

## Mathematics education in culturally diverse classrooms

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### 1. A dialogic perspective on learning in multicultural mathematics classrooms

Approaches to the study of human interaction can be divided into two broad approaches that Linell (1998), for example, refers to as *monologism* and *dialogism*. Monologism is associated with a formalist perspective on social interaction, with communication seen as a kind of exchange that takes place between individuals. Dialogism, by contrast, is practice-oriented, and sees communication as an ongoing process of negotiation between people and contexts (see Linell 1998, p. 6-8). The roots of dialogism can be traced back to Bakhtin (e.g. 1986), for whom meaning emerged from the interplay of voices.

Alrø and Skovsmose (2002) apply the distinction between monologism and dialogism to different perspectives on learning. For example, they associate monologism with Piaget's learning theory, by which they mean:

that the basic mechanisms for constructing mathematical knowledge are to be found in the individual and not in the interaction between individuals. (p. 246)

They associate dialogism with the Vygotskian perspective on learning:

which assumes that cognition is constituted by cultural processes (p. 247)

Alrø and Skovsmose relate a monologic view of learning with what they call a 'bureaucratic' model of mathematics education, in which mathematical authority is wielded by the teacher, and which derives from a set curriculum, text book and other bureaucratic structures through which what happens in mathematics classrooms is stipulated (p. 26). From this perspective, mathematics is a body of pre-existing knowledge, set out in the curriculum or textbook and passed on by teachers to students. A dialogic view of learning, however, sees mathematics as *created* in the classroom, through argumentation involving students and teachers. Curriculum, textbooks and bureaucracy still exist, of course, but are seen as part of the context in which the dialogue between learners and teachers takes place.

Since research is also a form of social interaction, the distinction between monologism and dialogism can be extended to the research process. A monologic approach sees the research process as a form of information exchange. The research 'collects' information from participants. Such an approach tends to privilege the perspective of the researcher. A dialogic approach to research acknowledges the social nature of the research process. Such an approach sees the meanings and

understandings that arise as situated within a social context, a context that includes the researcher and their project as much as the participants. From this perspective, researchers are not so much collecting information as constructing meanings with the other participants, which are seen as emerging from the interaction between them. Researchers, therefore, seek to include the voices of the different participants.

We agree with Alrø and Skovsmose that a dialogic approach to mathematics education is preferable. We would also argue for a dialogic approach to research in mathematics education. One reason for this view derives from our interest in multicultural classrooms. By 'multicultural classrooms', we mean that a range of cultural associations or backgrounds are represented amongst the students within the class. Such classrooms are increasingly apparent around the world, and increasingly of concern to researchers in mathematics education. If we take a monologic perspective on the learning of mathematics, a problem arises. Research into the situatedness of mathematics and of mathematics learning (e.g. Powell; Frankenstein 1997, Nunes; Schlieman; Carraher 1993) has shown how the way in which students make sense of mathematics is related to the social and cultural context in which they are located. From a monological point of view, context should not matter: the mathematics curriculum can be taught to all students equally. Unfortunately, of course, research around the world points to differential levels of mathematical achievement for students from culturally less-favoured backgrounds (e.g. Secada, 1992). This suggests that a monologic, bureaucratic view of learning is inadequate. If, as in the dialogic view, mathematics is seen as a product of the mathematics classroom, rather than as an 'input', it becomes possible to incorporate the cultural context in which students learn mathematics. In particular, it becomes possible, indeed necessary, to include the range of voices that participate in the learning process. These voices include those of the students and teachers who are present in the classroom, as well as those from outside the classroom but who influence the dialogue, such as parents and what might be called the anonymous voice of the curriculum or textbook. If the teaching and learning of mathematics involves dialogue between these different voices, the research process must also pay attention to them. Furthermore, the research process itself should be seen as a process of dialogue between researchers and participants. The papers included in this special issue all report research which seeks to hear to some of these different voices, in order to enrich our understanding of the process of teaching and learning mathematics.

### 2. The current issue

The papers in this issue explore different aspects of the role of culture and language in the teaching and learning of mathematics in multicultural classrooms. The different contributors explore the voices of parents, teachers, students and textbooks, collectively highlighting the complex web of meanings that are present in mathematics classrooms.

In their paper, Gorgorió and Planas draw on the theoretical constructs of culture, cultural distance and cultural conflict. They discuss how cultural distance arises from the different meanings that students bring to the mathematics classroom. They analyse how the absence of discussion of these different meanings turns into cultural conflict and reflect how this alienation in the classroom discourse occurs. Based on case studies with immigrant children, they describe how strong negative feelings and refusal to participate in classroom activities can develop. This behaviour is interpreted as a means to protect the own cultural identity against a distant or even hostile school environment. Their work thus highlights the voices of immigrant students.

The contribution of Andrews, Yee, Greenhough, Hughes and Winter focuses on the voice of the teacher in multicultural classrooms. Based on case study data, they explore the views of two teachers on the role of the parents, the community and the children's homes in the learning of mathematics. In particular, they point out the importance of parents and the relationship between home and school. They also reveal the different perspectives of teachers on this relationship. They emphasise the necessity to reflect these aspects in teacher education and in-service teacher education in order to enable future teachers to be more inclusive of multicultural students.

The voices of the parents are reflected intensively in two further papers: those of Civil, Planas and Quintos and of Hawighorst. Civil, Planas and Quintos refer to two research studies with similar theoretical background in two different settings, in Spain and in the USA. From a socio-cultural perspective they describe the experiences of immigrant parents with the teaching of mathematics in their former educational system and compare it with their experiences in the current educational system. Secondly they analyse the role of language referring to the native and the second language. Their research shows that, whilst differences in education systems are themselves a factor, the values or degree of 'recognition' attached to these systems by parents are also important.

The study of Hawighorst takes a similar approach: it analyses parents' views on mathematics and mathematics education, but contrasts parents from different social and cultural background, i.e. parents, who have immigrated to Germany from the former Soviet Union, as well as indigenous German parents. The study shows the influence of the familial circumstances on the comprehension of mathematics and the ways in which the students learn mathematics.

The paper of Knijnik, Wanderer and Oliveira highlights the voices of pre-service teachers from the Brazilian landless people social movement. Drawing on ethnomathematics as a theoretical background, they analyse the different kinds of oral practices that are common in the landless peoples' culture. They show how pre-service teachers give meaning to these practices and explore some of the tensions that arise from the values and assumptions the trainees have about such practices.

The last paper of Novotná and Moraová returns to the issue of the relation of mathematics learning and language. They describe part of a study of learning mathematics in a foreign language, focusing on the

learning of mathematics by Czech students based on textbooks written in English. They analyse in detail the potential obstacles that come from the vocabulary and the grammar of the textbook.

### 3. Mathematics education in multicultural classrooms

The papers included in this issue highlight different factors impinging on the teaching and learning of mathematics in multicultural classrooms. Although the contributors adopt different theoretical approaches, they all refer to socio-cultural perspectives that regard mathematics as a cultural phenomenon. For example in the approach of ethnomathematics (see d'Ambrosio, 1985, Bishop 1988), which is the theoretical approach taken by Knijnik, Wanderer and de Olivera, culture is understood as the totality of conventionalised modes of expression, ways of understanding, attitudes of a group, including their opinions about mathematics and the way it is practiced. Thus, mathematics is a cultural product with universal aspects that finds its manifold expressions in various cultures, traditions and living situations. It has to be emphasised that from this perspective, culture is not bound to nationality.

As the papers in this issue demonstrate, cultures impinge on the mathematics classroom in different ways. Parents value some approaches to mathematics teaching more than others. Based on their prior experiences in different cultural environments, students interpret what happens in mathematics classrooms in different ways. Mathematics textbooks reflect cultural practices that may not be familiar to all students. These different voices may all contribute to the meanings that students create within their mathematics lessons. Where differences are perceived by students, they may lead to conflict, loss of engagement and underachievement. It seems clear, therefore, that as classrooms become increasingly multicultural, there is a need to understand in greater depth the processes through which different voices are heard or silenced in the teaching and learning of mathematics.

A further conclusion that can be drawn from the papers in this issue concerns the importance of the methodological approach that researchers use to investigate these different voices. These papers are all qualitatively oriented, generally based on case studies. They contain ethno-methodological aspects in their procedure and design, in such a way that the studies have taken place within the researched cultures. In particular, in most cases the researchers have sought to understand and engage with the meanings, values and perspectives of the different participants. In order to achieve this goal, the researchers and the objects of the research necessarily have a close relationship: the researchers are not considered as strangers in the researched cultures (see also Jungwirth, 2003, 197). It is in this sense that these studies can be characterised as dialogic in nature: the researchers' understandings of the situations they investigate have arisen through their engagement with some of the participants.

Finally, it is evident from several of these studies, that in order to improve learning and attainment of all

students in multicultural mathematics classrooms, the process of dialogue must continue. Whilst identification of differences in values, meanings or interpretations is an important first step, it does not on its own necessarily lead to change. The students referred to in Gorgorió and Planas's paper may be acutely aware of difference: the challenge for teachers and researchers is what to do about it. Addressing that challenge also requires dialogue. As Knijnik, Wanderer and de Olivera show, the awareness of difference was only a first step for the trainee teachers they worked with. For many of them, the mathematical practices of the people they had observed were not valued. Knijnik, Wanderer and de Olivera give a sense of how challenging the process of dialogue between different perspectives can be. Thus dialogue between teachers and parents, homes and schools, textbook authors and students all have an important part to play. For such dialogues to be possible, however, the different voices must first be heard. That is the contribution of this special issue.

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