or “scaffolding” of an adult or more capable peer (Vygotsky, 1978;Wertsch, 1984). But the ZPD is essentially a static concept, representing an individual mental state at any point rather than a dynamic, dialogic process (as Wells, 1999, p.102, also concludes). We need ways of describing how intersubjectivity (in the sociocultural sense this term is used by Wertsch, 1984) is pursued, maintained or lost in the course of classroom talk. In earlier work I introduced a new concept, the *Intermental Development Zone* (IDZ), to focus on the way that a teacher and learner can stay attuned to each other’s changing states of knowledge and understanding over the course of an educational activity (Mercer, 2000, chapter 6). My aim was to conceptualize cognitive development and learning interactively. The IDZ represents the dynamic, reflexive maintenance of a purposeful shared consciousness by a teacher and learner, focused on the task in hand and dedicated to the objective of learning. It is represented in talk by explicit references to shared experience (present, past and future), common tasks and goals, but can also be sustained by tacit invocations of common knowledge which are intelligible to the participants. Its quality is dependent on the contextualizing efforts of those involved. If their dialogue fails to keep participating minds mutually attuned and focused on the task, the IDZ collapses and the scaffolding of learning stops. Like the notions of ZPD and scaffolding (as introduced by Wood, Bruner and Ross, 1976) , the notion of the IDZ focuses attention on how a learner progresses under guidance in an activity; but it does so in a way

which is more dynamic, more interactive and more clearly related to the task-related talk of both teacher and learner. I will illustrate the use of this concept through examples, later.

In her recent research on children's talk during project work, Rasmussen (2005) has used the concept of *participation trajectory* (adapted from the work of Dreier, 2002, and others) to highlight the pattern of children's involvement in a particular, extended classroom activity from its inception to its conclusion some weeks later. The concept helps a researcher perceive a series of observed events as a journey for those involved, and so heightens sensitivity to continuities and discontinuities in children's educational experience. Dreier's own recommendation is that we should "move from studying how a person deals with one particular situation to how a person conducts his or her life in a trajectory of participation in and across social contexts (such) as one's home, school, workplace and so forth." (Dreier, 2002, p. 3.) The concept has also been used to good effect by Payler (2005) in her study of the young children's transition from pre-school to primary school, revealing how discontinuities in their educational experience, exacerbated by the different pedagogic approaches used by teachers in the two institutions, had significant effects on the quality of their participation and learning. However, while this concept very usefully encourages and enables a temporal focus on the social nature of learning, it is focused on individual patterns of involvement in social processes. The kind of trajectory with which I am concerned here is not of individual social actors moving across settings (such as home and school), but of speakers moving together through a series of related interactions

within the same institution (school). It is not a participation trajectory, but a *dialogic trajectory*.

## INTO THE CLASSROOM

To provide a concrete basis for the rest of my discussion of temporality, I will use several extracts of transcribed talk. These all come from a series of lessons recorded in one primary classroom in south east England over a period of four months, as part of a recent project on talk and collaborative activity in science and maths education in which several schools were involved (as reported in more detail in Dawes, 2004; Mercer, Dawes, Wegerif & Sams, 2004; Mercer & Sams, 2006). The first is Extract 1, below. Please read it now, without further introduction, and consider what sense you can make of the observed event from the transcript alone. (*Notes on transcription are included at the end of the article.*)

### **Extract 1: Introductory whole-class plenary, March 18**

Teacher        Before you go on to the next step on the  
                      computer what do you need to make sure  
                      that the whole group has done? Oh! More  
                      hands up than that. Emma?

Emma            Agreed.

Teacher        Agreed. The whole group needs to agree. *Teacher writes “everybody*

*agrees” on board.*

OK one of my speech bubbles. I wonder what kind of things we might hear each other saying during today’s lesson?

*Teacher draws a speech bubble. Points to a child.*

Axel What do you think?

Teacher What do you think?  
Anything else you might hear people saying as we have today’s lesson? Kaye?

*Teacher writes “What do you think?” in speech bubble*

Kaye What is your idea?

*Teacher draws a speech bubble and writes in it “What is your idea?”*

Teacher Brilliant! What’s your idea? Oh, Sydney?

Sydney Why do you think that?

Teacher Excellent. Well done.  
Any other things we might hear people say? Rebecca?

*Teacher draws a speech bubble and writes “Why do you think that?”*

Rebecca I’m not too sure on that idea. What do you think?

Teacher Brilliant. Well done. What do we need to

*Teacher draws a new*

remember in our groups? Kiera? *speech bubble.*

Kiera That everybody gets a turn to talk

Teacher Everybody gets a turn to talk. *Teacher points to Anna.*

Anna Everybody needs to share their opinions

Teacher Yeah – and are we all the same?

Children No

Teacher Will there be someone in your group that perhaps wants to talk all the time?

Children Yes.

Teacher Will there be someone in your group who doesn't want to talk at all?

Class Yes!

Teacher How are you going to get that person who doesn't want to talk at all to say something? Shane? What do you think? How are you going to get that person who sits there and doesn't say anything to say something in your group? Help him out Tyber.

- Tyber            Ask them.
- Teacher        Ask them – brilliant. What about that        *Emphasises “all”*  
                          person who talks *all* the time?
- Alan            Tell him to shut up.
- Teacher        Ooh! Are you? I hope not because that’s  
                          not positive language is it? What could  
                          you do to help them out? Kiera?
- Kiera            Ask them and then ask somebody else        *Teacher silences an*  
                          and then ask the other person.                *interruption with a gesture*
- Teacher        Brilliant. Making sure that you ask  
                          everybody in the group. Excellent. Kaye?

I expect that readers could make a good deal of sense of what was going on in the observed lesson from the transcript. For those who study classroom interaction, it would have many familiar linguistic features. A researcher’s interpretation of a piece of conversational data will itself have a historical quality, as new data will be compared with past experience of similar language events. But to gain more than a superficial understanding of this extract as a representation of an educational event, some additional background information is needed. In a journal article such as this, I would normally offer some information to readers in advance of the extract, as follows (with the precise content dependent on the focus of the article):

**Extract 1: background information**

Extract 1 comes from the data of an interventional research project, set in English primary schools, and focused on the development of children's use of spoken language as a tool for reasoning in science and mathematics. The participants were a teacher and her usual class of 10-11 year olds, and the extract is part of the recording which was made of an introductory whole-class session to a maths lesson. The children were sitting in groups of three or four at their tables, looking towards the teacher who was standing at the front of the class. In the series of lessons we were recording, the teacher was not only expressly concerned with children's learning of the curriculum (and in particular science and maths), but also with the development of the children's abilities to talk, reason and work well together in groups. As part of the project intervention, she had worked with members of the research team in the previous weeks to set up a programme of activities called *Thinking Together* (Dawes, Mercer & Wegerif, 2003) for raising the children's awareness of how they talked and worked in groups. This was the sixth in a series of lessons in which the use of talk for reasoning had been given special attention. In the previous one (which we also recorded), she had discussed with children how they could most effectively work together to solve problems, drawing on the concept of *Exploratory Talk* which had been developed through earlier phases of this research from the work of Barnes and Todd (1977). Exploratory Talk is

discussion in which partners engage critically but constructively with each other's ideas. Relevant information is offered for joint consideration.

Proposals may be challenged and counter-challenged, but if so reasons are given and alternatives are offered. Agreement is sought as a basis for joint progress. Knowledge is made publicly accountable and reasoning is visible in the talk. (Mercer, 2000, p. 98.)

In that previous lesson, the teacher had drawn from her discussion with her class the following three points, writing them up on the board as she did so:



1. Members of groups should seek agreement before making decisions
2. Group members should ask each other for their ideas and opinions (“What do you think?”)
3. Group members should give reasons for their views, and be asked for them if appropriate (“Why do you think that?”)

She then put up on the wall of the classroom a set of *ground rules for talk*, which represented the essence of Exploratory Talk and which had been elaborated in the earlier teacher-led whole-class discussion of talking in groups. The notion of ground rules for talk, like that of Exploratory Talk, is an element of the Thinking Together programme based on earlier research - see for example Edwards & Mercer, 1987; Mercer, 1995 – and had been introduced to the teacher by the researchers. These rules were as follows:

### **Our ground rules for talk**

We share our ideas and listen to one another

We talk one at a time.

We respect each others' opinions

We give reasons to explain our ideas

If we disagree we try to ask “why?”

We always try to agree at the end.

There were thus two types of objectives devised by the teacher for this lesson, concerned with the study of mathematics and with encouraging the use of Exploratory Talk. Immediately after this introductory plenary, the children began to

work on maths problems together in small groups, using a computer program called *Function Machine*. Their maths objective was to work out how to solve the problem of what function had been applied to each number they put in to the “machine”, by considering the number that it produced as an output. The specific talk objective was to use the ground rules in doing this task, related to the broader objective (pursued over a series of lessons) of developing skills for effective collaboration. Just before the start of Extract 1, the teacher had written both objectives on the board and explained them.

As the background information above explains, members of the research team had been involved in the planning which generated the educational content for this extract. This meant that the researchers were involved in its history and so, rather unusually, we could draw on past experience shared with the teacher when making sense of what was said and done. We were thus able to infer that in her talk the teacher was drawing directly upon prior experience shared with her class. She uses questions to draw out from the children not only relevant comments on how they should interact, but also a collective recall of previous lessons – most specifically, to establish a shared understanding of the ground rules for talk. We can see her characteristic teacher’s use of “we” in this respect: “What do we need to remember in our groups?” She elicits *models of speech acts* which would represent an appropriate use of the ground rules they have agreed: the phrases “What do you think?” and “Why do you think that?”. She then encodes these models in the more permanent language mode of writing (her “speech bubbles”), which could then travel through time as a shared resource for the class as they pursued their activity.

Several of the teacher’s questions signify temporality, for example:

“Before you go on to the next step on the computer what do you need to make sure that the whole group has done?”

“I wonder what kind of things we might hear each other saying during today’s lesson?”

“Will there be someone in your group that perhaps wants to talk all the time?”

These utterances seem designed to highlight for students the ways that knowledge gained in past activity can be used to anticipate future needs. This one extract therefore shows a teacher using talk to attempt to build the future of her students’ educational experience on the foundations of their shared history. Before we leave Extract 1, please note the teacher’s last remark “I hope not because that’s not positive language is it?” because I will consider it later.

## **THE TEMPORAL CONTEXT OF CLASSROOM TALK**

Talk which mediates joint intellectual activity poses a considerable methodological challenge for a discourse analyst, because any specific interaction has two aspects, both of which have a temporal quality: a *historical aspect* and a *dynamic aspect*. Historically, the interaction will be located within a particular institutional and cultural context. Speakers’ relationships also have histories. Things that are said may invoke knowledge from the joint past experience of those interacting (e.g. their recall of previous activities they have pursued together), or from the rather different kind of common knowledge which is available to people who have had similar, though separate, past experiences. (For example, two people conversing who had at different

times studied linguistics at the same university could safely assume much shared understanding of both the subject and the locations in which it was studied, even if they had not been contemporaries.)

The *dynamic* aspect refers to the fact that conversations are not planned, they *emerge*. Speakers' contributions are contingent on what their partners say, and speakers will not even know in advance exactly what they are going to say and for how long they will speak (Roth, 2006, p. 251). The basis of common knowledge upon which shared understanding depends is constantly being developed as participants in a continuing conversation interact. The nature of the shared knowledge being invoked in any dialogue is therefore potentially quite complex. It is in a state of flux, as immediate shared experiences and corresponding conversational content provide the resources for building the temporal foundations of future talk. A profound problem for researchers concerned with the joint construction of knowledge (and, indeed, with understanding how conversational communication works at all) is inferring what knowledge resources speakers are using. They may make explicit references to shared past experience or other types of common knowledge, but they often invoke such historical, temporal resources only implicitly. As Littleton comments, "observable interactions are likely to have unobservable determinants in the histories of individuals, groups and institutions." (1999, p. 182). Lemke likewise observes: "Time is not Galilean in such systems; the longer term, the nonproximate event, may be more relevant to the next move than the immediately preceding event." (2001, p. 23) However, we can only deal with this phenomenon in a partial, limited fashion, by sampling discourse over time and by drawing in our analysis on any resources of knowledge we share with the speakers.

We also need to take into account that educational dialogue in classrooms is a cultural artefact, and its special nature is embodied in its distinctive, functional qualities as a speech genre (or set of genres), which have been so well described by generations of classroom researchers. As I mentioned earlier, some characteristic features of that genre, such as teachers' *recaps*, are designed to invoke knowledge from the joint past experience of those interacting (i.e. their recall of previous activities they have pursued together).

To make educational sense of a particular classroom interaction, then, it would help to know not only what happened within the interaction, but also what happened before it, what the participants were expecting to happen, and what they learned from it. That is, it would be useful to have information about:

1. *the shared history of the participants*. It helps to know whether a teacher and a class have worked together before, if there have been previous lessons on this topic, and if the students had encountered this particular kind of task before (and so could be expected by the teacher to have some relevant past experience). This can, and should, strongly influence an analyst's interpretation of the meaning and significance of utterances for the participants - for example regarding the function of questions in which the teacher appears to be seeking information from the learner (i.e., are these stimulated recall questions, or attempts to gauge the understanding of a learner with whom the teacher is unfamiliar?). Access to recordings of prior lessons could thus be a crucial resource. However, it is not a comprehensive history of an event or the shared experience of the participants that analysts need, but rather those

aspects of shared knowledge which the participants *treat as relevant to their current task* and so invoke in their dialogue. For instance, in Extract 1, the teacher's question "What do you need to make sure that the whole group has done?" would have a very different meaning for members of a class who have spent a previous lesson discussing what a group should do to work effectively from those of a class which was just beginning to do so on this occasion. The very same teacher elicitation could, depending on the local history of the exchange, invoke very different kinds of responses from a student. This issue also relates to the next point:

2. *The temporal development of the dialogue.* We do not only need background information about shared experience prior to the observed event, we also want information about the progress of the talk itself. A conversation is like a sophisticated type of dual-control (or multi-control) track-laying vehicle: its participating "drivers" use the history of their encounter to build the foundations for its future path as it proceeds. Conversations run on contextual tracks made of common knowledge (as discussed in more detail in Mercer, 2000, chapters 2 and 3).

In their seminal study of classroom talk, Barnes and Todd (1977) explain how when a group of children are working together

meanings for what is going on in the conversation are constructed not from any one utterance on its own, but from cycles of utterances, perhaps over quite lengthy sections of the interaction. Now these cycles are not readily isolable: they adhere to the interaction between utterances, and the speaker-hearer's intentions for, and interpretation of, these utterances.

When we analyze talk, what we are trying to do is to feel our way into the meanings of the participants made for the interaction as it happened. But the meanings which the participants made were not stable. They were fluid and changing, built up out of the existing knowledge and expectations which they brought to the situation, along with their own implicit summary of what went on in the conversation, and their reaction to that summary. Meanings change in the course of on-going events in the conversation, which lead to a reinterpretation of what has gone on so far. (1977, p. 17)

This dynamic aspect of conversational interaction is what Gee (1999) calls its *reflexivity*. It is the historically cumulative, reflexive nature of conversation which requires “explicitness” to be treated as a relative concept, because speakers need only be as explicit as is necessary for effective communication (Grice, 1975). If people conversing share a relatively advanced understanding of a technical subject, much basic knowledge about it can be left implicit, even if the relevant knowledge has been gained quite separately by the participants. They also build joint semantic resources for implicit reference as they continue to interact. Of course, speakers do not necessarily follow Gricean maxims. Inappropriate judgements about explicitness are a common source of misunderstandings, in classroom as in other settings. A temporal perspective may help us understand this problematic aspect of the joint construction of knowledge.

3. *The trajectory of the event.* As well as the history of the event, it would also help to have some information about how participants perceive its projected future. For example, do the participants know that they have up to an hour or

so to spend together on the problem, or is this jointly perceived as a brief encounter? Is it a preparation for a formal test? Is there evidence of a shared perception of the trajectory, amongst participants? Is there a shared understanding that this educational task is part of a longer educational journey, or is it a “one-off” event?

4. *The educational outcomes of the event.* The goal of some research into language and social interaction may be no more than an understanding of the nature of the process observed. But for educational researchers like myself, there is also usually an interest in the educational value of any teaching-and-learning interaction. To put it bluntly, I often want to know if there is evidence that any students have been educated as a result of the dialogue I observe. I might also want to explain why participation in the same educational, discursive events has apparently led to different educational outcomes among students. One way of exploring this is to track back from observable outcomes through the history of those events.

Of course, as researchers we will never have all the information we might want for making a temporal analysis, but that does not justify ignoring that information which we can obtain. We can make efforts to gain some of it by observing and recording series of events over time, rather than single events; by talking to the participants; and by gathering other kind of documentary data such as timetables, teachers’ lesson plans, students’ work and so on. And to use this information effectively, we also need a clear conceptualization of educational dialogue as a temporal process.

## **BACK TO THE CLASSROOM**



We now return to the primary classroom which figured in Extract 1. Extract 2 (below) took place ten days later, on the next occasion when that class was recorded. Again, it is taken from whole class session at the start of a lesson, before the children began a group-based activity.

***Extract 2: Introductory whole-class plenary, 29 March***

- Teacher Can you remember what we had to sort in our science lesson?
- Anna Food.
- Teacher Food. Brilliant! We had to sort it into different categories didn't we? This time we're going to be sorting numbers. So that's our objective – sorting numbers. I'm going to work with Donal and Alan to-day and in my group I've decided I'm going to sort the numbers by multiples of three, and I don't care what they think. What's the matter Maya?
- Maya You should, um, decide as a group.
- Teacher Oh super. There's one of our ground rules already, "Decide as a group".
- Writes this objective on board.*
- Teacher takes on role of child with grumpy expression*
- Writes "Decide as a*

OK. How am I going to do that? Because *group*” on board

I want to sort my numbers by multiples of three. How am I going to make sure that we decide that as a group?

Kiera Ask them what they think. Also, when you ask what they think, don’t turn your back on them because that’s not positive body language. *Teacher writes “Ask them what they think”.*

Teacher You mentioned positive body language. What other type of language do we need to make sure is positive? Not just our body language– come on Sydney – join in please. What other sort of language do we need to make sure is positive?

Child The way we talk.

Teacher The way we talk! Am I going to say “I’m going to sort these in multiples of three!”?

Child No.

Teacher Maya, what would you say if you were in my situation?

Maya Um, “I want to sort them by multiples of three. What do you think about it?”

Teacher That would be a good thing to say.

*[and then a little later]*

Teacher OK, as I’m wandering around the

classroom and looking and watching and listening to what you are doing, I wonder what sort of things I might hear you saying. Go on. Tell your partner one thing you might say. Bernice, can you tell Sydney?

*Children talk to each other.*

And ...stop! Ready? Looking this way.

Donal's group. Share one of the things I might hear you say.

Donal      What do you think?

Teacher     What do *you* think? Brilliant – Emma?

*Emphasises the word “you” and writes “What do you think?” on board.*

Emma       Why do you think that?

Teacher     Why do you think that? That's another good one, not just what but *why* do you think that? Brilliant.

*Writes “Why do you think that?” on board.*

There is a familiar quality about the opening sequence of Extract 2. As in Extract 1, the teacher is beginning a plenary session by checking the students' recall of how they are expected to work in a group. She begins this session with an appeal to the children's memory of past activity, by making an intertextual link to earlier dialogue: “Can you remember what we had to sort in our science lesson?”

This appeal is responded to accordingly by one of the students. We can see here an exemplification of both the *historical aspect* and the *dynamic aspect* of classroom

talk, as participants draw on their shared past experience to build the contextual foundations for their continuing interaction. As I mentioned earlier, an *elicitation* of this kind is one of several dialogic tools teachers commonly use to try to help children see the continuity of educational experience and to encourage them to recall knowledge of past events which is relevant to current or future activity.

The teacher provides positive feedback on Anna's response ("Food") and then recaps the previous activity: "We had to sort it into different categories didn't we?". In contrast, her next remark is future-orientated: "This time we are going to be sorting numbers. So that's our objective – sorting numbers". By invoking the generic category of action of "sorting", she marks as similar two classroom activities (one past and one in the immediate future) which might have seemed quite disparate to the students. Drawing on such shared experiential resources a teacher can use dialogue to set up and maintain an Intermental Development Zone (IDZ, as discussed earlier) to support learning, enabling participants to take a shared perspective on a task and pursue common (or at least compatible) goals. This may help students to perceive a series of activities as stages on a learning journey rather than as disconnected events.

Next, the teacher makes a very different kind of statement: "I'm going to work with Donal and Alan to-day and in my group I've decided I'm going to sort the numbers by multiples of three, and I don't care what they think." She is role-playing a child, and this seems an unusual kind of teacher-talk. But we see that Maya responds in a way that the teacher treats as appropriate – the flow of the interaction is smoothly maintained. Maya's response "You should, um, decide as a group" shows that she is familiar with the teacher's rhetorical strategy and understands its pedagogic function.

Her response also shows that she realises that this dramatic characterisation is not a diversion from the current topic, but an illustration of a transgression of the ground rules – and so demands a critical comment. The fact that the teacher and student can go directly into this role-play, without any explicit introduction, illustrates particularly well the historically-contextualized, reflexive nature of talk in classrooms. The collaborative success of this bit of dialogue suggests that an IDZ is being maintained: both teacher and student are operating within a shared frame of reference which supports the pursuit of the problem set by the teacher.

Later in the extract, the teacher asks: “How am I going to make sure that we decide together as a group?” Kiera’s response, “Ask them what they think”, paraphrases what the teacher had written up in a speech bubble in the earlier lesson (and which is now included as a permanent notice with the ground rules for talk on the classroom wall). Kiera then goes on to mention the need for “positive body language”. The teacher picks this up and highlights “(an)other type of language” which “we need to make sure is positive”. As earlier observers of this class, we can infer that a routine has been established for opening these lessons – an inference we can check against our data. We also see here the use by a child of a term (“positive language”) used by the teacher at the very end of Extract 1. It is very unlikely that a child’s use of such a special term has any source but the teacher, and our historical data supports the interpretation of this as appropriation by the child.

We next go to another introductory plenary, a month later. The teacher is asking the children for comments on how they will work together.

***Extract 3: Introductory whole-class plenary, 26 April***

Teacher: What would happen if I didn't check everyone agrees with the idea?  
I wonder what would happen – Emma? (*her reply is inaudible*) Yes, you'd be dominating the group. You'd be making decisions that not everybody perhaps has had a chance to think through.

Luke: Positive body language.

Teacher: What was that one you just said? Positive body language. Brilliant. That's not something I'm going to hear is it? No – it's something I can see. How do I see positive body language Donal?

Donal: Looking at people and then you can see if they are nodding.

Teacher: If you are looking at somebody it's going to be much more polite and show more respect than if you've got your back to somebody when they are talking.

We see here again the use of the term *positive body language*, reappearing like an echo of lessons past. It is a special term, a piece of technical vocabulary for talking about talk *as a topic of study*, which provides lexical evidence of the historical continuity of the dialogue in this class as a micro-community of discourse. In these ways, we see that the talk of each lesson can be considered as a part of one long conversation amongst the members of this class (Maybin, op. cit.). The repetition of the term “positive body language” is a *cohesive tie* (Halliday & Hasan, 1976), linking the talk of the series of lessons into one extended text. A search for the word

“positive” in all the talk data for this class showed that there were just two instances of a child using the term collocated with the word “language”, – in Extracts 2 and 3, in whole class sessions. The teacher used it five times, always collocated with “language”, in two of the five recorded lessons. There was no recorded evidence of children taking up this expression and making active use of it in their groups without the teacher: though as reflection on ways of talking was not ever specified as part of such activity this is not surprising. However, Donal’s explanation of the term suggests that its meaning is commonly understood. We therefore have some temporal evidence of this class developing *through* educational dialogue a shared vocabulary for talking *about* educational dialogue.

## TALK AMONGST STUDENTS

So far, I have only presented extracts from teacher-led, whole-class sessions. But of course educational dialogues also take place amongst children, and such dialogues were a prime focus of attention in the research which provided the data I am using. In British schools, as in many other countries, students are commonly put into groups to carry out activities of a problem-solving type. But what sense do they make of the injunction to “work together”, and to what extent are their expectations shaped by the teacher’s instructions, examples and guidance? Research in British schools by myself and colleagues over more than a decade supports the view that a shared understanding about how to talk and work effectively in groups is rare amongst primary children (Wegerif & Scrimshaw, 1997; Mercer, Wegerif & Dawes, 1999; Mercer, 1995, 2000). Talk during group work which could be described as “exploratory” is not common: it more commonly resembles the competitive and uncooperative argumentation we have called “disputational talk” or the friendly but uncritical discussion we have called

“cumulative talk”. Examples of explicit reasoning, and of co-reasoning, as exemplified by the use of requests for information, challenges, and attempts to seek agreement are hard to find. It was on the basis of such observations that we designed the interventional Thinking Together programme, in which teachers were encouraged to raise children’s awareness of how they used talk to get things done, to set up ground rules for talk, and to guide and model the use of Exploratory Talk.

The next three extracts all come from group activities in the same classroom and the same series of lessons, when students were working together in groups of three without the teacher. The first, Extract 4, is from a group activity which directly followed Extract 2, the plenary on the 29<sup>th</sup> of March. Three children are working together on maths problems in which they have been given a series of numbers with one of the series missing, and have to work out the missing number. At the point the extract begins, they are starting a new problem. Alan is making the first guess at what the missing item might be. The emboldened parts of the text relate to my subsequent comments.

***Extract 4: Group work, 29 March***

Alan: Four. **What do you think?**

Muj: Yes, four

Neeran: Is fifteen a multiple of four? No four fours are sixteen.



Alan: Yes it is. No. No.

Muj: No

Alan: Is nine?

Muj: No

Neeran: **Why do you think that?**

Alan: Because it goes four, eight then twelve, so it misses nine out.

In Extract 4, we see Alan and Neeran asking “What do you think?” and “Why do you think that?”. These are literal reproductions of the model questions put up on the board by the teacher in a previous lesson (as explained earlier in the section *Extract 1: background information*) and provided by other children (Donal and Emma) as responses to the teacher in Extract 2. Now it might be expected that such questions would be commonly heard in group activity in any primary classroom: they are, after all, no more than everyday phrases with everyday meanings. However, the observational research mentioned above suggests that such an expectation is not justified. The kind of dialogue we have called Exploratory Talk, is rare and so are questions such as “What do you think?”, “Why do you think that?” and “Do you agree?” which are associated with it. Moreover, pre-intervention recordings made in the classroom which provided the data used here were consistent with those observations. It is therefore a reasonable inference that the children in Extract 4 are following the class’s ground rules for talk which were established around a month ago. Alan and Neeran’s questions illustrate what I have called the *historical aspect* of dialogue: they index the past experience of the class as a community of inquiry

(Wells, 1999). This gives them a different meaning than if they were uttered in another class where no special preparation for thinking together in groups had taken place. Their function is not only to carry forward the discussion, but also to invoke agreed norms for behaviour within this community. In that sense the ground rules have shaped what I have called the *dynamic aspect* of the talk and they provide resources for the maintenance of an IDZ. The talk embodies prior learning by the children about the use of language as a cultural and cognitive tool, and can also be seen to embody the teacher's objectives for this series of lessons, as described in the earlier section *Extract 1: background information*, for developing effective collaboration in groups. The available temporally-extended data thus provides information about the *dialogic trajectory* of activity in this class. An analysis of educational dialogue which took no account of the temporal dimension, with its historical and dynamic aspects, could provide only a relatively impoverished understanding of what was going on in Extract 4 and would have little useful to say about what learning was expected of the children and what had been learned.

The next two transcripts are from the activity of two different groups in the same class. Extract 5 was recorded almost a month after Extract 4; and the final example, Extract 6, was recorded slightly more than a month after that. In both cases the children are involved in solving a maths problem in which they have to select an appropriate number to enter in a computer-based calculation. I will present them and comment on them together. Again, emboldened text relates to my comments which follow.

***Extract 5: Group work, 26 April***

Kylie: Let's just try a smaller number. **Who agrees we try a smaller number? I agree** [*Tony and Maya raise their hands*]

Rebecca: I don't

Kylie: So – what number? Maya, you choose a number

Maya: Six

Kylie: **Do we all agree on six?** Tony and Maya? Yes Rebecca?

Rebecca: No, try that other one

Kylie: We are! **Do you agree on six?**

Rebecca: No

Kylie: **Why?**

***Extract 6: Group work, 7 June***

Sofia: Sofia: Five, seven and five equals twelve. So put five.

Beau: **Do you agree?**

Kirsty: Yes, and then we need to sort this out.

[*and then a little later...*]

Sofia: I know, **why don't we use the seven again?**

- Kirsty:           **What do we do now?**
- Sofia:           **What do you think** we should do?
- Kirsty:           I don't know, it's too hard. I have never done this before.
- Beau:            I haven't done this before.
- Sofia:           **What can we remember?** A blank square. All I can remember is numbers. Eight add one is nine.

In these two extracts we again see children using questions such as “What do you think?” and “Do you agree?” which can be traced directly back to the establishment of the ground rules in their class (by now several months earlier). We can also see them use other related but different expressions: “Who agrees we try a smaller number?”, “What do we do now?” and “What can we remember?”. These can be read as evidence that they have not followed the ground rules only in a mechanistic way, by simply parroting the model speech acts offered by the teacher, but rather have learned how to apply them in an appropriate, creative way in their discussions. In Extract 6, Sofia's final remark “What can we remember?” is interesting in itself, from a temporal perspective, because it is an appeal to the relevant shared knowledge of her group gained through earlier classroom activities, which might allow them to “recognize” (as Roth, 2006, puts it) the apparently new problem they are facing.

A temporal analysis supports the claim that the nature and quality of the children's discussion in Extracts 5 and 6 has been shaped by past events, namely the whole-class

and small-group sessions of the Thinking Together lessons in which their teacher established the ground rules for talk and guided the development of their skills in using language as a tool for reasoning. I present here only specific examples, but the programme of research from which this data comes has shown that the relative incidence of children's use of talk of an "exploratory" kind increases significantly in the experimental classrooms where the Thinking Together programme has been implemented, becoming much more frequent than in matching control classes (as assessed by methods described in Wegerif and Mercer, 1997; Mercer, 2004). That research has also provided quantitative evidence of significant pre/post-intervention improvements in problem-solving and curriculum learning in science and maths for children whose teachers implemented the programme (as reported for the project which included the class represented in the current paper in Dawes, 2004; Mercer, Dawes, Wegerif & Sams, 2004; and Mercer & Sams, 2006). In contrast with the findings some other similar interventional research (notably Hogan, 1999), we have therefore demonstrated that raising children's awareness of how they use language to reason collectively helps them to reason more effectively as individuals. Moreover, a close examination of the talk data has enabled us to track the temporal development of the dialogue within particular groups of children as they attempted to solve problems, so that we could see how their deliberations led to correct or incorrect solutions. This means that we have independent evidence that children's appropriation of the ground rules does not merely induce a superficial form of verbal behaviour, but helps them use language more effectively as a tool for thinking, collectively and alone.

By examining both the process and the outcomes of the extended dialogues of teachers and children, it is possible to draw more valid and useful conclusions about

the significance of classroom interaction than if the analysis is focused only on processes (as is often the case in sociolinguistic research and conversation analysis) or on outcomes (as is often the case in more psychological, experimental-style investigations). In this particular case, the qualitative, temporal analysis of talk had a crucial role, when used in complement with quantitative measures of outcomes, in explaining how teachers can effectively help develop children's skills in using language as a cultural and cognitive tool.

## **DISCUSSION**

I have used data from an interventional classroom research project in this paper, but not to argue for the effectiveness of a particular intervention. Rather, I have used that data to illustrate my argument that the relationship between time, talk and learning is intrinsically important to classroom education, and deserves further exploration. The coherence of educational experience is dependent on talk amongst participants, and so analyses of the ways that their continuing shared experience is represented and the ways that talk itself develops and coheres over an extended period are required if we are to understand the process of teaching-and-learning.

Concepts such as reflexivity, intertextuality, dialogic trajectory and Intermental Development Zone, as discussed earlier, can be used to highlight the interactional, dynamic, self-contextualizing nature of classroom education. In broader terms, a sociocultural perspective provides an appropriate theoretical base for developing a more temporally-sensitive understanding of teaching and learning. But stronger conceptual links need to be built between the different levels of human activity

identified by sociocultural theory - the cultural, the psychological and the social – so that we do not treat the cultural context of educational activity as static and given, but explain how it is sustained and renewed through the creative activities of people in conversation and embodied in the products of joint intellectual endeavour (cf. Sawyer, 2001). Making progress will require taking account of what Lemke has called the “multiple timescales” of human social activity, development and learning, so that we are “as willing to look at biography and history as at situations and moments, as methodologically and theoretically prepared to study institutions and communities as to study students and classrooms.” (2001, p. 25).

Methodologically, we need better ways of analysing classroom talk as a continuing, social mode of thinking, ways which reveal how the joint construction of knowledge is achieved over time. Talk which mediates continuing joint intellectual activity poses a considerable methodological challenge for a discourse analyst because of its reflexivity. I have suggested that every conversational interaction has a *historical aspect* and a *dynamic aspect*. Historically, the interaction is located within a particular institutional and cultural context, and speakers’ relationships also have local and more specific histories. Speakers may invoke any knowledge from the past experience of all those interacting, whether gained separately or jointly. The dynamic aspect refers to the fact that talk is inherently reflexive: its contextual base is in a constant state of flux, as immediate shared experiences and corresponding conversational content provide the resources for building future conversational context. A key problem for researchers concerned with explaining how talk is used for the joint construction of knowledge (or, indeed, with understanding how conversational communication functions at all) is understanding of how speakers build contextual foundations for their talk. We can only do this in a partial, limited fashion, by sampling their

discourse over time and by drawing in our analysis on any resources of common knowledge we share with the speakers. But however difficult it may be to find a solution, the problem cannot be avoided. We need to reveal how the joint construction of knowledge is achieved by participants over time, because the process of teaching-and-learning depends on the development of a foundation of common knowledge.

A temporal analysis can help us see how students' ideas change through the extended process of interaction with a teacher and other students, and how new concepts, ways of using language and ways of solving problems are appropriated. Although my focus has been on talk, my argument for the significance of the temporal dimension in the study of educational events and processes has a wider relevance, with implications for the kind of information we need to gather. If, as researchers, we want to appreciate the educational value of an observed interaction between a teacher and a class of students, we should seek available information about what happened before that interaction and what happened subsequently. It would also be helpful to know what the participants expected from the event and to make some assessment of what the students learned from it. This is no more than common sense, but it is nevertheless not consistent with some research methodologies. Analytic methods which do not recognize or deal with the temporal development of talk, its reflexivity and cohesive nature over longer timescales than one episode or lesson will inevitably fail to capture the essence of the educational process. Methods for analysing discourse in which the analyst simply attends to the relationship between contributions made by participants in one recorded conversation, without applying available information about previous related interactions and historically contextual knowledge shared by participants (as seems to be advocated by some conversation analysts, e.g. Schegloff, 1997) would not work.



The use of coding schemes in which utterances with the same syntactic form and/or explicit content are taken to have the same pragmatic or semantic value, regardless of their location in the temporal sequence of communication, would also be inappropriate. And rather than trying, in the interests of “objectivity”, to distance ourselves as analysts from the perspectives of those inside in the long conversations of teaching and learning, we should rather try to gain access to the relevant interpretative knowledge used by those insiders. As Roth (2001) says, in advocating the dual role of teacher-researcher, knowing a school culture from the inside allows researchers to appropriate participants’ competence systems and so enables a richer interpretation of observed language and events.

Teachers use talk to sow seeds from which, in time, may grow the understanding of their students. Dialogues with teachers, and with their fellows, enable students to consolidate and develop their understanding over time, so that they can build new understanding upon the foundations of past experience. As educational researchers, we need to understand more about the temporal processes and outcomes of educational dialogues, because only then will we be able to help teachers to see how the resources of the time they spend with their students can be used to best effect.

### **ACKNOWLEDGEMENTS**

The data examples used in this paper are from a project *Language, Thinking and ICT in the Primary Curriculum* which was financed by a grant from the Nuffield Foundation (EDU/00169/G). The research was carried out by Lyn Dawes, Steve Higgins, Claire Sams, Rupert Wegerif and myself. The participation in this research

of teachers and children in Milton Keynes schools, and the support of MK Borough Council and the Nuffield Foundation, is acknowledged with thanks. I am extremely grateful for the constructive comments on earlier drafts of this paper provided by Lyn Dawes, Judith Kleine Staarman, Karen Littleton and Ingvill Rasmussen; and to Caroline Coffin, Janet Maybin and Karen Littleton for providing valuable bibliographic resources and references for exploring the topic of temporality. The reviewers for the *Journal of the Learning Sciences* also helped the development of this paper by providing very clear and useful comments.

### **Notes on Data and Transcription.**

The transcripts used were taken from video recordings of a series of lessons (each about 45 minutes long) that were video-recorded in one teacher's class in a primary school in southeast England. I have used a very simple transcription format, in which speech is rendered as grammatical phrases and sentences, to represent the sense that I, as researcher with access to the raw data, have made of what was said. Information about non-verbal aspects of communication judged pertinent to the analysis is included in a third column (or in parentheses). My judgement was that the inclusion of additional information at my disposal, such as length of pauses or other prosodic and contextual details, would be distracting to readers and irrelevant to the issues I am addressing.

### **REFERENCES**

Agha, A. & Wortham, A. (2005) (Eds). *Discourse across speech-events: intertextuality and interdiscursivity in social life*. Special issue of *Journal of Linguistic Anthropology*, 15 (1), 1-150.

- Alexander, R. (2000). *Culture and Pedagogy; International comparisons in primary education*. Oxford: Blackwell.
- Alexander, R. (2004). *Towards Dialogic teaching: rethinking classroom talk*. Cambridge, UK: Dialogos.
- Barnes, D. (1992). The role of talk in learning. In K. Norman (Ed.) *Thinking Voices: The work of the National Oracy Project* (pp. 123-128). London: Hodder & Stoughton,.
- Barnes, D. & Todd, F. (1977). *Communication and Learning in Small Groups*. London: Routledge & Kegan Paul.
- Bereiter, C. (1997). Situated cognition and how to overcome it. In D. Kirschner and J. Whitson (Eds.), *Situated Cognition: social, semiotic and psychological perspectives* (pp. 281-300). Hillsdale, NJ: Erlbaum.
- Blatchford, P. and Kutnick, P. (2003) (Eds.). Special issue: Developing group work in everyday classrooms. *International Journal of Educational Research*, 39 (1 & 2), 1-170.
- Bloome, D., & Egan-Robertson, A. (1993). The social construction of intertextuality and classroom reading and writing. *Reading Research Quarterly*, 28 (4), 303-333.
- Cobb, P. (1999). Individual and collective mathematical learning: the case of statistical data analysis. *Mathematical thinking and learning*, 18 (1), 46-48.
- Christie, F. (1999). The pedagogic device and the teaching of English. In F. Christie (Ed.) *Pedagogy and the Shaping of Consciousness* (pp. 156-184). London: Continuum Press.

Christie, F. (2002). *Classroom Discourse Analysis: a functional perspective*. London: Continuum Press.

Crook, C. (1999). Computers in the community of classrooms. In K. Littleton & P. Light (Eds.), *Learning with computers: analysing productive interaction* (pp. 102-117). London: Routledge.

Daniels, H. (2001). *Vygotsky and Pedagogy*. London: Routledge/Falmer.

Dawes, L. (2004). Talk and Learning in Classroom Science. *International Journal of Science Education*, 26 (6) 677–695.

Dawes, L., Mercer, N., & Wegerif, R. (2003). *Thinking Together: A programme of activities for developing speaking, listening and thinking skills for children aged 8-11*. Birmingham, UK: Imaginative Minds.

Dreier, O. (1999). Personal trajectories of participation across contexts of social practice. *Outlines: Critical Social Studies*, 1, 5-32.

Edwards, A. D., & Westgate, D. (1994). *Investigating Classroom Talk* (2<sup>nd</sup> ed.). London: The Falmer Press.

Edwards, D., & Mercer, N. (1987). *Common Knowledge: The development of understanding in the classroom*. London: Methuen/Routledge.

Erickson, F. (1996). Going for the zone: the social and cognitive ecology of teacher-student interaction in classroom conversations. In D. Hicks (Ed.), *Discourse, Learning and Schooling* (pp. 29-62). Cambridge: Cambridge University Press.

Gee, J.P. (1999). *An Introduction to Discourse Analysis: Theory and method*. London: Routledge.

- Gee, J.P., & Green, J. (1998). Discourse analysis, learning and social practice: a methodological study. *Review of Research in Education*, 23, 119-169.
- Gibbons, P. (2002). *Scaffolding Language, Scaffolding Learning: Teaching second language learners in the mainstream classroom*. Portsmouth, NH: Heinemann.
- Grice, H. (1975). Logic and conversation. In P. Cole and J. Morgan (Eds.) *Syntax and Semantics, Vol. 3: Speech Acts* (pp. 61- 82). New York: Academic Press.
- Halliday, M.A.K., & Hasan, R. (1976). *Cohesion in English*. London: Longman.
- Hanks, W.F. (2001). Indexicality. In A. Duranti (Ed.), *Key terms in language and culture* (pp. 180-183). Oxford: Blackwell.
- Hicks, D. (1996) (Ed.). *Discourse, Learning and Schooling*. Cambridge: Cambridge University Press.
- Hogan, K. (1999). Thinking aloud together: A test of an intervention to foster students' collaborative scientific reasoning . *Journal of Research in Science Teaching*, 36 (10), 1085-1109.
- Issroff, K. (1999). Time-based analysis of students studying the Periodic Table. In K. Littleton & P. Light (Eds.). *Learning with computers: Analysing productive interaction* (pp. 46-61). London: Routledge,.
- Lemke, J. (2001). The long and the short of it: comments on multiple timescale studies of human activity. *The Journal of the Learning Sciences*, 10 (1&2), 17-26.
- Littleton, K. (1999). Productivity through interaction: an overview. In K. Littleton & P. Light (Eds.) *Learning with Computers: Analyzing productive interaction* (pp. 179-194). London: Routledge,

- Martin, J., & Rose, D. (2003). *Working with discourse: Meaning beyond the clause*. London: Continuum Press.
- Maybin, J. (2005). *Children's Voices: talk, knowledge and identity*. Basingstoke: Palgrave Macmillan.
- Mercer, N. (1995). *The Guided Construction of Knowledge: Talk amongst teachers and learners*. Clevedon: Multilingual Matters.
- Mercer, N. (2000). *Words and Minds: How we use language to think together*. London: Routledge.
- Mercer, N. (2004). Sociocultural discourse analysis: analysing classroom talk as a social mode of thinking. *Journal of Applied Linguistics*, 1 (2), 137-168.
- Mercer, N., & Sams, C. (2006) Teaching children how to use language to solve maths problems, *Language and Education*, 20 (6), 507-527.
- Mercer, N., Wegerif, R., & Dawes, L. (1999). Children's talk and the development of reasoning in the classroom. *British Educational Research Journal*, 25 (1), 95-111.
- Mercer, N., Dawes, R., Wegerif, R., & Sams, C. (2004). Reasoning as a scientist: Ways of helping children to use language to learn science. *British Educational Research Journal*, 30 (3), 367-385.
- Payler, J. (2005). *Exploring Foundations: sociocultural influences on the learning processes of four year old children in a pre-school and reception class*. Doctoral thesis, Graduate School of Education, University of Southampton, UK.
- Potter, J. and Wetherell, M. (1994). *Discourse and Social Psychology*. London: Sage.

- Rasmussen, I. (2005). *Project Work and ICT: studying learning as participation trajectories*. Doctoral thesis, Faculty of Education, University of Oslo, Norway.
- Roth, W-M. (2001). Situating cognition. *The Journal of the Learning Sciences*, 10 (1&2), 27-61.
- Roth, W-M. (2005). *Talking Science: language and learning in science*. Lanham, MD: Rowman & Littlefield.
- Roth, W-M. (2006). *Learning Science: A singular plural perspective*. Rotterdam: Sense Publishers.
- Sawyer, K. (2001). *Creating Conversations: Improvisation in everyday discourse*. Cresskill, NJ: Hampton Press.
- Schegloff, E. (1997). Whose text? Whose context? *Discourse and Society*, 8 (2), 165-187.
- Scott, P., Mortimer, E., & Aguiar, O. (2006) The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. *Science Education*, 90 (4), 605-631.
- Shuart-Faris, N., & Bloome, D. (Eds.) (2005). *Intertextuality and Research on Classroom Education*. Greenwich, CT: IAP.
- Silverstein, M., & Urban, G. (Eds.) (1996). *Natural histories of discourse*. Chicago: University of Chicago Press.
- ten Have, P. (1999). *Doing Conversation Analysis: a practical guide*. London: Sage.
- Vygotsky, L.S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. London: Harvard University Press.

Wegerif, R. and Mercer, N. (1997). Using computer-based text analysis to integrate quantitative and qualitative methods in the investigation of collaborative learning.

*Language and Education, 11* (4), 271-286.

Wegerif, R. and Scrimshaw, P. (1997) (Eds.). *Computers and Talk in the Primary Classroom*. Clevedon: Multilingual Matters.

Wells, G. (1999). *Dialogic Enquiry: Towards a sociocultural practice and theory of education*. Cambridge: Cambridge University Press.

Wells, G., & Claxton, G. (2002) (Eds.) *Learning for Life in the 21<sup>st</sup> Century*. Oxford: Blackwell.

Wertsch, J. (1984). The Zone of Proximal Development: some conceptual issues. In B. Rogoff & J. Wertsch (Eds.) *Children's Learning in the Zone of Proximal Development: New Directions in Child Development, 23* (pp.7-18). New York: Jossey-Bass.

Wertsch, J.V. (1985) (Ed.). *Culture, Communication and Cognition: Vygotskian perspectives*. Cambridge: Cambridge University Press.

Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem-solving. *Journal of Child Psychology and Child Psychiatry, 17*, 89–100.