

A Cross-national Study of Teaching and Learning in Primary Science Classrooms

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This presentation reports on the methodological issues confronting an Australian-German-Taiwanese team planning comparative video ethnographic research into primary science classrooms. The issues that will be canvassed include: the benefits of cross-cultural comparisons in providing perspectives on local practice, the theoretical justifications of such comparisons, selection of cases for comparison and possibilities for claiming cultural representativeness, the planning of appropriate data sets, the different comparative stories offered by different analytical frames, practical issues of communication and data sharing, and issues of entanglement of language and culture in the analysis.

Background

There has been increasing interest in international comparisons of teaching and learning, and Australian students' performance in Mathematics and Science compared to other countries has been scrutinized carefully and driven calls for curriculum reform. As part of the TIMSS international study, video capture of classrooms across national boundaries has raised questions about the varying foci of teaching and learning including relative attention to reasoning in mathematics and science classrooms (Stigler & Hiebert, 1997; Lokan, Hollingsworth & Hackling 2006) and the possibility of significant cultural determinants of classroom practice (Stigler & Hiebert 1998). There have arisen, as part of this attention, significant international comparative studies exploring cultural signatures in mathematics teaching (Clarke et al., 2006). Arising from a dissatisfaction with reductive coding approaches to cross national comparisons of science teaching and learning, the project this paper describes involves a range of video analyses of sequences of primary school science lessons in Australia, Taiwan and Germany, focused on the cultural determinants framing support of student reasoning in science. This paper will describe some of the methodological issues that have arisen in planning the project.

Research focus and methods

The project — *Exploring quality primary education (EQUALPRIME) in different cultures: A cross-national study of teaching and learning in primary science classrooms* — will begin in 2011. The methodology has been developed in a series of team meetings (email discussion followed by meetings of one week in Taipei, one week in Berlin), but will be refined as the project progresses. The focus and approach of the project has been documented from team discussions as a ‘shared repertoire’. The research questions dealing with cross cultural comparisons are:

1. To what extent is there a coherent and distinct body of science teaching and learning practice in each of the countries, and how is this practice framed by teacher beliefs and particular cultural traditions?
2. In what ways are distinct forms of knowledge and practice differentially privileged in each of the countries?
3. How do teachers in different cultures create opportunities for students to engage in scientific reasoning and quality learning?

This paper attempts to capture some of the key issues that arise in such a study and the methodological response in each case. The analysis draws on notes taken at team meetings and presentations given by participants, including a discussion paper by Sharon Chen (2010), from the National Taiwanese Normal University.

Findings and discussion

The benefits of cross national comparisons are not obvious. A common justification is that we can learn from countries that do well in international tests, and currently there is a lot of interest in Science and Mathematics Education in Finland on this basis. There is a danger that such comparisons could be seen as comparative in an inappropriate competitive sense. There is also a question as to how transposable practices are, given their deeply cultural nature. A more defensible argument for cross cultural studies is that they broaden and differentiate researchers’ perspectives, and increase our sensitivity to pedagogical variation and pedagogical response. They have the potential to unveil unnoticed, taken-for-granted practices.

The possibilities opened up by video

The classroom is a complex environment in which many things are happening at any one time and there are as many different interpretations of the learning that occurs as there are people in the room. The learning events that occur cannot be directly perceived but nevertheless there are many signs – verbal, visual, mathematical and gestural – on which an interpretive analysis can be based. By having two cameras, one focused on the teacher and one on a group of students, the possibility of fast playback for stimulated recall interviews, and good quality audio recording of teacher and groups using digital microphones, we can generate data that allow the capture of sufficient complexity in interactions, with participant commentary, that will support multiple theoretical takes on teaching and learning. The increasing sophistication of software analysis packages such as Studiocode and NVivo allow repeated viewing and close scrutiny of interactions that has never been

possible in situ. By capturing video of sequences of lessons we can potentially make sense of the classroom as a learning community developing ideas across time.

Sampling issues: What do selected classrooms represent?

With a study that looks in depth at teacher practice and student learning and perceptions across a 6-12 lesson sequence, the sample size must be limited, in our case to 4-8 teachers in each country. The problem becomes one of choice of teachers, and clarifying the method of choice so that it is equivalent in each country. The different countries do not have national testing in science that might be used for selection, and in any case the quest for good practice in supporting reasoning may not be satisfied by looking at test scores, given the low level nature of many high stakes testing regimes. There is no objective sampling measure we can rely on.

In EQUALPRIME we decided at the outset to restrict our representation to ‘good’ teachers rather than claiming ‘exemplary’ practice, or attempting to represent the variety of teachers in a country. We will focus on one year level only (Grade 4) and a small number of topics. The problem of representativeness arises in relation to teachers – how do we define ‘good’ – and students, given that different student groupings (urban or rural, socio economic circumstances, established or recent migrant families) may benefit from, and demand, different teaching approaches. Each country will attempt to include teachers in schools that vary in socio-economic context. We have taken the approach used in the Learners Perspective Study (Clarke et al 2006), in arguing that what we mean by a ‘good’ teacher in any country is a teacher who is acknowledged by knowledgeable peers as representing good practice. This would also include the views of the researchers themselves, who are experienced teacher educators and familiar with standards of practice. Here again there are dangers however, in that teacher educators are by the nature of their positions reform oriented, and could tend to select on the basis of reform preferences. In some sense the question of what is culturally central in teachers’ practice is an empirical question, in that given the range in practice that will clearly occur, what we would look for are signature practices that are present in all classes in a country, that are distinctive and different from other countries’ practices. In recognizing and affirming this, the team will be to a large extent dependent on the knowledge and insights of the local research team, so that any question of capturing cultural essence will be fundamentally reflexive; dependent on researcher analyses in which we ourselves will play a defining role. In a sense, we are arguing that what we aim to capture is an expression of primary science practice that is valued and aimed-for by professionals with a stake in the improvement of science teaching and learning in that country.

Dealing with complexity: What should be focused on? What is the unit of analysis?

In analyzing classroom data, different theoretical perspectives create different realities. Theoretical frameworks dictate the type of data that is collected. The complexity of classroom interactions, involving teacher moves that can be interpreted at many levels, and this is true also of student responses and artifacts. In order to capture classrooms, multiple but complementary perspectives have been advocated to provide insights into the many facets of teaching and learning in classrooms (Xu & Clarke, 2010). In this study we are comparing the cultural aspects of teacher support

of reasoning in science, leading to two separate sets of decisions to be made. The first relates to theoretical frames. In capturing specific cultural differences we will need to determine a theoretical perspective that will be fruitful in identifying these, yet until we undertake the analysis we will not know what these differences might be. In preparing for this research however the team met first in Taiwan and then in Germany, and observed local classes in action. We observed also videotape of Australian class, and an Australian visit is planned for 2011. In discussion, the team has identified what seem to be substantial differences in the patterns and pace of teacher-student interactions, the patterns of control of ideas between students and teachers, and the rules that govern student contributions to discussion. These differences have guided us in our choice of a suite of potential analyses but in fact the particular analyses that are performed will be decided and refined iteratively, in order to choose approaches that are most sensitive to the differences that emerge.

The second set of decisions to be made pertains to the 'reasoning' construct. There are a number of theoretical perspectives on how we might define and study reasoning, including current interest in argumentation in science (Osborne, 2010), epistemological aspects of reasoning (Tytler & Peterson, 2004) and model based reasoning (Lehrer & Schauble, 2006). There are also differing perspectives on how we might describe and analyse the conceptual level at which the classroom operates. These matters have been the subject of team discussion and decisions around particular frameworks to be used in coding will be ongoing.

The unit of analysis has also been discussed. Good teaching is characterized at a number of levels – by the structure of the development of ideas across a unit, by the structure of individual lessons, but the way activities are introduced, managed and discussed, and by the micro detail of teacher-student interaction. Cultural differences may show up in analyses at any of these levels.

Data reduction and analysis

Working in teams at five sites in three different countries will place considerable demands on data coordination and sharing. The project team has developed a document outlining the rules pertaining to data reduction and sharing of data. Ethical considerations are important in deciding on the process. Each team will perform an overall analysis of lessons to set the context of the unit, and select lessons that will be shared with the wider team along with an overall contextualizing analysis. Teachers will be consulted concerning which video sequences will be distributed in this way. For the Taiwanese and German videos, English translations will be produced electronically to sit within the video.

Broadly speaking, the analyses will follow two broad theoretical categories. The selected coding schemes represent two fundamentally different theoretical accounts of meaning making; a cognitive perspective focusing on formal reasoning and knowledge structures that underpins reasoning/argumentation and conceptual analyses, and a socio cultural perspective focusing on participation, interaction and language, involving discourse (Mortimer & Scott, 2003) and representational analyses. The question remains; how will we decide on details of the analyses at a remove, and who will perform the analyses for which countries' data?

Studiocode software will be used by the Australian and possibly the German teams, but the Taiwanese team is not Macintoshⁱ based and will use a different

analysis package. This may make it difficult to share analyses at a detailed level. The type of coding that has been agreed on is a combination of ‘instance’ coding, which identifies patterns of types of events across lessons (e.g. discursive moves), and ethnographic analyses, which look for meaning within sequences of interactions.

One of the issues we are faced with is choice of coding categories, and reliability. It will be very difficult to ensure reliability of coding if researchers are not working side by side, or indeed to develop and refine agreed protocols, but meetings have been planned to carry out joint coding. The other possible way of working will be to have particular coding analyses carried out by one team, but shared at the analysis and writing stage to ensure fidelity of interpretation and sharing of ownership of intellectual property. One of the key challenges in coding and analyzing data from different countries involves the role of language and culture in interpreting ‘what is going on’. How will we ensure that each data set is fairly and insightfully represented? It has become clear, in team meetings, that the analysis discussions between the researchers themselves, at working meetings, will be important data sources for unpacking cultural differences in teaching and learning. Discussions and comparative analyses will also take place between the multiple within-country teams.

Working as a team and with teachers – roles, and ethical considerations

One of the discussion points has been the extent to which we involve teachers in discussions about our research focus. Teachers will clearly wish to know what we are looking for, and in a spirit of collaboration we need to explain our focus on reasoning. However, there is a danger that in being too specific, the teachers will change their normal practice. Will this affect our claims of cultural representativeness?

Video images of teachers and children immediately place one in an ethically sensitive situation. It has been agreed that the teachers will be consulted as to which video images are available for analyses by the wider team, and all team members having access to the data will sign agreements concerning confidentiality. Teachers will also have control over which video images might be available for use in conference reports or for teacher education purposes.

There is a danger in cross national studies that comparison is invited which may show a country in a relatively negative light. That this is not part of the intention of the study has been explicitly discussed, but there will need to be ongoing scrutiny of analyses and reporting to ensure the research performs a positive function for all countries.

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ⁱ Studiocode software only runs on Macintosh computers