Chapter 8
Systematic Observation: Changes and Continuities Over Time

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Abstract Systematic observation of classrooms has a long and interesting history. This chapter presents a review of systematic observation that has been used as a research tool to study classrooms for the last 100 years. The methods of data collection and analysis used in the studies are described and discussed, with changes and continuities over time highlighted. The chapter argues that systematic observation of classroom practices has made an important contribution to our understanding of educational processes by enabling the study of pedagogic process in the naturalistic setting of the classroom. Such research has provided detailed and precise evidence about the extent to which educational innovations and policy reforms have resulted in changes in classroom practices and pupil learning outcomes. The chapter concludes with some comments on the current state of development in the field of systematic classroom observation and on ways in which it might usefully develop over the coming years.

Keywords Systematic observation • Classroom interaction • Classroom discourse • Mixed methods

Introduction

Systematic observation is a well-established type of research for studying classroom interaction that is said to date back a hundred years (Meehan et al. 2004). Essentially it involves allocating observed verbal and non-verbal behaviours to a set of previously specified categories and is generally used to collect quantitative data (Mercer 2010). The behaviours are usually quantified and they can be subjected to statistical analysis. For example, the observer may record the relative number of spoken interactions between teachers and students or measure the extent to which

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they produce types of utterance as defined by the researcher's categories, such as particular types of questions asked by teachers, who answered the question, and the type of follow-up given to the answer. The basic procedure for a systematic observation study is that researchers use their research questions and initial observations of classroom life to construct a set of categories into which all relevant verbal and non-verbal interactions can be classified. Observers are then trained to identify behaviours corresponding to each category and the reliability of their judgements checked so that they can sit in classrooms or work from video recordings and assign what they see and hear to the categories.

Many systematic observation studies of classroom interaction have used statistical techniques to analyse the coding of teacher behaviours and student learning outcomes to study whether there is any evidence of an association between the relative occurrence of particular features of classroom talk and students' success on task or learning gain. As well as allowing for an examination of any associations between aspects of and measures of outcome, the use of coding schemes for analysing classroom interaction also allows for a lot of data to be processed fairly quickly. This enables researchers to survey life in a large sample of classrooms without analysing it all in detail and to move fairly quickly and easily from observations to analysis. As will be argued throughout this chapter, systematic observation has undoubtedly provided interesting and useful insights into the patterning of classroom interaction in whole-class, group-based and one-to-one teaching and its impact on learning, and recent developments in the use of computerised systematic observation corpus data analysis software have ensured it continuing relevance and use/utility in educational research and evaluation.

The chapter starts with a discussion of how systematic observation has evolved over the last hundred years before going on to review recent developments in the use of systematic observation as a research tool. It concludes with a discussion of how systematic observation can be used in combination with other research approaches to inform and transform learning and teaching and learning outcomes in classrooms around the world.

A Brief History of Systematic Observation

The first published systematic observation study dates back to 1912 focusing on a study of teacher questioning (Stevens 1912). Two years later, observers noted students' participation in teacher-led recitations by marking a seating chart with small circles for each request to recite and small squares for each response to the request (Horn 1914). Similarly in 1928, Puckett used a series of symbols on a seating chart to record a range of teaching and student behaviours as 'pupil raised hand', 'was called on by the teacher' and 'made a fair response' (Engelhart 1972, p. 123). In the following year, a study of the relationship between teaching behaviour patterns of effective and ineffective teachers as determined by learning outcomes was reported by Barr (1931). Barr's observational data included counts of motivating behaviours

(e.g. nods approval) and types of questions asked by teachers (e.g. recall of facts, real judgements). Similarly in 1934, Wrightstone reported on a study in which teacher interactions with pupils were recorded on a class matrix to capture different teacher behaviours, such as 'proposes a question', 'allows a pupil to make a voluntary contribution' and discourages or prohibits a pupil contribution' (cited in Engelhart 1972, p. 124).

The use of systematic observation in process-product research, in which counts of verbal and non-verbal behaviours were correlated with behaviour and outcome measures, rapidly developed in the mid-1940s. Working with kindergarten and primary school teachers, Anderson and his colleagues from the University of Chicago developed 26 categories of verbal and non-verbal teacher behaviours that were grouped into two main categories known as 'dominative' and 'integrative' behaviours relative to their influence on student behaviours (Anderson et al. 1946). Examples of integrative behaviours included questioning to help a student define, refine and solve a problem, approving, commending and accepting a student contribution and asking questions about a student's expressed interests. Both sets of behaviours were observed and recorded in the system, as well as individual or group contacts of teachers with students. It was found that the teacher's behaviour and personality influenced the students in their classrooms: teachers who were dominative in their classrooms tended to promote 'aggressive and antagonistic behaviours in their students as expressed towards both the teacher and their classmates', whereas teachers who used socially integrative behaviours tended to facilitate friendly, cooperative and self-directive behaviours in their pupils.

In 1949, following on from the work of Anderson, Withall, also a graduate student from the University of Chicago, published a landmark systematic observation study entitled 'The Development of a Technique for the Measurement of Social-Emotional Climate in Classrooms' (Withall and Lewis 1963). In his study, Withall argued that the social-emotional climate in the classroom was an outcome determined by the teacher's verbal behaviour. Using an extensive analysis of audio recordings of daily classroom sessions in a sample of junior high school classes, seven categories of teacher verbal behaviours were eventually identified in Withall's Social-Emotional Climate Index: (i) commended or approved the learner, (ii) conveyed understanding or acceptance of the learner, (iii) gave information to or asked questions of fact, (iv) comprised 'chit-chat' and routine administrative items, (v) limited or controlled the learner's behaviour, (vi) deprecated or disapproved and (vii) defended or supported the teacher (p. 698). The first three categories were seen as 'learner-centred', the last three as 'teacher-centred' and the fourth category in the middle was seen neutral in terms of climate or tone. Users of the Social-Emotional Climate Index were instructed to listen carefully to determine the dominant intent of the teacher's voice. If the intent was to sustain the learner more than the teacher, the statement was categorised into one of the first three categories, whereas if the intent of the teacher's statement was to support the teacher more than the learner, then it was categorised into the last three categories.

Building on Withall's categories, Flanders, also a graduate of the University of Chicago, developed his interaction analysis system by added three new items to the

original seven (Flanders 1970). Two of the new categories were for student verbalisations, and the third was for silence or confusion. A unique aspect of Flanders' system was the development of a matrix that allowed for multiple coding using the ten categories of behaviours to record the interaction sequences of a lesson. Whatever happened in a three-second interval was classed as an event and coded immediately. It was this sequencing of classroom interactions that made Flanders' system so popular in educational research so that systematic observation of classrooms investigating various aspects of classroom processes connected to student outcomes, known as process-product studies, flourished from the 1960s onwards. Out of Flanders' systematic observations of classroom work in the USA there developed the 'two-thirds' rule: about two-thirds of classroom time is devoted to talking; about two-thirds of this time, the person talking is the teacher; and two-thirds of teacher talk is made up of opinions, directing and criticising students.

The growing popularity of systematic observation in educational research was reflected in the publication of *Mirrors for Behaviour: An Anthology of Observation Systems* in 1967 (Simon and Boyer 1967). In the anthology 26 observation systems are presented, and this was followed by the publication of 66 more observation systems in an additional volume of *Mirrors for Behaviour* in 1970 (Simon and Boyer 1970). In both volumes, Simon and Boyer assigned the observation schedules to either the affective or cognitive domain or both. They argued that the affective observation systems deal with the emotional climate of the classroom by coding the teacher's behaviours to students, while the cognitive observation systems deal with the thought processes as expressed in the classroom through the coding of teacher statements, questions to students and student responses to the questions.

In the *Review of Educational Research*, Rosenshine (1970) conducted a review of systematic observation instruments and grouped them into two major divisions: category systems and rating systems. He argued that category systems were low-inference measures because they focused on specific, observable, objective behaviours that could be recorded as frequency counts. On the other hand, he classified rating systems as high inference because the observer had to infer the constructs to be rated, such as enthusiasm of the teacher, clarity of explanation or how supportive the teacher was of the students. In addition, rating systems required the observer to infer the frequency of such behaviours to arrive at ratings such as consistently, sometimes or always. Three years later, Rosenshine and Furst (1973) estimated well over 120 systematic systems had been developed at the time of writing. In addition to category and rating systems, they also introduced the sign system as a category in which an event is recorded only once regardless of how often it occurs within a given period. The 1970s also saw the development multiple coding schemes making use of more than one instrument (Stallings 1977).

By the end of the 1980s, many more multiple coding systems, in which a single behaviour or event is coded in two or more category systems, such as roles of the individual, gender and content of the interaction, had been developed in a number of different countries such as Israel, New Zealand and Australia (Anderson and Burns 1989). By the 1990s, more qualitative, ecological and ethnographic observation systems using participant observation and field notes to capture observations in

narrative form were being developed, emphasising the social context of learning and leading to a decline in process-product research (Stallings and Mohlman 1990).

Similarly in the UK, throughout the1960s and 70s, process-product research was increasingly being used in British primary schools to study teaching styles and their impact on pupil behaviours and learning outcomes. In 1975 the Observational Research and Classroom Learning Evaluation (ORACLE) project was launched consisting of two main studies: a longitudinal process-product study over a period of 5 years of teaching and learning in the junior age (7–11) classrooms and a second study focusing on the use of collaborative group work (Eggleston et al. 1976). The study was designed to research the impact of the recommendations of the 1967 review of primary education in England, entitled *Children and their Primary Schools,* and unofficially known as the Plowden Report, on classroom practices. The report recommended that the child should be at the heart of the education process and was seen as the start of 'child-centred' education in England. The first study used the reacher record (Boydell 1974), and the second used the pupil record (Boydell 1975).

The research suggested that in a typical primary classroom, pupils usually interacted individually with the teacher. Either the teacher moved rapidly around the classroom helping children with difficulties or pupils queued at the teacher's desk, waiting their turn for attention. Many of the interactions were brief (40% being over in under 5 seconds), and in an average class of 35 pupils, a teacher could manage on average could 6 minutes of individual interaction per child per day. The findings therefore suggested classroom interaction between teachers and pupils was largely asymmetrical, with teachers typically spending 78% of the time interacting with pupils, whereas a pupil, on average, spent 84% of the time working on his/her own without interacting with either the teacher or another pupil (Galton 1987).

The study found pupils received most attention from the teacher during the 15% of time they were part of whole-class teaching, and where it was found, there were higher levels of time on task and greater frequency in the use of open questions and statements of ideas. Group activity was rare: when children did talk to each other, over 60% of their conversations were to do with matters not connected to the task in hand. The findings were supported by other UK studies such as those by Mortimore et al. (1988) and Alexander et al. (1996). Taken together, the evidence suggested there was a need for a better balance in the use of class, group and class teaching according to 'fitness for purpose' (Alexander et al. 1992).

In order to study the impact of the national curriculum on teaching and learning practices in the English primary classroom, 20 years on Maurice Galton and his colleagues replicated the 1976 ORACLE study using the same observation instruments and the same classrooms so that the ambiguities arising from the use of different samples and different methods could be reduced (Galton et al. 1999). The follow-up study found there had been a decline in individual interactions with a corresponding increase in teacher interaction with both groups and the whole class. Compared with 1976, individual interactions had changed from 43.1% to 48.4%, group interactions from 14.6% to 16.4% and whole-class interactions from 31.3% to 35.2%. Whereas in 1976 the ORACLE findings loosely followed Flanders' (1970) *two-thirds rule of*

classroom activity involving talk, in 1996 around *three-quarters* of all classroom activity involved talk, either questions or statements, the consequence of the 16% increase in the proportion of whole-class teacher-pupil interaction. However, the increase in whole-class teaching was largely made up of teachers talking *at* pupils through statements and not in talking *with* pupils by asking questions and building on their answers.

Teacher use of statements and questions remained remarkably stable across the two decades: in 1976 an ORACLE teacher typically made use of 3.7 times as many statements as questions, and in 1996 the ratio was 3.6. Similarly in studies conducted by Alexander over a 4-year period, most of the questions asked by teachers were of a low cognitive level, requiring one- or two-word responses, and many were rhetorical (Alexander et al. 1996). There were very few cases in which pupils initiated the questioning. Overall, despite the increase in whole-class teaching, the ORACLE findings suggest the pattern of teachers' discourse at the level of questions and statements has remained relatively stable across the two decades.

In terms of changes in teacher use of questions and statements over the 20-year period, while the shift to whole-class teaching meant there was a greater emphasis on teachers instructing and asking questions, factual and closed questions were still dominant. They accounted for the greatest part of the increased proportion of questioning, and teachers devoted more time to telling pupils facts and ideas and giving directions than their counterparts of 20 years ago. However, while there has been an increase in the overall proportion of time spent on whole-class teaching, there has not been a radical shift in the pattern of teacher-pupil interaction, largely made up of teacher explanation and closed questioning, with little in the way of authentic questions, suggesting a considerable degree of consistency in the underlying pedagogy across the two decades.

Broadening the Focus of Systematic Observation

As discussed in the previous section, the popularity of systematic observation in researching classrooms started to decline from the 1990s onwards. This was largely due to the growing popularity of sociocultural research and linguistic ethnography approaches to researching classroom practices. Such approaches were also assisted by the development of computer-based software for observing classrooms and for conducting quantitative corpus data analysis of spoken and written texts. It was increasingly being recognised that studying and understanding classroom processes presented considerable theoretical and practical challenges and that categorical coding schemes by themselves often ignored the historical, institutional and cultural context within which a lesson is located. To address these concerns, many sociocultural studies used observational, interventional and/or quasi-experimental designs incorporating the collection of quantitative and qualitative data to capture the fluid process of classroom interaction, whereby teachers and students build relationships and shared understandings over time (Mercer 2010).

Drawing on the fields of social and developmental psychology and pedagogical studies, sociocultural researchers emphasised the role of teachers and students as active participants in the construction of knowledge on the basis of ideas and experiences contributed by the students as well as the teacher. The sociocultural view of learning suggested that classroom discourse is not effective unless students play an active part in their learning. This view of learning suggested that learning does not take place through the addition of discrete facts to an existing store of knowledge but when new information, experiences and ways of understanding are related to an existing understanding of the matter in hand (Hardman 2008). One of the most important ways of working on this understanding was through talk, particularly where students are given the opportunity to assume greater control over their own learning by initiating ideas and responses. In this way, they can contribute to the shaping of the verbal agenda and introduce alternative frames of reference which are open to negotiation and where the criteria of relevance are not imposed.

Sociocultural theory therefore questioned the value of the linguistic and cognitive demands made on students within the traditional teacher-led question-answer recitation format where the students are mainly expected to be passive and to recall, when asked, what they have learned and to report other people's thinking. It led to the researching of alternative approaches to traditional transmission modes of teaching in whole-class teaching, including the use of cooperative group work. In an attempt to open up classroom discourse and encourage greater student participation, research focused on the promotion of 'higher-order' questioning techniques to promote reflection, self-examination and enquiry through the use of 'open' questions which invited students to speculate, hypothesise, reason, evaluate and consider a range of possible answers (Wragg 1999). It also led to the researching of a range of alternatives to teacher questions, including the use of provocative, open-ended statements, encouraging students to ask their own questions and maintaining silence so that students have thinking time before they respond (Dillon 1994). Such alternatives to teacher questions also led, as will be discussed later, to a shift in emphasis in the way teachers reacted in their feedback to student responses.

Sociocultural into classroom interaction and discourse has also been informed by work on the linguistic patterning of teacher-student interaction carried out in the UK and USA in the 1970s. Sinclair and Coulthard (1975) revealed the initiation-response-feedback (IRF) exchange as being central to teacher/pupil interaction. In its prototypical form, a teaching exchange consists of three moves: an *initiation*, usually in the form of a teacher question; a *response*, in which a pupil attempts to answer the question; and a *follow-up* move, in which the teacher provides some form of feedback (very often in the form of an evaluation) to the pupil's response. In a similar study in the USA, Mehan (1979) used 'evaluate' to designate the third move because it was found that this move in the exchange was often used to provide an evaluation of a student's answer.

International research into classroom interaction and discourse suggests the IRF structure is central to all classroom teaching (Alexander 2001; Hardman and Abd-Kadir 2010). It is particularly prevalent in directive forms of teaching and often consists of closed teacher questions, brief student answers which teachers do not

build upon, superficial praise rather than diagnostic feedback and an emphasis on recalling information rather than genuine exploration. This has led some researchers to call for the demise of the IRF exchange because of the cognitively limiting role it appears to afford to students where most of the questions asked by teachers are of a low cognitive level designed to funnel responses towards a required answer (Lemke 1990).

While accepting its pervasiveness, other researchers have argued that the IRF can be functionally effective, leading to very different levels of student engagement and participation. Mercer (1995), for example, argued that it can be an effective means of monitoring students' knowledge and understanding, guiding their learning and identifying knowledge and experience which is considered educationally significant, thereby promoting academic forms of discourse. Others suggest that the IRF structure can take on a variety of forms and functions leading to different levels of student participation and engagement, particularly through the use that is made of the feedback move. Nassaji and Wells (2000), for example, suggest that through feedback which goes beyond evaluation of the pupil's answer, the teacher can extend the answer to draw out its significance so as to create a greater equality of participation for the student.

Similarly, Nystrand et al. (1997) advocated that teachers pay more attention to the way in which they evaluate student responses so that there is more 'high-level evaluation' whereby teachers incorporate student answers into subsequent questions. In this process, which they termed *uptake*, they suggested that teacher's questions should be shaped by what immediately precedes them so that they are genuine questions. When such high-level evaluation occurs, the teacher ratifies the importance of a student's response and allows it to modify or affect the course of the discussion in some way, weaving it into the fabric of an unfolding exchange. Such high-level evaluation therefore chains together teacher questions and student responses so that the discourse gradually takes on a conversation-like quality, thereby encouraging more student participation.

Computer-Based Systematic Classroom Observation

The development of computer-based software for observing classrooms and for text analysis for analysing large databases of written and spoken language that can be subjected to statistical analysis has greatly facilitated the sociocultural research into classroom interaction and discourse practices. Such software is a powerful tool for sorting, storing and organising and systematically analysing a large set of classroom data. The computerised systems have enabled researchers to observe lessons in real time and are much quicker than traditional paper and pencil methods because the data is instantly stored and therefore available for immediate analysis.

For example, a computerised system developed by Smith and Hardman (2003) logged (for each teaching exchange): the actor, the discourse move and who the receiver was. The observation schedule primarily focused on the three-part, IRF

structure and gathered data on teachers' questions, whether questions were answered (and by whom) and the types of evaluation given in response to answers. It also recorded pupil initiations in the form of questions and statements. Within each discourse move, a range of *modifiers* were available. For example, the system recorded whether teacher questions were 'open' (i.e. as in Galton, Hargreaves, Comber, Wall and Pell's 1999, study, defined in terms of the teacher's reaction to the pupils' answer: only if the teacher will accept more than one answer to the question would it be judged as open) or 'closed' (i.e. calling for a single response or offering facts). Responses were coded according to whether a boy or girl answered or whether there was a choral reply.

Teacher feedback to a pupil's answer was coded according to whether it was praised, criticised, accepted or probed for further elaboration. The system also recorded teacher explanations, directions, refocusing of the class and reading and writing activities. In order to see whether teachers are using a range of discourse styles as suggested in the research literature, the system also captured a range of alternative strategies, for example, *uptake* questions (where the teacher incorporates a pupil's answer into a subsequent question). As well as logging the *frequency* of each discourse move as it happened, the system also gathered data on the *duration* of each discourse move. This allowed the researcher to gather valuable information about the pace of a lesson.

Studies of national strategies designed to improve the teaching of literacy and numeracy in England carried out by Hardman and his colleagues using macro and micro levels of analysis through the computer-based systematic observation and discourse analysis revealed the ubiquity of the IRF structure (Mroz et al. 2000; Hardman et al. 2003, 2005; Smith et al. 2004, 2006, 2007). Overall, it was found that in the whole-class section of literacy and numeracy lessons, teachers spent the majority of their time either explaining or using highly structured question and answer sequences. Compared to earlier studies of English primary classrooms, the findings suggested that traditional patterns of whole-class interaction had not been dramatically transformed by the national strategies designed to increase the amount of 'whole-class interactive teaching' (Reynolds and Farrell 1996).

The studies revealed that far from encouraging and extending pupil contributions to promote higher levels of interaction and cognitive engagement, most of the questions asked by teachers were of a low cognitive level designed to funnel pupil responses towards a required answer. Overall, it was found that open questions (designed to elicit more than one answer) made up 10% of the questioning exchanges and 15% of teachers did not ask any such questions. Probing by the teacher, where the teacher stayed with the same pupil to ask further questions to encourage sustained and extended dialogue, occurred in just over 11% of the questioning exchanges. Uptake questioning (building a pupil's answer into a subsequent question) occurred in only 4% of the teaching exchanges, and 43% of the teachers did not use any such moves. Only rarely were teachers' questions used to assist pupils to more complete or elaborated ideas. Most of the pupils' exchanges were very short, lasting on average 5 seconds, and were limited to three words or less for 70% of the time.

The findings are similar to a computerised analysis of teacher-pupil discourse moves of more than 200 eighth- and ninth-grade English and social studies classes in a variety of schools in the Midwest of America (Nystrand et al. 2003). One of the aims of the research was to identify changes over time in the patterning of the classroom discourse with a particular focus on the use of dialogic episodes leading to greater student participation in the classroom talk. Nystrand and his colleagues found that whole-class discussion in which there is an open exchange of ideas averaged less than 50 seconds in the eighth grade and less than 15 seconds in the ninth grade. Using markers of interactive discourse such as open-ended questions, uptake questions, pupil questions, cognitive level and level of evaluation, it was found that shifts from recitational to dialogic discourse patterns were rare: in 1151 instructional episodes that they observed (i.e. when a teacher moves on to a new topic), only 66 episodes (6.69%) could be described as dialogic in nature.

Research in primary classrooms in low-income countries also shows the domination of teacher-led recitation. For example, evidence from Burma (Hardman et al. 2014, Kenya (Ackers and Hardman 2001; Pontefract and Hardman 2005; Hardman et al. 2009), Nigeria (Abd-Kadir and Hardman 2007) and Tanzania (Hardman et al. 2012) shows that teacher-pupil interaction often takes the form of lengthy recitations of question (by the teacher) and answer (by individual pupils or the whole class) within an IRF structure. The practice of asking pupils to complete a sentence either through a direct repetition of the teacher's explanation or pupil's answer or through omitting the final word, or words, or a combination of both these strategies was very common.

Similar to sociocultural research, linguistic ethnographic and conversation analysis approaches emphasised that language and social life are mutually shaping. Everyday talk, including classroom, is always referential, interpersonal, emotive and evaluative, and socialisation is a never-ending process that is mediated through talk and interaction. The pedagogic implication is that children use talk in the classrooms to negotiate and explore their identities, and because such social situations are unique, generalisations of the kind made by quantitative researchers are of questionable validity. Conversation analysis emerged in the 1960s from the sociological field of ethnomethodology to study how the social world operates through people's actions, by focusing on how social interaction is achieved through everyday talk and how people perceive their social experiences. Research in conversation analysis over the past 30 years has shown how technical aspects of talk-in-interaction are structured, whereby participants perform and coordinate activities through talking together and build their social lives and construct their social relations with one another. It has been widely used in the analysis of talk in work-related settings (Drew and Heritage 2006) and in classroom research (Seedhouse 2005) exploring the relationship between pedagogy and interaction in English as a second language classrooms and between the pedagogical focus of the interaction and the organisation of turn-taking, sequence and repair.

Research by Lefstein and Snell (2011) in the UK integrating linguistic ethnographic approaches, using lesson transcription and microanalysis of selected episodes, with computer-assisted systematic classroom observation focusing on

whole-class teaching, has enabled a more nuanced interpretation of teacher pacing in lessons. They found teacher use of pace is rooted in the meaningful content of the conversation, including the extent to which this content is new and/or surprising to participants, if and how the conversation matters and how participants treat one another's contributions, so that at 'their extremes, objective and subjective pace may be inversely related: meaningful and important content requires us to slow down in order to attend and think; less consequential ideas require that we speed up, to get through the material as quickly as possible' (p.21). Lefstein and Snell's research into classroom practices demonstrates how systematic observation and micro-ethnographic approaches can be combined leading to the generation and testing of hypotheses and more generalisable findings while maintaining qualitative and ethnographic insights (Lefstein and Snell 2014).

Similarly, Molinari and colleagues used computerised corpus data software to analyse micro-transitions occurring within IRF exchanges in Italian primary school lessons (Molinari et al. 2012). The teachers' questions were coded according to two categories, function and form, and the pupils' answers were coded according to three categories: form, correctness and production. The teachers' follow-ups were coded into two categories, one concerning the teaching-learning processes and the second assessing the relational quality. The relational quality of the third turn was coded with reference to both content and non-verbal indicators (the teacher's voice tone, facial expressions, hand gestures, eye gazes). The coding of this last category was made possible by the convergence between the information coming from the transcripts and from the videos.

The study found that while IRF sequences are a pervasive linguistic feature of classroom discourse, and that in most cases teachers firmly control the interaction, the use of authentic questions often led to bound exchanges in which a more dialogic interaction between teachers and students was possible. The statistical sequential analysis of the links between teaching exchanges was used to explore whether the form of a question, either open or closed, triggers differently interactive sequences. It was found that authentic questions were significantly followed by complex answers and the reinitiation of the same question to different pupils. Teacher follow-up was also found to be important in extending the teaching exchanges. Where teachers accepted or rejected an answer, the sequence was often short, but in cases where the teacher followed up an incorrect answer to help the student reformulate it in a more correct way, the exchanges became more extended and dialogic in nature. At the third turn, the teacher might also elaborate on the response by reformulating it or adding details and information in order to improve the quality of the answer. They would also extend the turn with requests for clarification, use of examples and solicitation of reformulations or reflections to co-construct and guide the development of deduction skills, reasoning and thinking. These sequences were, therefore, fruitful occasions for co-constructing knowledge and encouraging student active participation in the discourse.

Such microanalysis of the transitions across teaching exchanges as used by Mollinari and colleagues therefore makes it possible to verify under which circumstances classroom discourse can take on a more dialogic function. The results dem-

onstrate that teachers can open up the classroom discourse to students in several different ways through the use of a wider repertoire of initiations and follow-ups. The findings also point to the importance of training teachers in the use of open or authentic questions and following up student answers with probes, comments and questions which build on and scaffold the student answers.

Looking to the Future

The analysis of classroom processes brings with it many challenges for researchers as discussed throughout this chapter. No approach by itself, whether it uses qualitative or quantitative methods or an experimental design or naturalistic observation, will adequately capture the complexity of classroom life. As each will have its strengths and weaknesses, it makes sense to combine two or more methods that draw on both quantitative and qualitative analysis so that weaknesses are counterbalanced and evidence of more than one kind is generated to address concerns about validity and methodological consistency. There is also the need to conduct more rigorous research to investigate how different forms of classroom talk impact on learning outcomes. More large-scale, longitudinal studies which use systematic quantitative analysis and qualitative analysis to conduct impact and process evaluations to consolidate and extend the evidence base are needed.

It will also be important to involve teachers in the analysis of classroom talk and interaction to help in the transforming of beliefs, knowledge, understandings, skills and commitments, in what they know and able to do in their classroom practice with regard to teaching and learning. The school and classroom should be the focus of interventions for improving the quality of teaching and learning, involving the school head and all the teachers in creating a genuine teaching community through ownership of the process. School-based teacher development and research programmes building on existing systems and structures, and linked to study materials, coaching, observation and feedback by colleagues, can help teachers to explore their own beliefs and classroom practices as a way of bridging the gap between theories and pedagogical practice and to explore alternative classroom interaction and discourse approaches (Hardman 2011).

While the development of observational software has done much to enhance the researching of classroom practices by enabling the sorting, storing, organising and systematic analysis of large data sets, it works best when the coding systems are informed by a more nuanced understanding of classroom talk derived from linguistic and micro-ethnographic analysis. Similarly, such qualitative analysis of classroom talk will be complemented by systematic quantitative analysis when the large data sets are used to show the significance and generalisability of the findings derived from the microanalysis. Systematic observation software therefore has a key role to play in the future of educational research and evaluation.

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