Speaking in and about mathematics classrooms internationally: The technical vocabulary of students and teachers

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David Clarke is a Professor of Education and the Director of the International Centre for Classroom Research (ICCR) at the University of Melbourne. Over the last 15 years, Professor Clarke's research activity has centred on capturing the complexity of classroom practice through a program of international video-based classroom research. The ICCR is unique in the facilities it offers for the manipulation and analysis of classroom data and provides the focus for collaborative activities among researchers from China, the Czech Republic, Germany, Hong Kong, Israel, Japan, Korea, New Zealand, Norway, the Philippines, Portugal, Singapore, South Africa, Sweden, the United Kingdom and the United States of America. Under Professor Clarke's direction the ICCR has developed a system for web-mediated, secure, high-speed data entry, retrieval and analysis on an international scale (*videoPortal*). Other significant research has addressed teacher professional learning, metacognition, problem-based learning, and assessment (particularly the use of open-ended tasks for assessment and instruction in mathematics). Current research activities involve multi-theoretic research designs, cross-cultural analyses and the challenge of research synthesis in education. Professor Clarke has over 120 research publications, including 8 books, 35 book chapters, 41 refereed journal articles, and 39 refereed papers in conference proceedings.

Abstract

This presentation takes patterns of language use as the entry point for the consideration of discourses in and about the mathematics classroom. These patterns of language take the form of discourses performed *within* mathematics classrooms around the world and among the international mathematics education community *about* the mathematics classroom. Cross-cultural comparisons reveal how discourses in and about the mathematics classroom have developed in different cultures. Research is used to explore the role of spoken language in mathematics classrooms situated in Asian and Western countries. In conceptualising effective learning, researchers, teachers and curriculum developers need to locate proficiency with mathematical language within their framework of valued learning outcomes. Further, different cultures, employing different languages, have chosen to name and therefore privilege different classroom activities. Research is reported into how language is and might be used to describe the events of mathematics classrooms in different cultures. Research and theorising undertaken in and about those mathematics classrooms must be sensitive to the participants' conceptions of classroom practice, as performed in classroom discourse and as expressed in the professional discourse of mathematics educators in those communities.

Presentation summary

Classroom discourse (and professional discourse about classrooms) is a form of social performance undertaken within affordances and constraints that can be both cultural and linguistic. The nature of these discourses, as performed *in* mathematics classrooms, provides a key indicator of pedagogical principles underlying classroom practice and the theories of learning on which these principles are implicitly founded. The discourses *about* mathematics classrooms give expression to these pedagogical principles sometimes explicitly and sometimes through embedding privileged forms of practice in the naming conventions by which the mathematics classroom is described. From research undertaken in classrooms situated in different cultures, it appears that both mathematical discourse and professional discourse take different forms and are differently valued in different communities. This presentation draws on and connects research into these two discourses.

The spoken mathematics study

Research was conducted into the situated use of mathematical language in selected mathematics classrooms internationally. The major concern of this study was to document the opportunity provided to students in each classroom for the oral articulation of the relatively sophisticated mathematical terms that formed the conceptual content of the lesson and to distinguish one classroom from another according to how such student mathematical orality was afforded or constrained in both public and private classroom contexts.

This research was undertaken as a sub-project within the Learner's Perspective Study, in which data generation used

three video cameras, supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews. The complete research design has been detailed elsewhere (Clarke, 2006). For the analysis reported here, the essential details relate to the standardisation of transcription and translation procedures. Since three video records were generated for each lesson (teacher camera, student camera and whole class camera), it was possible to transcribe three different types of oral interactions: (i) whole class interactions, involving utterances for which the audience was all or most of the class, including the teacher; (ii) teacher–student interactions, involving utterances exchanged between the teacher and any student or student group, not intended to be audible to the whole class; and (iii) student–student interactions, involving utterances between students, not intended to be audible to the whole class. All three types of oral interactions were transcribed, although type (iii) interactions could only be documented for the selected focus students in each lesson. Where necessary, all transcripts were then translated into English.

The analysis determined the number of utterances occurring in whole class and teacher–student interactions in a sequence of five lessons from each of the classrooms studied (a total of 105 lessons from 21 classrooms in Berlin, Hong Kong, Melbourne, San Diego, Seoul, Shanghai, Singapore and Tokyo), together with the frequency of public statement of mathematical terms and, in a separate analysis, the number of utterances and spoken mathematical terms in the context of student–student (rather than public) interactions. An utterance was taken to be a single, continuous oral communication of any length by an individual or group (choral). *Private* student–student interactions were distinguished from whole class or teacher–student interactions, both of which were considered to be *public* from the point of view of the student.

The average number of public utterances per lesson provides an indication of the public oral interactivity of a particular classroom. Figure 1 distinguishes utterances by the teacher (light grey), individual students (black) and choral responses by the class (e.g. in Seoul) or a group of students (e.g. in San Diego) (dark grey). Any teacher-elicited, public utterance spoken simultaneously by a group of students (most commonly by a majority of the class) was designated a 'choral response'. Lesson length varied between 40 and 45 minutes and the number of utterances has been standardised to 45 minutes. Each bar in Figure 1 represents the average over five lessons for that classroom. Figure 2 shows the number of publicly spoken mathematical terms (as defined earlier)

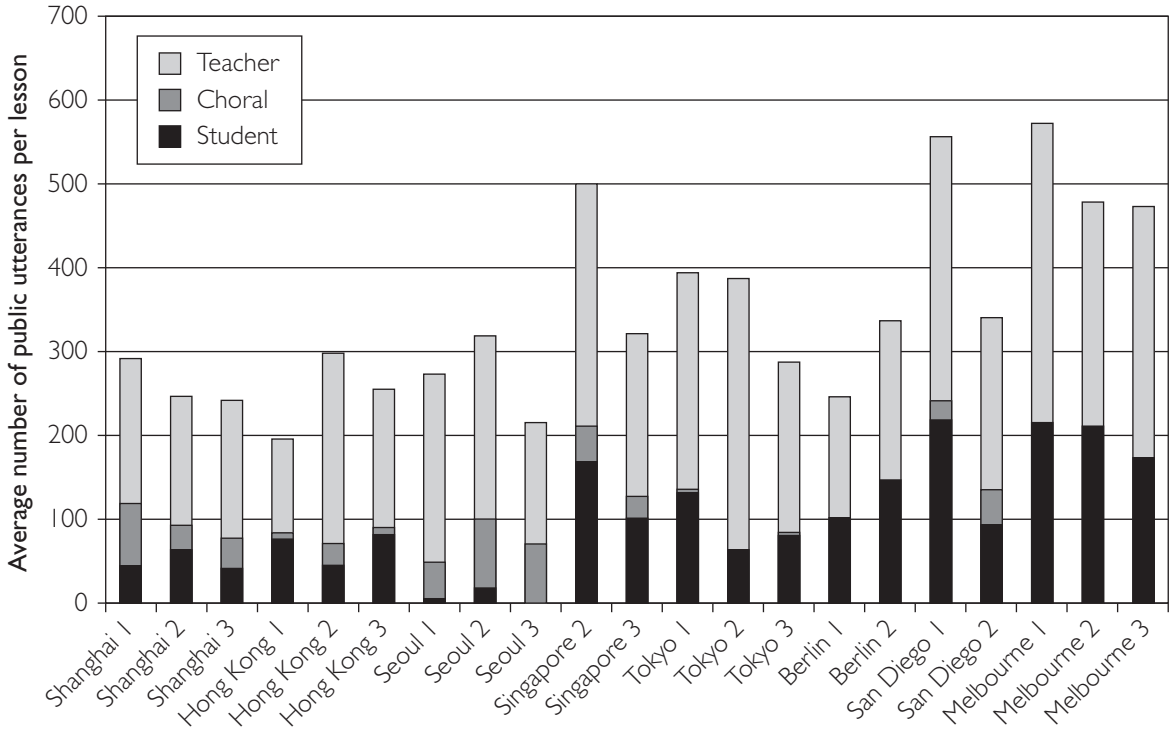

Figure 1: Average number of public utterances per lesson in whole class and teacher–student interactions (public oral interactivity)

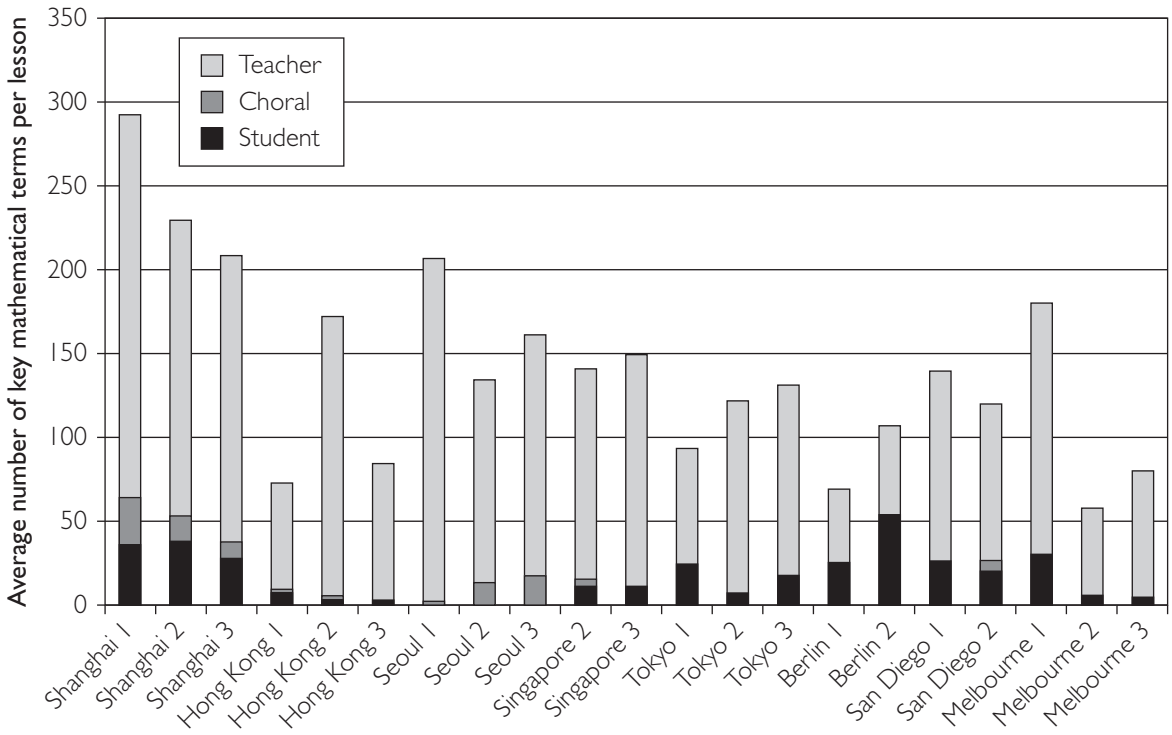

Figure 2: Average number of key mathematical terms per lesson in public utterances (whole class and teacher–student interactions) (mathematical orality)

per lesson, averaged over five lessons for each classroom.

The classrooms studied can be also distinguished by the use made of the choral recitation of mathematical terms or phrases by the class. This recitation included both choral response to a teacher question and the reading aloud of text presented on the board or in the textbook. The most striking difference between first and second stage analyses (Figures 1 and 2) was the reversal of the order of classrooms according to whether one considers public oral interactivity (Stage One) or mathematical orality (Stage Two).

In considering student-student utterances, only focus students' 'private' utterances could be recorded. The classrooms in Shanghai and Seoul were characterised by the almost complete absence of this form of interaction. Frequency counts were constructed for both public and private Oral Interactivity and Mathematical Orality and expressed as per focus student per lesson, effectively averaged over the spoken contributions of at least 10 students per classroom. Detailed findings are reported elsewhere (e.g. Clarke & Xu, 2008).

It is clear that some mathematics teachers valued spoken mathematics and some did not. Some teachers orchestrated the public rehearsal of spoken mathematics, but discouraged private (student-student) talk (e.g. Shanghai 1, 2 and 3), while other teachers utilised student–student mathematical conversations as a key instructional tool (e.g. San Diego 2 and Melbourne 1). If the goal of classroom mathematical activity was fluency and accuracy in the use of written mathematics, then the teacher may accord little priority to students developing any fluency in spoken mathematics (e.g. Seoul 1, 2 and 3). On the other hand, if the teacher subscribes to the view that student understanding resides in the capacity to both justify and explain the use of mathematical procedures, in addition to technical proficiency in carrying out those procedures in solving mathematics problems, then the nurturing of student proficiency in the spoken language of mathematics will be prioritised, both for its own sake as a valued skill and also because of the key role that language plays in the process whereby knowledge is constructed. Despite the frequently assumed similarities of practice in classrooms characterised as Asian, differences in the nature of students' publicly spoken mathematics in classrooms in Seoul, Hong Kong, Shanghai, Singapore and Tokyo were non-trivial and suggest different instructional theories underlying classroom practice.

The international classroom Lexicon Project

The Lexicon Project is based on the premise that the international dominance of English runs the risk of denying researchers, theoreticians and practitioners access to many sophisticated, technical classroom-related terms in languages other than English, which might otherwise contribute significantly to our understanding of classroom instruction and learning. The intended product of this research is a 'Classroom Lexicon' of such terms, with English definitions and descriptive detail, supported by video exemplars. Such a video-illustrated lexicon has the potential to be a major resource in teacher pre-service and in-service programs and to offer new insights to classroom researchers. The lexicon is produced by face-to-face negotiation with researchers from more than 10 countries, through the collaborative coding of a selection of video material of mathematics lessons drawn from classrooms in Cesky Budejovice, Hong Kong, Melbourne, San Diego, Shanghai, Tokyo and Uppsala. The particular lessons were chosen in consultation with local researchers in each country to provide a wide variety of different classroom activities in order to stimulate participants' recall of the largest possible number of pedagogical terms.

It might be expected that the internationalisation of the mathematics education community would afford an expansive re-conception of the practice of mathematics teaching reflective of the wide diversity of classroom practices found in mathematics classrooms around the world. Ironically, internationalisation has strengthened the establishment of English as the lingua franca of the international mathematics education community and thereby restricted international use of some of the subtle and sophisticated constructs by which mathematics teachers and teacher educators in non-English speaking countries would describe and evaluate the practices occurring in their mathematics classrooms.

If an activity is named, it can be recognised and it becomes possible to ask 'how well is it done?' and 'how might it be done better?' Not only is an unnamed activity less accessible for research analysis, but practising teachers are denied recognition of an activity that at least one culture feels is sufficiently important to have been given a specific name. An unnamed activity will be absent from any catalogue of desirable teacher actions and consequently denied specific promotion in any program of mathematics teacher education. Actions considered as essential components of the mathematics teacher's repertoire in one country – for example, *mise en commun* (France), *pudian* (China), *učitelská ozvěna* (Czech Republic) or *matome* (Japan) – may be entirely absent from any catalogue of accomplished teaching practices in English. Yet each of these same pedagogical activities may well reward independent research, offering novel instructional and learning opportunities (see, for example, Shimizu, 2008).

> *Mise en commun* – a whole-class activity in which the teacher elicits student solutions for the purpose of drawing on the contrasting approaches to synthesise and highlight targeted key concepts.
>
> *Pudian* – an introductory activity in which the teacher elicits student prior knowledge and experience for the purpose of constructing connections to the content to be covered in the lesson.
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> *Ucitelská ozvěna* – the 'teacher's echo' when the teacher

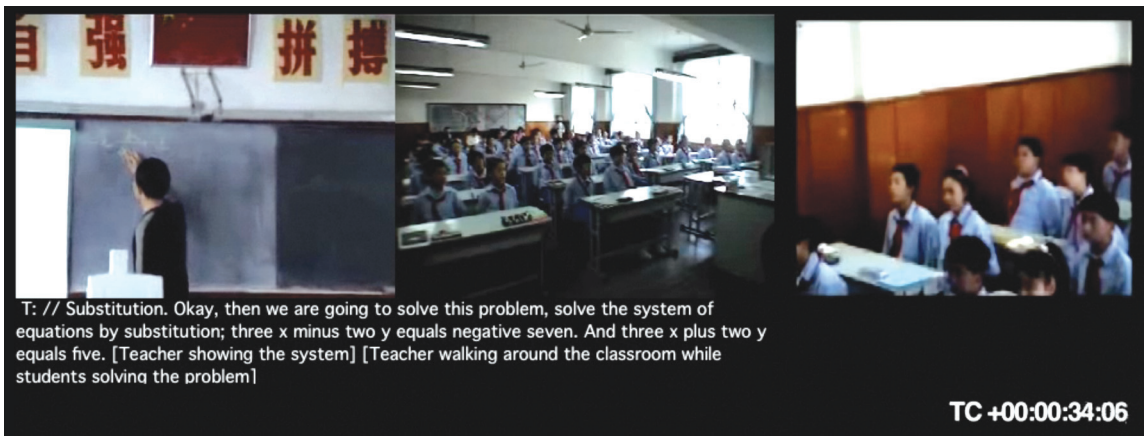

Figure 3: Video stimulus layout (key elements are: three synchronized camera views – teacher camera, whole class camera, student camera; classroom dialogue in English subtitles; timecode)

reformulates a student's answer to increase its clarity or mathematical correctness; ideally, without appropriating the student's intellectual ownership of the response.

Matome – a teacher-orchestrated discussion, drawing together the major conceptual threads of a lesson or extended activity – most commonly a summative activity at the end of the lesson.

We, as researchers, select our theoretical tools because the actions and outcomes they privilege resonate with educational values that we already hold. These educational values find their embodiment in the forms of classroom activity that our culture has chosen to name. This reproductive process can only amplify our pre-existing assumptions regarding what is to be valued and what is to be discarded. Research-based advocacy of instructional practice runs the risk of only entrenching the vision of the classroom enshrined in the researcher's language and culture. Language does not just mediate the researcher's categorisation of what occurs in the classroom. Language was there before us, determining which classroom activities are conceptualised and enacted by the participants. Further, the theories we construct are constrained to those constructs and relationships we are capable of naming. And our 'evidence-based' instructional advocacy reproduces this chain of compounded constraints, leading us to ignore other, potentially effective, instructional alternatives.

Summative remarks

The professional discourse of the international mathematics education community is constrained by the dominance of English. The classrooms experienced and described by teachers and researchers speaking non-English languages are different classrooms. In the same way that the differential promotion of fluency in spoken mathematics in different classrooms around the world enacts a different classroom mathematics, teachers, other educators, and researchers in different countries have at their disposal very different linguistic tools by which to conceptualise, theorise about, and research the mathematics classroom. Our capacity to study, understand and enact classroom practice must be enhanced rather than constrained by our growing internationalisation.

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