Making Connections
Making Connections
Comparing Mathematics Classrooms Around the World

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SERIES PREFACE

The Learner’s Perspective Study provides a vehicle for the work of an international community of classroom researchers. The work of this community will be reported in a series of books of which this is the second. The documentation of the practices of classrooms in other countries causes us to question and revise our assumptions about our own practice and the theories on which that practice is based. International comparative and cross-cultural research has the capacity to inform practice, shape policy and develop theory at a level commensurate with regional, national or global priorities. International comparative research offers us more than insights into the novel, interesting and adaptable practices employed in other school systems. It also offers us insights into the strange, invisible, and unquestioned routines and rituals of our own school system and our own classrooms. In addition, a cross-cultural perspective on classrooms can help us identify common values and shared assumptions, encouraging the adaptation of practices from one classroom for use in a different cultural setting. As these findings become more widely available, they will be increasingly utilised in the professional development of teachers and in the development of new theory.

David Clarke
Series Editor
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Chapter One

The Learner’s Perspective Study and International Comparisons of Classroom Practice

Introduction

The practices of classrooms are the most evident institutionalised means by which the policies of a nation’s educational system are put into effect. The curriculum can be viewed as the embodiment of the aspirations of the school system in which the classroom is situated. To a significant extent, the teacher is the agent of the system by whose actions the curriculum is put into effect. Teachers, however, interpret the curriculum in idiosyncratic fashion, within the constraints and affordances of both system and culture. Research in the Learner’s Perspective Study (LPS) has made clear just how culturally-situated are the practices of classrooms around the world, and the extent to which students are collaborators with the teacher, complicit in the development and enactment of patterns of participation that reflect individual, societal and cultural priorities and associated value systems (this book and Clarke, Keitel, & Shimizu, 2006).

International comparative and cross-cultural research has the capacity to inform practice, shape policy and develop theory at a level commensurate with regional, national or global priorities. This book, its companion volume, and the series of publications of which these are a part, provide evidence of various possibilities of combining analyses that address macro and micro level concerns in mathematics education and suggest possible directions for practical advances. The community at large has the right to expect any advocacy of practice to be evidence-based – which shifts the debate from the potential value of research to consideration of what constitutes evidence sufficient to support the advocacy of any particular practice in any particular classroom.

Within any educational system, the possibilities for experimentation and innovation are limited by more than just methodological and ethical considerations: they are limited by our capacity to conceive possible alternatives. They are also limited by our assumptions regarding acceptable practice. These assumptions are the result of a long local history of educational practice, in which every development was a response to emergent local need and reflective of changing local values. Well-entrenched practices sublimate this history of development. In the school system(s) of any country, the resultant amalgam of tradition and recent

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innovation is deeply reflective of assumptions that do more than mirror the encompassing culture: they embody and constitute it. International comparative research offers us more than insights into the novel, interesting and adaptable practices employed in other school systems. It also offers us insights into the strange, invisible, and unquestioned routines and rituals of our own school system and, in the case of this book, our own mathematics classrooms.

International comparative research has an additional power: the capacity to reveal similarity within difference, structure within extreme diversity. Anderson-Levitt (2002) noted the “significant national differences in teacher gender, degree of specialization in math, amount of planning time, and duties outside class” (p. 19). But these differences co-exist with similarities in school organization, classroom organization, and curriculum content. Anderson-Levitt (2002, p. 20) juxtaposed the statement by LeTendre, Baker, Akiba, Goesling, and Wiseman (2001) that “Japanese, German and U.S. teachers all appear to be working from a very similar ‘cultural script’” (p. 9) with the conclusions of Stigler and Hiebert (1999) that U.S. and Japanese teachers use different cultural scripts for running lessons. The apparent conflict is usefully (if partially) resolved by noting with Anderson, Ryan and Shapiro (1989) that both U.S. and Japanese teachers draw on the same small repertoire of “whole-class, lecture-recitation and seatwork lessons conducted by one teacher with a group of children isolated in a classroom” (Anderson-Levitt, 2002, p. 21), but they utilise their options within this repertoire differently. Given the cultural dissimilarities and the separate development over time of traditions of practice in schools as geographically distant as Sweden and China or Germany and Japan, any similarities should startle us just as much as any differences.

If, in fact, educational policy and practice represent the enactment of both societal and cultural values, the classroom, as a profoundly social setting, seems a sensible place to look for explanations and consequences of the differences and similarities identified in international comparative studies of curriculum, teaching practice, and student achievement (see Clarke, 2003; Lerman, 1994). Within the specific focus of classroom practice, the central problem of international comparative research (Emanuelsson & Clarke, 2004) translates into: How best might the practices of classrooms be compared internationally if our purpose is to inform those practices?

Both the curriculum and the teacher have been the focus of recent international comparative studies. Among the studies of curriculum and teaching practice, we can lose sight of the student. Thorsten makes this point beautifully.

What is absent from nearly all the rhetoric and variables of TIMSS pointing to the future needs of the global economy is indeed this human side: the notion that students themselves are agents. TIMSS makes students from 41 countries into passive objects of 41 bureaucratic gazes, all linked to the seduction of one global economic curriculum (Thorsten, 2000, p. 71).

Educational research has increasingly drawn our attention to the importance of the social processes whereby competence is constructed and in which competence is
constituted (for both teaching and learning). In particular, the agency of the student, the nature of learner practice, and the cultural specificity of that agency and that practice must be accommodated within our research designs. The Learner’s Perspective Study (LPS) has effected that accommodation.

*International Comparative Studies: What can we hope to learn?*

International comparative research in mathematics education is a growing field. There is a need for enlightened discussion as to how the results of international studies relate to the research methods and techniques used, to the theoretical and analytical perspectives enacted in the research, and to the political aims of the stakeholders who promote them. It is essential that the research community consider the different comparative approaches available and the consequent differences in project outcomes. The abiding challenge for classroom research is the realization of structure in diversity. The structure in this case takes the form of patterns of participation: regularities in the social practices of mathematics classrooms. Only through the identification of patterns of classroom participation and their connection with learning, can our research inform individual and collective ways of understanding learning and teaching in mathematics, and inform the development of classroom practices likely to support the effective participation of all members of the classroom community. The expansion of our field of view to include international rather than just local classrooms increases the diversity and heightens the challenge of the search for structure, while increasing the significance of any structures, once found.

Educational research has tried on a variety of methodological attire. Process–product studies came and went. Local constraints on what can and cannot be manipulated in school-like settings place serious constraints on experimentation. International research offers opportunities to study settings and characteristics untenable in the researcher’s local situation. Contextual elements such as class size, use of technology, combinations of social background, and the multi-cultural or mono-cultural composition of the class are available for study and comparison across the data set of an international comparative research project. Importantly, international comparative studies can reveal possibilities for practice that would go unrecognized within the established norms of educational practice of one country or one culture. Our capacity to conceive of alternatives to our current practice is constrained by deep-rooted assumptions, reflecting cultural and societal values that we lack the perspective to question. The comparisons made possible by international research facilitate our identification and interrogation of these assumptions. Such interrogation opens up possibilities for innovation that might not otherwise be identified; possibilities that might then become the focus of design-based research in specific cultural settings (cf. The Design-Based Research Collective, 2003).

Such comparisons need not be competitive evaluations. It is possible to benefit from the identification of the similarities and differences in locally-identified good practice without identifying one set of practices as “better than” another set of
practices, except perhaps in so far as one set of practices are better aligned with the needs and aspirations of a particular setting. Of course, our capacity to make any such evaluative judgments, even locally situated judgments, requires evidence of outcome; and the confident attribution of learning outcomes to specific instructional practices poses significant methodological challenges. The post-lesson video-stimulated interviews employed in the LPS provide the basis for such attributions.

International comparisons of student achievement such as the Program for International Student Assessment (PISA) or the Third International Mathematics and Science Study (TIMSS) are not only producing data for comparative purposes, they also produce conceptions of what is important and of value in mathematics education. They are not only comparing, they are participating in the social construction of curricula in mathematics education. This thought is well developed in the work of Ian Hacking (1999). From this point of view, international comparisons are about homogenization of mathematics education. An analogous point was made powerfully by Keitel and Kilpatrick (1999).

A pseudo-consensus has been imposed (primarily by the English-speaking world) across systems so that curriculum can be taken as a constant rather than a variable, and so that the operation of other variables can be examined (Keitel & Kilpatrick, 1999, p. 253).

Keitel and Kilpatrick (1999) problematised the assumptions on which international comparative studies of school mathematics had been predicated. In particular, they questioned the treatment of the mathematics curriculum as unproblematic and the associated assumption that a single test could give comparable measures of curriculum effects across countries. They further suggested that the spectre of an “idealized international curriculum” lay behind even the most sophisticated research designs, including text and document analyses and the use of video to study classroom practice. The analogue of this idealized curriculum is the idealized international classroom with idealized participants. Such a conception ignores fundamental differences in affluence and aspiration, in values and in norms of social exchange. The power of international comparative research is to expand the range of the possible, not to constrain it to a culturally-neutral prescription of practice. Our aim in this project and in this book is to increase cultural and contextual sensitivity in comparative and international educational research, and to enrich both theory and practice, by reporting the diversity of practice in the classrooms of competent teachers around the world and by identifying the patterns of participation that we find there.

What is compared?

The question of what to compare is at the heart of international comparative research and has been addressed very differently in various studies. In most international comparisons of mathematics education, it is achievement in terms of test results that is compared. From such outcome comparisons we can conclude
that students in some countries are doing better than students in other countries according to the achievement constructs operationalised in the tests. Why this is the case is impossible to tell without further information. Recent studies also generated data about the possible prerequisites for learning mathematics. For example, the PISA 2003 context questionnaires included questions on student characteristics, student family background, student perceptions, school characteristics and school principals’ perceptions. Some of these data were used to compute an index on economic, social and cultural status of the students. A variety of correlations with achievement data have been reported. In the IEA’s Repeat of the Third International Mathematics and Science Study (TIMSS 1999), the impressive list includes amongst others: an index of home educational resources, the frequency with which students speak the language of the test at home, the students’ expectations for finishing school, an index of out-of-school study time, an index of students’ self-concept in mathematics, an index of teachers’ emphasis on mathematics homework, schools’ expectations of parental involvement or the frequency and seriousness of student behaviour threatening an orderly school environment (cf. Mullis et al., 2000). Achievement data also have been correlated to class size, education expenditure as percentages of GDP as absolute amounts per student in relation to distinct levels of education, formal teacher qualification and other indicators of resources. If any positive correlation of achievement with one of these variables was identified, this often gave rise to simplistic interpretations of causality, assuming one direction of causation. However, any such correlation evidence is both rare and contentious, and difficult to interpret.

We need to know what is happening in the teaching process in order to understand the outcomes of this process. And this was exactly what the TIMSS-99 video study (Hiebert et al., 2003) did in the most advanced attempt to produce useful descriptions of mathematics teaching in different high-achieving countries. One hundred eighth grade classes were selected by random sampling in seven countries. In each class, one lesson was video-recorded. This project supported the comparison of the mathematics classrooms in the different countries with regard to, for instance: length of lesson, time devoted to mathematical work, time devoted to problem segments, percentage of time devoted to independent problems, time per independent problem, time devoted to practising new content, time devoted to public interaction, number of problems assigned as homework, number of outside interruptions, number of problems of moderate complexity, number of problems that included proofs, number of problems using real life connections, number of problems requiring the students to make connections, time devoted to repeating procedures, number of words said by teacher (publicly), number of words said by students (publicly), number of lessons during which the chalkboard was used, and number of lessons during which computational calculators were used. Even if the classrooms of each country could be identified with distinctive combinations of attributes, the connection between any particular classroom attributes and national mathematics achievement remained problematic. For example, the national average scores for middle school students in Japan and Hong Kong on the TIMSS 1999 mathematics assessment were very similar, yet the level of procedural complexity
of the problems used in the mathematics classrooms in the two countries was very different (see Figure 2, in Hiebert et al., 2003, p. 6). The average proportion of time spent in mathematics classrooms in Hong Kong and Japan in reviewing previous content was identical, but there were significant differences in the amount of time spent introducing (rather than practicing) new content (see Figure 1, in Hiebert et al., 2003, p. 5). These difficulties in drawing conclusions that might support the advocacy of any particular instructional strategy derive in part from the need (inherent in a nationally representative study) to characterize classrooms by dissociated, quantifiable characteristics, whose connection to a single national outcome (average student mathematics achievement) can only be conjectured. Underlying any such international comparison is the assumed legitimacy of characterizing ‘typical instructional practice’ in each country, and the concomitant assumption that such typical practice might be causally connected to national achievement measures. In order to consider alternative answers to the question “What should we compare?” it is necessary to consider alternatives to either competitive comparisons or correlational studies that can offer opportunities for multidisciplinary endeavors and collaboration between researchers and practitioners in order to reach better performance within our different educational systems for the benefit of all students.

It seems reasonable to clarify the goals comparative studies try to achieve and the levels and units of analysis that can be accomplished by the types of data produced. Comparisons, such as “Lesson Studies” (Fernandez & Yoshida, 2004), can be driven by the desire to find good examples of teaching or classroom organisation in order to adapt these to local needs and conditions and to implement them in our own country. Other countries’ practices can also serve as mirrors in the quest to understand the practice of our own country. On the other hand, reference to an international data set can be motivated by the search for similarities, which can be analysed with the help of theories that focus on structural features of the school setting. These approaches are not mutually exclusive, but each involves a different level of analysis and consequently produces results with a different character informed by a different frame of reference.

The data set produced in the LPS is sufficiently complex to allow for different levels and units of analysis, such as lesson structure, forms and functions of particular lesson elements (Lesson Events), structure of tasks and forms of classroom interaction, forms of the evolvement of a distinct mathematical topic, teachers’ intentions and students’ rationales. As was the case with the earlier work of Clarke and his colleagues (Clarke, 2001), the LPS research team has produced multi-faceted analyses of a commonly held database, undertaken from different educational and theoretical positions. This approach offers a variety of mutually informing perspectives intended, in their combination, to provide a much richer portrayal of classroom practice than would be possible from any single analysis; richer also than a similar number of disconnected analyses of different databases.
Similarity and Difference in International Comparative Research

Schmidt, McKnight, Valverde, Houang and Wiley (1997) investigated the mathematics curricula of the “almost 50” countries participating in the Third International Mathematics and Science Study (TIMSS). The documented differences in curricular organisation were extensive. Even within a single country differentiated curricular catered to communities perceived as having different needs. Countries differed in the extent of such differentiation, in the complexity or uniformity of their school systems, and in the distribution of educational decision-making responsibility within those school systems. Given such diversity, the identification of any curricular similarity with regard to mathematics should be seen as significant. And there were significant similarities. There were similarities of topic, if not of curricular location; broad correspondences of grade level and content that, on closer inspection, revealed differences in the detail of content and sequence; differences in the range of content addressed at a particular grade level, but which repeated particular developmental sequences where common content was addressed over several grade levels. In another international study of mathematics curricula, the OECD study of thirteen countries’ innovative programs in mathematics, science and technology found that, “Virtually everywhere, the curriculum is becoming more practical” (Atkin & Black, 1997, p. 24). Yet, despite this common trend, the same study found significant differences in the reasons that prompted the new curricula (Atkin & Black, 1996). These interwoven similarities and differences are the signature of international comparative research in mathematics education (Clarke, 2003).

Schmidt, McKnight, Valverde, Houang, and Wiley (1997) reported that differences in the characterization of mathematical activity were extreme at the Middle School level; from ‘representing’ situations mathematically, ‘generalizing’ and ‘justifying’ to ‘recalling mathematical objects and properties’ and ‘performing routine procedures.’ Despite the apparent diversity, it was the latter two expectations that were emphasised in the curricula studied. Given the documented diversity, it is the occurrence of similarity that requires explanation. Some curricular similarities may be the heritage of a colonial past. Others may be the result of more recent cultural imperialism or simply good international marketing.

LeTendre, Baker, Akiba, Goesling and Wiseman (2001) claimed that “Policy debates in the U.S. are increasingly informed by use of internationally generated, comparative data” (p. 3). LeTendre and his colleagues went on to argue that criticisms of international comparative research on the basis of “culture clash” ignored international isomorphisms at the level of institutions (particularly schools). LeTendre et al. reported yet another interweaving of similarity and difference.

We find some differences in how teachers’ work is organised, but similarities in teachers’ belief patterns. We find that core teaching practices and teacher beliefs show little national variation, but that other aspects of teachers’ work (e.g., non-instructional duties) do show variation (LeTendre, Baker, Akiba, Goesling & Wiseman, 2001, p. 3)
These differences and the similarities are interconnected and interdependent and it is likely that policy and practice are best informed by research that examines the nature of the interconnection of specific similarities and differences, rather than simply the frequency of their occurrence. One of the dangers of identifying any facet of classroom or school practice for independent comparison is that the object of analysis is disconnected from the local (national) context that provides its rationale. Hence we find a growth in utilitarian curricula motivated differently from country to country.

Classrooms are inherently social places, where teacher and students improvise their interactions within the constraints and affordances of cultural, societal and institutional norms. Eugene Ionescu is reputed to have said, “Only the ephemeral is of lasting value.” Social interactions are nothing if not ephemeral and, since it is through social interaction that we experience the world, the understanding of social interactions must underlie any attempts to improve the human condition – in this case, the effectiveness of our mathematics classrooms. Our difficulties in characterizing social interactions for the purpose of theory building are compounded by the fluid and transient nature of the phenomena we seek to describe. While social practice may become progressively crystallized as culture, cultures evolve and reinvent themselves in response to local situations. Attempts to categorise social behaviour run the risk of sacrificing the dynamism, contextual-dependence and variation that constitute their essential attributes. This poses a challenge both for methodology and for theory. The ephemeral nature of social interactions is something that must be honoured in the methodology but transcended in the analysis.

**Data and Approaches to Analysis in the Learner’s Perspective Study**

The Learner’s Perspective Study documented sequences of at least ten lessons, using three video cameras, supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews, and by test and questionnaire data, and copies of student written material (Clarke, 1998, 2001, 2003). In each classroom, formal data generation was preceded by a one-week familiarization period in which the research team undertook preliminary classroom videotaping and post-lesson interviewing until such time as the teacher and students were accustomed to the classroom presence of the researchers and familiar with the research process. In each participating country, the focus of data generation was the classrooms of three teachers, identified by the local mathematics education community as competent, and situated in demographically different school communities within the one major city. For each school system (country), this design generated a data set of at least 30 ‘well-taught’ lessons (three sequences of at least ten lessons), involving 120 video records, 60 student interviews, 12 teacher interviews, plus researcher field notes, test and questionnaire data, and scanned student written material. Well-taught, in the context of this study, meant that the teachers in each country were recruited according to local criteria for competence: visibility as presenters at conferences for other teachers,
leadership roles in professional organizations, and, acclamation by colleagues and students. It is not surprising, therefore, that the classroom of a competent teacher in Uppsala might look a little different from the classroom of a competent teacher in Shanghai or San Diego. The local construction and enactment of competence was one of the most appealing aspects of this study. Greater detail on data generation procedures is provided in the appendix to this book. The generation of data has been completed in Australia, China (Hong Kong, Shanghai and Macau), the Czech Republic, Germany, Israel, Japan, Korea, the Philippines, Singapore, South Africa, Sweden, and the USA. The teacher and student interviews offer insight into both the teacher’s and the students’ participation in (and reconstruction of) particular lesson events and the significance and meaning that the students associated with their actions and those of the teacher and their classmates.

Erickson (2006) distinguishes three approaches to the analysis of video:

– Whole-to-part, inductive approaches, which he associates with context analysis, ethnographic/sociolinguistic discourse analysis and conversational analysis;
– Part-to-whole, deductive approaches, related to speech-act analysis, in which instances of research interest are identified within an interactional event and the distribution of these instances displayed for that event; and,
– Manifest content approaches, derived from subject matter/pedagogical knowledge, and emphasizing the manifestation of subject matter knowledge by whatever means.

To these we want to add a fourth point, "Whole-to-part, abductive approaches," which is similar to Erickson’s first point but the analysis proceeds by an iterative process shifting between inductive and deductive steps. All four approaches are in evidence in this book, sometimes in the same chapter. Erickson draws attention to the danger that the latter two of his approaches may “fit so closely with conventional wisdom about manifest curriculum and subject matter pedagogy that they suffer from tunnel vision and from a literalist approach to the way in which meanings are communicated in social interaction” (Erikson, 2006, p. 187).

Inevitably, any analysis of classroom video data reflects the interests and theoretical and cultural orientations of the researcher conducting the analysis; cultural orientation offering another aspect of the “tunnel vision” suggested by Erickson. The interrogation of a shared data set by researchers that are differently situated with respect to educational system, theoretical orientation and cultural affiliation provides an excellent safeguard against any researcher’s projection of a pre-existing agenda or value system onto those data going uncontested. Shepard (1991) argued that psychometricians’ test construction and consequent analyses represented the enactment of a specific theory of learning that remained largely unacknowledged and, therefore, uncontested. The combination of perspectives present within the international LPS research team created a form of methodological dialectic that acted to reveal any such implicit frames of reference.

The most interesting current work combines serious attention to subject matter and learning with close attention to the behavioural organization of the
social interaction, verbal and nonverbal, within which teaching and learning take place, as well as to the ways in which spoken and written discourse in classrooms relate to social and cultural processes in operation across wide spans of time and social space, beyond the walls of the classroom as well as within it (Erickson, 2006, p. 187).

While the data analysed and reported here remain situated within the confines of the classroom, we would like to think that the other attributes listed by Erickson constitute a fair description of the work reported in this book considered as a totality, but with the significant omission of the additional dimension offered by the capacity for comparison between classrooms situated in culturally disparate communities. The analysis of video is inevitably enacted as a series of selective choices concerning what to attend to, what distinctions to draw, what patterns to privilege with the status of categories, and what relationships between categories or data types to explore. It is a virtue of video that it permits revisiting, not just for the purposes of secondary analysis, but as part of the inevitable reconsideration, after progressive cycles of code refinement, of data previously coded – revisited both to confirm the resilience of the elaborated code and to encompass the full data set in the most elaborated classification scheme. The cyclic iteration of coding and code revision is undertaken while holding the research purpose firmly in mind. Issues such as inter-rater reliability take on different meanings according to whether or not the intention is to make generalizations about nations or cultures or to construct empirically-grounded explanations of learning processes or instructional practice.

In the first TIMSS Video Study, national representative sampling was a priority (Stigler & Hiebert, 1999). An immediate pragmatic consequence was the documentation of single lessons only. The power to make generalizations about national patterns of lesson structure was bought at the cost of explanatory power related to the antecedent and consequent conditions by which the motivations and consequences of teachers’ actions might be understood. Similarly, the researchers’ interest in teaching practice led to an exclusive focus on ‘public talk’ (Kawanaka & Stigler, 1999) at the expense of documenting student ‘private’ collaborative work.

In the case of the Learner’s Perspective Study, the pragmatism functioned differently. Because the documentation of “the learner’s perspective” was a priority, a three camera approach was necessary to record student as well as teacher practices, student-student ‘private’ talk had to be documented, and post-lesson interviews utilised to unpack the multiple subjectivities in play in any classroom interaction. Similarly, the decision to document sequences of lessons for a particular class traded representative sampling for the power to study patterns of practice over several lessons and to situate a given teacher or learner action in terms of the events that led to or arose from that action.

Recent classroom research (Alton-Lee, Nuthall & Patrick, 1993; Clarke, 2001; Sahlström & Lindblad, 1998), backed by more sophisticated ways of generating and analysing data, has shown that some of the findings of the classroom research classics such as Bellack et al. (1966), Sinclair and Coulthard (1975) and Mehan (1979) are seriously skewed because of technological issues in data generation. In particular, this has concerned the ability to simultaneously record both student and
teacher interaction, and the ability to facilitate ways of working with these data.

The Learner’s Perspective Study is highly dependent on the recounting of various texts: classroom dialogue (‘public’ and ‘private’); teacher and student written material; and teacher and student interviews. These texts provide the basis from which to consider how the individuals in the classroom are positioned by the discourses in which they participate. It is important, however, to note that the discourse of educational research also acts to position participants in ways that afford and restrict certain interpretations. For example, analyses that attribute characteristics such as interest, motivation or values to individuals require a theory of psychology of the individual, albeit a socially-situated individual, that recognises personal histories and perceptions. Analyses intended to identify patterns of social interaction characteristic of social groups or settings require a theory of social situations in which social events and social structures are the constituent elements, and in which the generation of data on individual subjectivities is subordinated to group behaviours. The theoretical eclecticism that enriched the Learner’s Perceptive Study can be seen in the chapters in this book, which report different analyses constructed upon quite different theoretical foundations.

To reiterate the principles on which the methodology is founded: A study of learning in classroom settings is too restricted without the simultaneous documentation of the social and cultural practices in which the learner participated, the instructional materials, physical configuration of the classroom, and other contextual features with which the learner interacted, the teacher actions that preceded and followed the learning under investigation, and the extent to which the practices of others were reflexively related to the learner’s activities and the personal consequences of those activities. Such research requires a methodology that accords value and voice to all participants in the classroom. Such a methodology must document both the practices in which individuals participate and the meanings that individuals associate with those practices. One participates in social practice as a member of a social group, but this membership is a matter of interpretive affiliation by the participating individual. It is an oversimplification to discuss classroom practice as though it were constituted the same for each individual. The nature of an individual’s participation can in itself be seen as an interpretive act.

To draw the distinction between social and cognitive processes is not to preclude the influence of one upon the other (in either direction). Cobb (1994) framed the relationship as one of reciprocal contextuality, where the reflexivity between social and cognitive processes can be located in the implicit presence of each perspective in the other.

Learning as acculturation via guided participation implicitly assumes an actively constructing child . . . Learning as cognitive self-organization implicitly assumes that the child is participating in cultural practices (Cobb, 1994, p.17).

Erickson’s characterization of the classroom was strongly reflexive, “The
researcher seeks to understand the ways in which teachers and students, in their actions together, constitute environments for one another” (Erickson, 1986, p. 128). This is highly compatible with the LPS conception of classroom practice as being constituted as a single conjoined constructive process engaged in by teacher and students, experienced and co-constructed by the participants.

The publication *Scientific Research in Education* (National Research Council, 2002) triggered widespread debate concerning the tenets of rigorous, scholarly research in education. Among the principles espoused in that report, were the following:

- Pose significant questions that can be investigated empirically;
- Link research to relevant theory;
- Use methods that permit direct investigation of the questions;
- Provide a coherent and explicit chain of reasoning;
- Yield findings that replicate and generalize across studies; and
- Disclose research data and methods to enable and encourage professional scrutiny and critique (Feuer, Towne, & Shavelson, 2002).

We would argue that the Learner’s Perspective Study, as reported in this book, conforms to five of these six criteria. In the Learner’s Perspective Study, the study design sought to juxtapose the observable practices of the classroom (documented through videotape and written product) and the meanings attributed to those practices by individual participants (documented through video-stimulated post-lesson interviews and questionnaires). The analysis of such data takes the form of inter-textual analysis identifying linkages and tensions between forms of classroom text. The analyses reported in this book examine the similarities and differences in practice across many lessons documented in well-taught classrooms in a variety of countries and a variety of cultures. The fifth point above, relating to replicability and generalisability, is somewhat problematic in the context of a multi-cultural study of the scale reported here. However, with a more contemporary perspective on generalisability, where the locus of generalization is determined by the reader of the accounts rather then the author of the accounts (e.g. Eisner, 1991), we argue that the network of interrelated data and complementary accounts accumulated in relation to any one lesson or even any one lesson event accords the data a degree of trustworthiness that transcends mere replicability. Furthermore, providing the community of teachers internationally with multi-faceted portrayals of some of the ways in which their competent colleagues elsewhere construct their practice has the potential to expand the repertoire of mathematics teachers internationally. Educational consequences of this type, coupled with the capacity to advance theory in both learning and instruction, offer a form of fruitful inquiry that transforms older ideas of generalisability into more useful conceptions of consequence, utility, impact, adaptability, and the reconstruction of knowledge.

**COMPLEMENTARITY AS ESSENTIAL**

The distinguishing characteristic of the research design for the Learner’s
Perspective Study is the inclusion of four levels of complementary accounts: (a) At the level of data, the accounts of the various classroom participants are juxtaposed; (b) At the level of primary interpretation, complementary interpretations are developed by the research team from the various data sources related to particular incidents, settings, or individuals; (c) At the level of theoretical framework, complementary analyses are generated from a common data set through the application by different members of the research team of distinct analytical frameworks; and (d) At the level of culture, complementary characterizations of practice and meaning are constructed for the classrooms in each culture (and by the researchers from each culture) and these characterizations can then be compared and any similarities or differences identified for further analysis, particularly from the perspective of potential cross-cultural transfer.

Complementarity Between Participant Accounts: Establishing the Co-Construction of Classroom Practice

Like Wenger (1998), Clarke’s (2004) analysis of patterns of participation in classroom settings stressed the multiplicity and overlapping character of communities of practice and the role of the individual in contributing to the practice of a community (the class). Clarke (2001) has discussed the acts of interpretive affiliation, whereby the learners align themselves with various communities of practice and construct their participation and ultimately their practice through a customizing process in which their inclinations and capabilities are expressed within the constraints and affordances of the social situation and the overlapping communities that compete for the learner’s allegiance and participation. By examining sequences of ten lessons, the Learner’s Perspective Study provides data on the teacher’s and learners’ participation in the co-construction of the possible forms of participation through which classroom practice is constituted (cf. Brousseau, 1986). An example of utilizing the complementarity of teacher and student accounts can be found in several studies drawing on LPS-data (e.g. Emanuelsson & Sahlström, in press; Clarke, 2004). Clarke (2004) examined the legitimacy of the characterisation of kikan-shido (Between-Desks-Instruction) as a whole class pattern of participation, and situated the actions of teacher and learners in relation to this pattern of participation. By drawing on classroom video evidence and juxtaposing teacher and student interview data, it is possible to demonstrate that while engaging in kikan-shido, the teacher and the students participate in actions that are mutually constraining and affording, and that the resultant pattern of participation can only be understood through consideration of the actions of all participants. A key characteristic of kikan-shido, as it was practiced in the Australian LPS classrooms, was the implicit devolution of the responsibility for knowledge generation from the teacher to the student, while still institutionalizing the teacher’s obligation to scaffold the process of knowledge generation being enacted by the students. Comparison with the enactment of kikan-shido in other classrooms (Hong Kong, Shanghai, and San Diego, for example) provides significant insight into the pedagogical principles.
underlying the practices of different classrooms internationally. This example is discussed in much greater detail in chapter four of this book.

Complementarity Between LPS Researcher Accounts: A More Comprehensive Portrayal of Classroom Practice

Classrooms are complex social settings, and research that seeks to understand the learning that occurs in such settings must reflect and accommodate that complexity. This accommodation can occur if the data construction process generates a sufficiently rich data set. Such a data set can be adequately exploited only to the extent that the research design employs analytical techniques sensitive to the multifaceted and multiply-connected nature of the data.

We need to acknowledge the multiple potential meanings of the situations we are studying by deliberately giving voice to many of these meanings through accounts both from participants and from a variety of “readers” of those situations. The implementation of this approach requires the rejection of consensus and convergence as options for the synthesis of these accounts, and instead accords the accounts “complementary” status, subject to the requirement that they be consistent with the data from which they are derived, but not necessarily consistent with each other, since no object or situation, when viewed from different perspectives, necessarily appears the same (Clarke, 2001, p. 1).

In the LPS project, multiple, simultaneous analyses are being undertaken of the accumulated international data set from a variety of analytical perspectives. For example, while Ference Marton and his colleagues in Sweden and Hong Kong analyse the practices of classrooms in Shanghai informed by the perspective of Marton’s Theory of Variation, Clarke and his co-workers in Melbourne are undertaking analysis of the same lessons in relation to the Distribution of the Responsibility for Knowledge Generation. These two analytical approaches do not appeal to the same theoretical premises, but nor are they necessarily in conflict. They represent complementary analyses of a common body of data, aspiring to advance different theoretical perspectives and to inform practice in different ways.

Complementarity Between Project Accounts: Approaches to Studying Lesson Structure

Lesson structure can be interpreted in at least three ways (see Chapter 2):

- At the level of the whole lesson - regularity in the presence and sequence of instructional units of which lessons are composed;
- At the level of the topic – regularity in the occurrence of lesson elements at points in the instructional sequence associated with a curriculum topic, typically lasting several lessons;
- At the level of the constituent lesson events – regularity in the form and function of types of lesson events from which lessons are constituted.
A research design predicated on a nationally representative sampling of individual lessons, as in the TIMSS Video Studies (1995 and 1999), inevitably reports a statistically-based characterization of the representative lesson (the first of the alternatives listed above). The characterisation of the practices of a nation’s or a culture’s mathematics classrooms with a single lesson pattern was problematised by the preliminary results of the Learner’s Perspective Study (Clarke & Mesiti, 2003) and this is discussed in greater detail in the next chapter. Nonetheless, the TIMSS video study data offers the opportunity to estimate the prevalence of a particular activity type identified as significant from LPS data. Similarly, activities identified in the TIMSS project as prevalent within a particular country can be evaluated from within the LPS data in relation to their capacity to stimulate specific responses in students, particularly learning outcomes. The complementarity of these two projects is acknowledged and valued by both research groups.

Complementarity of accounts is an essential methodological and theoretical stance, adopted by the Learner’s Perspective Study, for the explication of mathematics teaching and learning in classroom settings, the advancement of theories relating to such settings, and the informing of practice in mathematics classrooms.

THE CONSTRUCTION OF MEANING IN MATHEMATICS CLASSROOMS

Research reports and the sharing of practices among international counterparts always stimulate reflection and thoughts for improving learning and teaching in one's own country. In a country such as China, there are reports of the introduction of pedagogical ideas originating in other cultures and associated with a greater emphasis on the process of mathematics learning and an interactive atmosphere in the classroom (e.g. Mok & Morris, 2001; Zhang & Dai, 2004; and Mok, 2005). In many countries all over the world attempts to improve the teaching and learning of mathematics have been centered on the identification of standards for curriculum content and student performance. Success will not occur merely by setting standards and holding teachers accountable for their achievement. Equally, the descriptive categorization of teacher practice (as undertaken in both the TIMSS video study and the Learner’s Perspective Study) is an important preliminary to an understanding of how classrooms function, but it is not an end in itself. Lacking evidence that might associate observed teacher practice with consequent student behaviors and learning, we are ill-equipped to advocate any particular set of practices as optimal. It is essential that research address the processes leading to learning in classroom settings. Without an understanding of these processes, attempts to improve teaching practices and learning outcomes in mathematics classrooms have little chance of success. The need to improve the quality of process as an essential precursor to the improvement of product is well understood in most other professional and industrial fields. The same principle needs to guide practices in education. The improvement of mathematics teaching must be founded
upon an understanding of both teaching and learning and the relationship of both activities to student achievement.

Much of our theorizing on learning in classroom settings has centered on the negotiation of meaning (Clarke, 1996; Cobb & Bauersfeld, 1995). These meanings are not restricted to content-specific meanings but include the negotiation of the social meanings by which the practices of the classroom are constituted and enacted (Yackel & Cobb, 1993). Further, it has been argued that every aspect of classroom experience is constructed by the participants, including both the situation or classroom context as well as any contexts invoked by the tasks employed in instruction (Clarke & Helme, 1994, 1998). In the Learner’s Perspective Study, the identification of such constructed or construed meanings was a major priority. It is axiomatic that such meanings will be culturally-derived in their construction and in their interpretation by the different researchers carrying out the analyses. The participation of an international research team in the collaborative analysis of a combined data pool provides an essential informing tension between the insights and assumptions offered by insider versus outsider knowledge.

The first TIMSS Video Study (Stigler & Hiebert, 1997, 1999) identified teaching as a cultural activity and sought to describe the characteristics of that activity in classrooms in Japan, Germany and the USA. One of the virtues of such international comparative research lies in its capacity to call into question practices that are so culturally ingrained as to be virtually invisible. The difficulty of such studies is the questionable legitimacy of any comparisons across cultures. If teaching is conceived in culturally specific terms, then a research strategy is required which documents local practice in a form that permits legitimate comparison. A standard approach is to ask teachers, via a questionnaire, to describe their instructional practices. This approach is fraught with difficulties even within a national sample, where terms such as "problem solving" are used in very different senses (Barnes, Clarke & Stephens, 2000; Clarke & Stephens, 1996). This lack of a shared language of teaching practice is compounded in a cross-cultural study based on questionnaire data. The responses are nearly impossible to interpret and legitimate comparisons cannot be made.

Videotaping offers a form of cross-cultural documentation that, however selective, is at least partially true to the original classroom and amenable to analysis within a single coherent framework and within multiple complementary frameworks. The use of videotape in international comparative classroom research is a comparatively recent innovation, and open to the same criticisms applicable to any study in which researchers embedded in one culture interpret the practices occurring in another. Yet a common language of analysis must be found if any form of comparison is to be made. If the interpretation and classification of classroom events in each country is undertaken with the collaboration of "local" researchers then the resultant characterization is likely to be both true to the original culture and in a form that permits legitimate comparative analysis. Equally, the perspective on local practice offered by outsiders brings its own benefits and insights.
Classrooms have been the subject of research for some time. Fine-grained analyses of classroom videotape data are increasingly present in the literature, but these have typically not been cross-national studies, in which the sheer scale of the samples precluded such detailed analysis. In this growing tradition of micro-analysis of classroom practices, Cobb and Bauersfeld (1995), for example, have described the "culture of the classroom" in the course of an investigation of "the emergence of mathematical meaning" in one second-grade classroom. In contrast, the first TIMSS Video Study utilized a random sub-sample of the full TIMSS student achievement sample (Lokan, Ford and Greenwood, 1996). The final video sample included 231 classrooms: 100 in Germany, 50 in Japan, and 81 in the United States (Stigler & Hiebert, 1997, p.4). Data generation and analysis procedures were developed and refined by a collaborative team of researchers from each of the three countries in the study. "Only one camera was used in each classroom, and it focused on what an ideal student would be focusing on - usually the teacher" (Stigler & Hiebert, 1997, p. 5). The videotape record was supplemented by a teacher questionnaire describing such things as the goal of the lesson, its place within the current sequence of lessons, and how typical the lesson was. In the Learner’s Perspective Study, video data was much more comprehensive, permitting more fine-grained analyses, and was augmented by post-lesson interviews with students in which the students controlled the video replay and identified classroom events of personal significance, discussing these events in detail (see appendix).

Entry points for analysis

In our research, members of the research team interpret the data, using particular forms of analysis, consistent with the researcher’s interests and theoretical positioning. These interpretations are our “readings” of the accounts offered by the video cameras and the transcribed reconstructive accounts obtained from classroom participants. These accounts are the evidence on which our various readings are founded.

Any number of interpretations, guided by any number of interests, can be built on the same foundation of evidence; but an interpretation ignoring that evidence can never be a defensible one (Vendler, 1997, p. 24).

The authors of the chapters of this book have constructed different interpretations based on their analyses of various subsets of a common body of data. Helen Vendler, quoted above, is introducing her interpretations of Shakespeare’s sonnets. In her introduction, Vendler is critical of the type of literary critic who “leaves it up to the reader to construct the poem” and states her goal explicitly: “I have hoped to help the reader actively to that construction by laying out evidence that no interpretation can ignore” (Vendler, 1997, p. 24). Extrapolating this to the context of educational research, if our data generation is to anticipate multiple analyses, then there is a heightened obligation to provide a detailed account of the data
generation, and equally to provide a detailed description and justification of the method of analysis. This transparency of data generation and analysis is all the more imperative because the two processes were not necessarily conceived together and cannot be used for mutual justification in the conventional manner.

Differences between the documented practices recorded on videotape and the participants’ discrepant accounts of those practices emerged through the juxtaposition of video and interview data. Williams and Clarke (2002) have explored some of the issues related to the interpretation of video and interview data, particularly in situations where the two data sources suggest discrepant interpretations. Williams and Clarke (2002) used data from the Learner’s Perspective Study to develop independent accounts of one student’s classroom practice and associated learning during a single lesson using video and interview data separately. The resultant accounts were inconsistent in several places, but some convergence of interpretation was possible through their juxtaposition. On the other hand, some differences were irreconcilable on the basis of one lesson’s data, but could be resolved with recourse to the lessons preceding and following the incidents in question. At the heart of the synthesis of data-level accounts are the questions, “Whose perspective is being documented?” and “Whose practice do we seek to understand?”

One of the propositions that occupies the first half of this book concerns the viability of Lesson Events as an entry point for data analysis. Chapters 2 through 7, outline the reasoning underlying this approach and then report the results of its application. Adopting Lesson Events as the entry point for analysis leaves open the possibility of scaling the analysis up (to the level of topic) or down (to the level of utterance or negotiative event (Clarke, 2001)), depending on the research focus.

The remaining chapters 8, 9, 10, and 11, report comparative analyses of data from the classrooms of two or more countries, with a variety of foci. In chapter 8, Liljestrand and Runesson address the possibility of tension between mathematical and everyday purposes. Häggstrom, in chapter 9, compares the introduction of linear equations in classrooms in Uppsala, Shanghai and Hong Kong. Khuzwayo compares teacher beliefs in South Africa, Australia and the USA, with respect to perceptions of constraints on teaching practice, and Clarke, in chapter 11, uses the combined international data set from six countries to interrogate assumptions about classroom practice.

The essential characteristic of this study of mathematics classrooms is the commitment to an integrative approach. Application of the data generation and analytical procedures developed in an Australian study (Clarke, 2001) to the study of classrooms in very different cultures anticipated a much more global examination of practice than that possible with data grounded in a single culture. The commitment to examining the interdependence of teaching and learning as related activities within an integrated body of classroom practice accepted an obligation to document (and analyse) relationships between participants’ practices as well as the occurrence of the individual practices themselves. The importance attached to the meanings that participants attributed to their actions and the actions of others and to the mathematical and social meanings that are the major products
of the classroom required a methodology able to access participants’ accounts of those meanings and to integrate these within a coherent picture of the classroom. It has been an exciting exploration that is still underway. We are very pleased to be able to share some of the findings with you.

REFERENCES


Erickson, F. (1986). Qualitative methods in research on teaching. In M. C. Wittrock (Ed.), *The handbook of research on teaching* (3rd edition) (pp. 119-161). New York: Macmillan.


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CHAPTER TWO

Addressing the Challenge of Legitimate International Comparisons:
Lesson Structure in the USA, Germany and Japan

INTRODUCTION

One of the major challenges confronting the international mathematics education community is how best to learn from each other’s classroom practices. Central to this issue is the choice of the instructional unit that will serve as the basis for any cross-cultural analysis of classroom practice. In most, probably all, countries, students interact with mathematics content via the instructional unit of the lesson. The lesson, therefore, seems a sensible place to start in the search for a viable unit of international comparative analysis of classroom practice.

In this chapter, analyses of lesson structure from each of the USA, Germany and Japan are reported. These reports are based on analyses of sequences of ten lessons, documented using three video cameras, and interpreted through the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews. The methodological approach of conducting case studies of the classroom practices over sequences of at least ten lessons in the classes of several competent eighth grade teachers in each of the participating countries offers an informative complement to the survey-style approach of the two video studies carried out by the Third International Mathematics and Science Study (TIMSS) (Hiebert et al., 2003; Stigler & Hiebert, 1999). Perhaps it is inevitable that a research design predicated on a nationally representative sampling of individual lessons, as in TIMSS, should report a statistically-based characterization of the representative lesson. A more fine-grained study of sequences of ten lessons, informed by the reconstructive accounts of the participants, has the potential to address questions such as:

– What are the recurrent pedagogical elements that might typify a teacher’s classroom practice and is there evidence of a recurrent lesson structure or sequence of such elements within the practices of a single teacher or group of teachers?

– What degree of variation in lesson structure is evident in the practices of the competent teachers studied in the USA, Germany and Japan?
The analyses reported in this chapter reveal significant structural variation in the different lessons in any one teacher’s lesson sequence. This degree of structural variation suggests that a single lesson pattern is unlikely to be an accurate or a useful representation of either an individual teacher’s lessons or of any nationally-representative sample of lessons. However, the recurrence of particular lesson components in the practices of teachers participating in the same or similar school systems suggests that some form of typification may be possible, given the correct unit of comparison. The chapter concludes with the suggestion that the comparison of lesson components (‘lesson events’) is more likely to be helpful than a lesson pattern or script as a guide to the similarities and differences between the practices of different mathematics teachers and their classrooms.

**Meaningful International Comparisons**

What are the contending bases for international comparative research and how is lesson structure situated within the logic of this research? One of the most widely reported results from studies of international assessment of student achievement such as the Third International Mathematics and Science Study (TIMSS) (Beaton & Robitaille, 1999) has been the high national mean scores for students from ‘Asian’ countries. This appears to have triggered the following (naive) line of reasoning: If Asian countries are consistently successful on international measures of mathematics performance, then less-successful non-Asian countries would do well to adapt for their use the instructional practices of Asian classrooms. Such a line of reasoning is grounded in four key assumptions:

i. that the term ‘Asian’ identifies a coherent cultural conglomerate with respect to educational practice;

ii. that the performances valued in international tests constitute an adequate model of mathematics, appropriate to the needs of the less-successful country;

iii. that differences in mathematical performance are attributable to differences in instructional practice, such as lesson structure (and not to other differences in culture, societal affluence or aspiration, or curriculum); and

iv. that the distinctive instructional practices of more-successful countries (e.g., norms of lesson structure), should these exist, can be meaningfully adapted for use by less-successful countries. Each of these key assumptions can be problematised on a variety of grounds (e.g., Clarke, 2003; Westbury, 1992).

Such cross-cultural comparisons can also be undertaken in a more introspective manner by individual countries. Wang (2001), in discussing technical concerns with TIMSS, cites Hu (2000, p. 8) as saying, “This study does not break down Americans by race, if they did, Asian Americans would likely score as high as Asians in their home countries, and Whites would rank near top of the European nations.” There are several ways to interpret this observation. It is worth comparing this quote with an analogous statement from Berliner (2001).

Which America are we talking about? . . . Average scores mislead completely in a country as heterogeneous as ours . . . The TIMSS-R tells us just what is
happening. In science, for the items common to both the TIMSS and the TIMSS-R, the scores of white students in the United States were exceeded by only three other nations. But black American school children were beaten by every single nation, and Hispanic kids were beaten by all but two nations. A similar pattern was true of mathematics scores . . . The true message of the TIMSS-R and other international assessments is that the United States will not improve in international standings until our terrible inequalities are fixed (David Berliner, *Washington Post*, Sunday, January 28, 2001).

Hu’s statement explicitly partitions the American population by race and makes comparisons with the performance of corresponding groups internationally. Berliner also partitions the population of US school students along racial lines and locates each sub-population on an international league table of student achievement. Similar partitioning along socio-economic or gender lines is also possible. In his 2005 address to the annual conference of the American Educational Research Association, Berliner pointed to the connection in the United States between race, socio-economic status and educational access and participation. The essential point that has been made by Clarke (2003) and others is that nationally aggregated data can conceal important differences in educational outcomes, reducing the explanatory potential of international studies and, possibly, producing misleading or erroneous recommendations for the future deployment of (limited) educational resources.

From several perspectives the comparison of national means of student achievement is problematic. Comparisons between sectors of the community within a given country may be more fruitful, even more so within a given state or school system. Such comparisons may at least highlight community groups who are less equal in the benefits they accrue from a school system intended to benefit all students equally. Educational policy can then be framed to address any inequalities.

But, what are the implications from the perspective of cultural traditions? Wang and Lin (2005) reviewed the research literature with respect to the mathematical performance of Chinese, Chinese-American and other US student groups. Their review problematised “ambiguous cross-national categorizations of East Asian students from Japan, China, Korea, and other East Asian regions and countries” (Wang & Lin, 2005, p. 4). The extent to which such culturally-inclusive categorizations can imply possibly misleading similarities can be seen in the accounts of classroom practice provided by Clarke, Keitel, Shimizu and their colleagues in the Learner’s Perspective Study (LPS) (Clarke, Keitel & Shimizu, 2006). Elsewhere, Wang and Lin made the point “Although Chinese students showed superiority to U.S. students in symbolic and abstract thinking, Chinese students show no advantage in graphing, understanding tables, or open-process problem solving” (Wang & Lin, 2005, p. 5). This latter statement emphasizes the dangers of over-aggregation for the purpose of cross-cultural comparison, but in this case in relation to the specific mathematical content.

Wang and Lin (2005) note that while there does appear to be a “widening gap between Chinese and U.S. students” (p. 5), “the performance gap between Chinese
Americans and Caucasian Americans also increases as both groups move through U.S. schools” (p. 5). Most importantly, Wang and Lin conclude “whether Chinese students actually outperform Chinese American students is still unresolved” (Wang & Lin, 2005, p. 5). All of which suggests that the cultural affiliation of the learner (whatever their geographical location) is possibly as important as the cultural alignment of the school or school system and certainly should not be simplistically identified with nationality.

The previous remarks are not intended to challenge the premise that school systems enact cultural values. However, they do challenge the simplistic identification of culture with nationality. Once the identification (confusion) of nation with culture has been problematised, then the utility of international comparative research can be considered with greater cultural sensitivity.

**Studying Lesson Structure**

The analysis of video data collected in the video component of TIMSS, as reported by Stigler and Hiebert (1999), centred on the proposition that the teaching practice of a nation (at least in the case of mathematics) could be explained to a significant extent by the teacher’s adherence to a culturally-based “teacher script.” Central to the identification of these cultural scripts for teaching were the Lesson Patterns reported by Stigler and Hiebert (1999) for Germany, Japan and the USA. The contention of Stigler and Hiebert was that at the level of the lesson, teaching in each of the three countries could be described by a “simple, common pattern” (Stigler & Hiebert, 1999, p. 82). By contrast, the Learner’s Perspective Study analysed sequences of ten lessons, documented using three video cameras, and supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews. A fine-grained study of sequences of ten lessons, informed by the reconstructive accounts of the participants, has the potential to identify any recurrent pedagogical elements in a teacher’s classroom practice and any evidence of regularity in the sequencing of those elements. Such regularities and recurrent elements have the potential to serve as the basis for comparative analysis.

Lesson structure can be interpreted in three senses:

i. At the level of the whole lesson – regularity in the presence and sequence of instructional units of which lessons are composed;

ii. At the level of the topic – regularity in the occurrence of lesson elements at points in the instructional sequence associated with a curriculum topic, typically lasting several lessons;

iii. At the level of the constituent lesson events – regularity in the form and function of types of lesson events from which lessons are constituted.

In terms of international comparison, it is useful to consider which of these three forms of lesson structure are likely to prove useful as units of comparative analysis. In this regard, it is important to recognize that the most appropriate unit for national typification may not prove useful for international comparison. In terms of national typification, we need to address the question: Is a nation’s or a culture’s
classroom practice most usefully characterized at the level of the whole lesson, in the manner in which a topic is constructed, delivered and experienced, or in the form and function of the specific activities from which lessons are composed? The same three alternatives are available for the purposes of international comparison, but the optimal unit of international comparison need not be the same as the optimal unit for national typification. We can conceive of the possibility of an idiosyncratic practice that might typify the classrooms of a nation, but be so unusual as to not constitute a legitimate basis for international comparison.

There are two quite distinct methodological alternatives:

**Alternative 1.** If two groups of objects are to be compared, one approach is to consider these two questions:

i. **Difference** – What is the characteristic about which the *comparison* is to be made?

ii. **Similarity** – How might each group of objects be separately *typified* with respect to that characteristic?

The international comparison of national norms of student achievement could be described as conforming to this approach, mediated by the test instrument employed. As Keitel and Kilpatrick (1999) have pointed out, such a test is the implicit embodiment of an idealised international curriculum taken as common across cultures and school systems. The order in which the two previous questions are posed is a major methodological signature.

**Alternative 2.** If two groups of objects are to be compared, consider these two questions:

i. **Similarity** – Which characteristics appear to *typify* this collection of objects?

ii. **Difference** – What *comparisons* can be made between these two groups of objects using the identified characteristics?

Posing the questions as in Alternative 2 reduces the danger of constraining the data to a predetermined structure, but may lead to the typification of the two groups by different emergent characteristics, restricting the common bases on which comparison of the two groups might be made. It should be noted also that Alternative 2 assumes a domain within which comparison is sought, such as classroom practice or curricular policy.

In terms of lesson structure, it might be that for one nation or culture there is no nationally characteristic structure to the lesson as a whole, but that particular types of idiosyncratic lesson events offer the most appropriate typification. For another nation or culture, there could be a high degree of regularity to the composition of lessons, or in the sequencing of particular types of instructional activity in the delivery of a topic. Such differences in the form of typification provide a basis for international comparison that reflects something more essential to each than the identification (imposition) of the same structural level as the basis for the comparison. The choice of Alternative 1 makes the basis for comparison a matter of prescription based on either theory or on the prevailing educational priorities of the country conducting the study. Choice of Alternative 2 makes the identification of possible bases for comparison an empirical result of the research.
Incommensurability of the emergent typifications becomes relevant if the comparison is intended to be evaluative. However, the identification of idiosyncratic practices, absent entirely in some classrooms, offers the teachers of those classrooms entirely new pedagogical tools, potentially valuable, since they derive from the practices of competent teachers elsewhere.

Lesson Patterns

In the writings of Stigler, Hiebert and their co-workers, we find an interesting shift from discussion (and advocacy) of “lesson scripts” (Stigler & Hiebert, 1998) to “lesson patterns” (Stigler & Hiebert, 1999) and via “hypothesised country models” to “lesson signatures” (Hiebert et al., 2003) as the means by which the classroom practices of countries might be usefully compared. This trend signifies an increasing recognition that meaningful comparison of teaching practice across an international sample requires a multi-dimensional framework and a greater sensitivity to variation than is possible within the confines of a ‘lesson script.’

Givvin et al. (2005) used the TIMSS-R video data to revisit the question: Are there national patterns of teaching? Their approach to the question was handicapped by four key simplifications:

i. Lesson Location – The significance of the location of the lesson within the instructional (topic) sequence as a source of variability was never addressed, either in their analysis nor in the subsequent discussion;

ii. Lesson as Unit of Analysis – The possibility that such teaching patterns might be manifest at a level of an instructional unit other than the lesson was not addressed;

iii. Category Independence – The three dimensions (Purpose, Classroom Interaction and Content Activity) are not independent. We would further suggest that it is in the analysis of their interaction and consideration of the participants’ intentions and interpretations that we are most likely to gain insight into the origins of each teacher’s lesson structure and the underlying pedagogical principles.

iv. Over-inclusive Codes – The three dimensions (Purpose, Classroom Interaction and Content Activity) on which the comparative analysis is undertaken were defined in extremely simplistic terms. This had the effect of maximizing the possibility of cross-classroom application of the coding scheme and minimizing variability through lack of sensitivity of the coding scheme to possible variation between classrooms.

Given the breadth of the categories applied, the degree of variability evident in each country’s lesson structure should be seen as quite striking. Our main point is that the inconclusiveness of the findings of Givvin et al. (2005) should not discourage those seeking national teaching patterns. It may reflect no more than the mistake of employing the lesson as the unit of comparison.

In relation to lesson structure and instructional practice as national characteristics, Anderson-Levitt (2002, p. 20) juxtaposed the statement by LeTendre et al. that “Japanese, German and U.S. teachers all appear to be working
from a very similar ‘cultural script’” (2001, p. 9) with the conclusions of Stigler and Hiebert (1999) that US and Japanese teachers use different cultural scripts for running lessons. As noted in chapter one, this apparent conflict can be resolved by noting that both US and Japanese teachers draw on the same small repertoire of “whole-class, lecture-recitation and seatwork lessons conducted by one teacher with a group of children isolated in a classroom” (Anderson-Levitt, 2002, p.21), but they utilise their options within this repertoire differently. This interweaving of differences and similarities is an essential characteristic of international comparative research. Policy is best informed by research that examines the nature of the interconnection of the various components of classroom practice rather than simply the frequency of their occurrence (Clarke, 2003).

The identification of national patterns of teaching was not one of the goals of the Learner’s Perspective Study. The research design focused on the classrooms of a small number of competent teachers in each of the participating countries. Because we selected competent teachers according to local criteria, there is a sense in which the practices of these teachers offer a representation of the pedagogical values in operation in that school system. But each teacher’s enactment of any such values would be likely to vary according to the student group, the topic to be taught and the individual teacher’s instructional inclinations. In such a study, it was the similarities and differences in the practices enacted in well-taught classrooms around the world that was of interest, rather than any national characterization of teachers or their classrooms. Nonetheless, given the visibility of the conjectured lesson patterns in various publications relating to international comparative research (see Clarke, 2003, for a more complete discussion), we felt justified in examining the postulated lesson patterns empirically.

There is no logical inconsistency here: Any identified national lesson pattern might be reasonably expected to manifest itself in the set of lessons collected in the LPS project from each of the three countries. The LPS identification of sequences of ten lessons by competent teachers adds interest to this analysis. What use do competent teachers make of the postulated national pattern? And, what consistency of lesson structure is evidenced in a ten lesson sequence by a competent teacher? Our analysis also serves to interrogate the consequences of the four key simplifications listed above. These are simplifications that any study committed to national typification and international comparison will find difficult to avoid. We would argue that it is the combination of such survey-style studies with the in-depth classroom analyses of the LPS project that holds greatest promise both to characterize teaching practice internationally and to inform that practice.

THE LEARNER’S PERSPECTIVE STUDY

As noted earlier, the LPS analysed sequences of ten lessons, documented using three video cameras, and supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews. Test, questionnaire, and student written material were also collected. This methodological approach is dealt with in detail in Clarke (1998, 2001, 2003) and
Clarke, Keitel and Shimizu (2006) (see appendix). It offers an informative complement to the survey-style approach of the TIMSS video study.

The research design for the LPS was developed specifically for the purpose of producing a sufficiently complex data set to support the investigation of such interconnections within mathematics classrooms in a wide variety of cultural contexts. In particular, the research design was constructed to complement the approach taken in the TIMSS Video Study by documenting sequences of lessons, rather than single lessons; by recording 'private' (interpersonal) conversations as well as public utterances; and by utilizing the retrospective video-stimulated accounts of classroom participants to determine not just the overt actions documented by the three video cameras, but also the antecedent conditions, motivations and intentions that prompted the observed actions, and the consequent interpretations, meanings and learning outcomes arising from those actions.

In each of the participating countries, three 8th grade classrooms in government schools in major urban settings were chosen according to the common criteria of teacher competence (as locally defined by the community), demographic diversity and the avoidance of atypicality in the student group. Of the eighty-three lessons from nine classrooms across three countries analysed in this chapter, it is useful to note the mathematical content addressed in each classroom, as shown in Table 1.

### Table 1. Mathematical Content of Lessons Analysed

<table>
<thead>
<tr>
<th>Classroom</th>
<th>Number of lessons</th>
<th>Mathematical Content</th>
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| US 1      | 10                | 1. Perimeter, Area and Volume  
|           |                   | 2. Equations, Inequalities and Formulas  
|           |                   | 3. Rational Number Concepts |
| US 2      | 5 double lessons  | 1. Functions, Relations and Patterns  
|           |                   | 2. Equations, Inequalities and Formulas  
|           |                   | 3. Problem Solving Strategies |
| US 3      | 10                | Equations, Inequalities and Formulas |
| Germany 1 | 10                | Integral Rational Terms and their Reformulation and Simplification |
| Germany 2 | 10                | 1. Common and Decimal Fractions  
|           |                   | 2. Equations of Fractional Terms |
| Germany 3 | 8 lessons including 2 doubles | Functions |
| Japan 1   | 10                | 1. Proportionality: Slope, Trigonometry and Interpolation  
|           |                   | 2. Functions, Relations and Patterns  
|           |                   | 3. Special Terms Used in Mathematics |
| Japan 2   | 10                | Geometric Congruence and Similarity |
| Japan 3   | 10                | System of Linear Equations |
We are not claiming that the 30 lessons recorded in Japan (for example) are in any way a nationally representative sample of Japanese eighth grade mathematics classroom practice. The question we addressed in our analysis concerned the extent to which the reported nationally characteristic lesson patterns for eighth grade mathematics teaching in Japan (Stigler & Hiebert, 1999) were evident in the practices of any of the three Japanese teachers’ we had studied and what might be learned from the correspondence or inconsistency in the occurrence of these patterns. Similarly, we looked for evidence of the US and German lesson patterns in the practices of the three teachers studied in each of those countries.

It is essential to emphasise that in this chapter we have analysed sequences of ten or more mathematics lessons taught by nine teachers designated as competent in three different countries. We cannot characterize the teaching of a country or a culture on the basis of such a selective sample and this was never our intention. Nor do we claim to compare teaching in one country with teaching in another. The research design was developed to support analyses intended to compare and contrast teachers and their classrooms, not cultures. Of course, the choice of school systems (Germany, Japan and the USA) was not accidental. It was intended to complement any general claims of national typicality by situating identified prevalent practice in relation to the antecedent conditions and consequent outcomes that might transform description into explanation. Also, since it was the specific intention of the TIMSS Video Study (Stigler & Hiebert, 1999) to characterize national practice in mathematics classrooms in the USA, Germany and Japan, it is reasonable to expect any lesson patterns reported as nationally typical to be evident to some extent in the respective LPS data bases of lessons from the USA, Germany and Japan.

The Analytical Approach

The purpose of our initial analysis can be stated simply: To determine whether the sequenced activity categories reported by Stigler and Hiebert (1999) could be identified in an analysis of the corresponding LPS data in the American, German and Japanese classrooms.

Consider first the reported characterisation of mathematics teaching in the United States of America. Based on the analysis of 81 single lessons, Stigler and Hiebert (1999) reported that US lessons could be generally characterized by the recurrence of four distinct classroom activities and that these activities, when placed in a particular sequence, formed the basis of a national lesson pattern.

The lesson pattern for the United States was reported as:

- Reviewing previous material;
- Demonstrating how to solve problems for the day;
- Practicing; and
- Correcting seatwork and assigning homework

(Stigler & Hiebert, 1999, p. 80)
Central to any reading of Stigler and Hiebert’s lesson patterns is an understanding of the distinction between their activity titles (such as “Demonstrating how to solve problems for the day”) and the brief descriptions provided of the most common or typical enactment of that activity.

After homework is checked, the teacher introduces new material, or reviews previous material, by presenting a few sample problems and demonstrating how to solve them. Often the teacher engages the students in a step-by-step demonstration by asking short-answer questions along the way. (Stigler & Hiebert, 1999, p. 80)

These descriptions of typicality do not constitute definitions of the relevant activity, although they did provide useful examples of the type of actions from which the activity category might be constituted. Without strict definitions that distinguished the finer characteristics of one activity from another, we interpreted the four activity categories as liberally as possible. This proved quite challenging. For example, the description of the activity “Demonstrating how to solve problems for the day” (above) includes the phrase “reviews previous material” which is itself the title of the first of the original four activities identified as classifying the structure of US lessons, yet it also appears subsumed within another activity.

A minute by minute analysis was conducted of the video record of all US lessons in the LPS data set in which it was determined which of the four activities best described the classroom behaviour for each minute of every lesson. The analysis was carried out by two researchers working independently and the results were compared and discussed and a consensus coding constructed.

In order to make the structure of individual lessons more readily comparable, a system was devised whereby each activity was allocated a particular colour/shade (see Figure 1) and these colours/shadings used to distinguish between lesson components and to make any structural regularities more readily apparent (see, for example, Figure 2).

![Figure 1. Allocation of colour for coding purposes to each of the classroom activities found in Stigler & Hiebert’s (1999) US lesson pattern](image)

The results that follow report the application of this same process of schematic representation to each of the LPS data sets from the USA, Germany and Japan. We begin first with the USA.
LESSON STRUCTURE IN THE USA, GERMANY AND JAPAN

RESULTS

Identifying the US Lesson Components within the LPS US Data

Figures 2, 3 and 4 represent the coding of the videotape footage from the LPS data of US Schools 1, 2 and 3 with the classroom activities as described in the US lesson pattern reported by Stigler and Hiebert (1999) and as set out in Figure 1.

![Diagram of US lesson pattern codes as applied to LPS US School 1](image)

The lesson pattern reported in the TIMSS Classroom Videotape Study, namely that a lesson begins with a) reviewing previous material, followed by b) demonstrating how to solve problems for the day, then c) practicing and finally ending with d) correcting seatwork and assigning homework, did not appear as the complete lesson structure in any lesson in US School 1, although it appeared as the first half of Lesson 6. In addition, not all activities were present in every lesson: Lessons 1 to 5 appear radically different in structure from Lessons 7 to 10, while the structure of Lesson 6 appears to be cyclic in nature. This progression in lesson structure across the lesson sequence (that is, across the teaching of one topic) suggests that for this teacher the deployment of the constituent classroom activities was a matter for purposeful choice according to the location of the lesson in the sequence.

Most lessons began with a warm-up activity or by checking homework and this rarely appeared to happen at any other time in the lesson. The progression in lesson structure over the course of the lesson sequence is most evident in the time devoted to teacher demonstration in the early lessons, almost completely replaced by the correction of seatwork in the later lessons. The teacher administered an ungraded, ‘conceptual’ test in Lesson 7 and the three lessons following this test were spent on explaining and correcting the tasks from the test in order to expand on and develop the students’ understanding of the related concepts.

It is important to note that, although the reported characteristics of the constituent activities were fairly vague, it was possible to use these categories for a comprehensive coding of all ten lessons in US School 1. In this sense, the broad categories reported by Stigler and Hiebert (1999) were evident in the LPS US data set. There was no evidence, however, of the reported sequence as a recurrent or regular pattern in the structuring of any of the documented lessons in this teacher’s classroom other than the first half of Lesson 6.
If any structural pattern could be said to be evident in this teacher’s lessons, it was the progressive shift in dominant activity from demonstration through participation to correction and explanation. This progression was enacted, however, not over the course of a single lesson, but instead over the entire lesson sequence. Prior to this analysis, Shimizu had already observed, “Japanese teachers usually plan a lesson as part of a unit, a sequence of several lessons. This means that each lesson in a unit has a different purpose for attaining the goals of the unit” (Shimizu, 1999, p. 194). The data from US Teacher 1 suggested that this American teacher structured each lesson according to its location within the topic or unit.

The structure of the lessons in School 2 (see Figure 3) appeared to be closest in structure to the pattern reported by Stigler and Hiebert (1999). All School 2 lessons were double lessons taking up two timetable periods. In fact, all the lessons in School 2 began with the reported sequence of classroom activities, while the structure of Lesson 3 is completely described by the Stigler and Hiebert (1999)
pattern. There is no doubt that the pedagogical demands of a double-period lesson influenced the teacher’s structuring of each lesson as a whole.

In addition to being the closest in structure to the reported pattern, each classroom activity type appeared in every School 2 lesson. Further, the time allocated to each activity was more evenly distributed than in US School 1.

The US lesson pattern, as described by Stigler and Hiebert (1999), did not appear as the complete lesson structure for any of the lessons from School 3. The earlier portions of Lessons 1 and 7 do resemble the TIMSS lesson pattern, although the lessons themselves in their entirety do not. As for LPS US School 1, not all four activity types appear in every lesson. Lessons 1, 5 and 7 had one similar structural feature: A significant period of each of these three lessons involved the repetitive alternation of student seatwork and the correction of student seatwork. By contrast, several lessons showed little pedagogical sub-structure, with only two or three classroom activities employed (particularly review and practice) and each extending for significant proportions of the lesson’s duration.

Almost all the School 3 lessons began with students correcting their homework from a transparency, which the teacher placed on the overhead projector. Any student concerns about the homework were then addressed at this time. Little time was devoted to teacher demonstration, while large portions of the lesson were spent in student practice. The contrast with US Teacher 1 is striking.

A few summative remarks can be made about the coding of the US data as this is displayed in Figures 2, 3 and 4. Firstly, it was possible to interpret the activity categories of the Stigler and Hiebert report sufficiently broadly to accommodate most of the documented activities in all three US classrooms. Secondly, the US lesson pattern reported by Stigler and Hiebert (1999) adequately described only one of the 25 lessons coded (US2-L3) in its entirety, although the lesson pattern appeared within the overall structure of several lessons. Thirdly, the lessons taught by any one teacher showed evidence of purposeful variation across the topic sequence for that classroom. Fourthly, the differences in lesson structure and topic
structure between teachers suggested that each teacher combined and sequenced the various activities in ways that were not only a reflection of the mathematical topic being taught, and of the location of the lesson in the topic sequence, but also of the pedagogical style of the individual teacher.

Identifying the German Lesson Components within the LPS German Data

The same procedure was followed in the case of the German LPS data set. Stigler and Hiebert (1999) reported the lesson pattern shown in Figure 5 and these classroom activity types were used to code the German videotape data. The results for each of the three German schools are shown in Figures 6, 7 and 8.

![Figure 5. Stigler & Hiebert's (1999) German lesson pattern](image)

![Figure 6. German lesson pattern codes as applied to LPS German. School 1](image)

![Figure 7. German lesson pattern codes as applied to LPS German School 2](image)