Linguistic Discrimination: an Issue for Research in Mathematics Education [1]

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How many languages do you speak? How do you use different languages in your work as a researcher or teacher? The presence of many languages in contemporary societies and classrooms presents many challenges for the practice of research and the organisation of research communities. Some languages appear to be more visible or valuable than others. English, in particular, is more visible in published research than other languages. This article seeks to consider how research in mathematics education may discriminate on the basis of language, both within the community of researchers and in the practice of research. The following questions are addressed.

- Do the structures and practices of our community privilege speakers and writers of some languages over others?
- What assumptions about languages are made in research in mathematics education?
- Do these assumptions or practices of the mathematics education research community reproduce disadvantage or discrimination?
- What are some possible effects of this discrimination?

In exploring the above questions, I seek to uncover some of the assumptions and conventions of our community and thereby to promote discussion, awareness and change. To do this, I will first present a definition of a notion of linguistic discrimination. I will also briefly consider the relationship between multilingualism and mathematics. I will then use the resulting position to consider the practices of the mathematics education community, focusing on the nature of publications and conference meetings. I will also consider the practice of research in mathematics education by examining two examples of research into multilingualism and the teaching and learning of mathematics.

What is linguistic discrimination?

Although the question of which languages are used in our classrooms is an important educational issue, decisions about the role of different languages in education are largely political (Edwards, 1994; Paulston, 1999). Who gets to use which languages in schools, as in wider society, is closely bound up with issues of access, power and dominance. Members of minority language groups, for example, must learn the majority group language to participate in formal education. In this way, minority languages may be devalued and speakers of such languages potentially disadvantaged. Differential opportunities, attitudes or treatment of speakers of minority languages, including school students, can be seen as a form of discrimination. Skutnabb-Kangas (1988) characterises such discrimination in terms of:

> ideologies and structures which are used to legitimate, effectuate and reproduce an unequal division of power and resources (both material and non-material) between groups which are defined on the basis of language (on the basis of their mother tongues) (p. 13)

Thus, a structural expectation within education systems that students from minority groups should only be taught subjects such as mathematics through a majority or dominant language can be seen as a form of discrimination, especially since there is evidence that educating students partly or entirely through their mother tongue is educationally advantageous (Cummins, 1996, 2000). In Skutnabb-Kangas' terms, discrimination arises from "ideologies and structures" and occurs through institutional practices and the social construction of the dominance of particular languages, as much as through the actions of individuals (Skutnabb-Kangas and Phillipson, 1994). Both individual actions and social structures are based on sets of often tacit assumptions about languages, their status and about the people who use them. It is these sets of assumptions which form the basis of ideology (Fairclough, 1989, p. 2). As individuals, we act within the structures of our institutions and of wider society, perhaps unaware that we may be reproducing disadvantage and discrimination.

Multilingualism and mathematics

What is a 'multilingual mathematics classroom'? For me, any classroom in which more than one language is present may be called 'multilingual'. This definition masks considerable complexity, however. I will highlight three of the more common scenarios for multilingual classrooms around the world, which I will call *monopolist, pluralist* and *globalist.*

In *monopolist* classrooms, all teaching and learning takes place in the dominant or majority language of wider society. In England, for example, English is used as the language of teaching and learning in all classrooms, even in schools serving minority-ethnic communities in which speakers of up to sixty different languages may be present in a single school (see, for example, Barwell, 2001, 2002b). Thus, multilingualism in this context describes the languages available in the classroom, although these languages are rarely used.

In *pluralist* classrooms, several of the languages present in wider society are used for teaching and learning and are

built in to national or local policies and curricula. Setati (1998), for example, describes the use of Setswana and English in a South African mathematics classroom (see also Adler, 2001; Setati *et al*, 2002) Even in pluralistic classrooms, however, some students will still be working in an additional language, if, say, they come from a minority language background within that society

Globalist classrooms are those in which teaching and learning are conducted using an internationally used language such as English The language of globalist classrooms is *not*, however, widely used in the society in which the school is located Some schools in Pakistan, for example, teach mathematics through the medium of English, despite English not being widely used in the surrounding community (see Barwell, 1998)

Within these different types of multilingual classrooms, some students are likely to be advantaged, others disadvantaged. Clearly, native speakers of the classroom language have some degree of advantage, as compared with fellow students who are still learning the language of teaching and learning. A ten-year-old Cantonese-speaking student who took part in my recent research in a UK (monopolist) classroom must learn mathematics using English, even as she learns English itself (see Barwell, 2002b)

Similarly, in globalist classrooms, it is often students from more advantaged socio-economic backgrounds who have most access outside school to the language used in the classroom (Fasold, 1984, p 27). Clearly, the nature of multilingualism in mathematics classrooms is highly complex and is linked to issues of power and advantage One possible response to this complexity is to take the view that mathematics transcends differences between languages and that multilingualism is not therefore an issue Is mathematics the same in different languages? I will set out my own position on this issue.

Mathematics in many languages

For me, language is more than a sort of code used to express thoughts. Using language is a part of social interaction (Edwards, 1997) and consists of sets of behaviours or practices which include ways of speaking and writing, describing, arguing, explaining, joking, and so on. Patterns of language use are associated with particular activities The relationship between linguistic and social practice is illustrated by Whorf's (1956, p. 135) example of workers being careless with their cigarette stubs in proximity to what they described as "empty gasoline drums" Their carelessness, which contrasted with their behaviour near to 'full' drums, led to an explosion Whorf argued that the workers' behaviour was linked to their use of the word 'empty' to describe barrels which contained flammable vapour. Language can therefore be seen as part of social practice or what Whorf refers to as "cultural norms" (p. 159). Since different languages employ different ways of talking about the world, they entail different behaviour towards the world, although this does *not* mean that language determines behaviour. As Whorf states:

> There are connections *but not correlations* [..] between cultural norms and linguistic patterns (p 159; *emphasis mine*)

Thus, language is a part of how we act.

In mathematics education, research has examined some of the particular language practices associated with mathematics classrooms (e.g. Morgan, 1998; Pimm, 1987; Rowland, 2000), although such studies have largely been based on the use of English. Pimm (1987), for example, analyses the nature of both written and spoken communication in British mathematics classrooms. Like Whorf, however, Pimm is careful not to make simplistic connections between linguistic and conceptual form, arguing that:

> It is very suspect [...] to go from observations about the marked surface features of particular dialects or languages to conclusions about the conceptual thought that can be carried by them. (p. 81)

To paraphrase Whorf's observation given above, there are connections but not correlations between the social practices of mathematics and the patterns of the mathematical discourses of different languages. This position is supported by the small number of studies which have explored features of mathematical language practices in non-European languages A study by Watson (1987), for example, highlights differences in the treatment of number in Yoruba and English. In a different study, Watson (1988) explored the mathematical discourses of Aboriginal language communities in Australia, which she compared with those of English She was able to relate differences between the two languages to, for example, the different value systems associated with mathematical talk (p. 264; see, also, Roberts, 1998).

Similar issues have been raised in relation to the Māori language (Barton *et al*, 1998). These studies, all of which aim to go beneath the 'marked surface features', support the view that there are 'connections' between different languages and the social and linguistic practices of mathematics in those languages Doing mathematics is different in different languages.

The argument I have developed above in relation to mathematics in many languages can be equally applied to the nature of research in mathematics education. Most researchers around the world live and work in multilingual societies and speak several languages The social practices involved in doing research are related to the linguistic practices of different languages. Forms of reasoning, including ways of seeing, arguing, questioning and making sense of the world, for example, are not necessarily the same in all languages, of which Watson's (1987, 1988) work on mathematics provides a particular example. Thus, both mathematics and mathematics education research are influenced by the language(s) in which they are conducted In the next sections of this article, I will consider the nature of linguistic discrimination in both the mathematics education research community and in the conduct of research itself, as well as possible consequences of such discrimination.

The mathematics education research community

This section deals with the activities and practices of the community of researchers who investigate and identify themselves with issues in mathematics education. I will

consider two of the main activities of the mathematics education research community: organising opportunities for discussion such as conferences and symposia and the publication of research in conference proceedings, research journals and books.

The majority of international conferences in mathematics education appear to be conducted in English. The annual meeting of the International Group for the Psychology of Mathematics Education (PME), for example, only accepts papers written in English, although it permits the inclusion of an abstract in a second language (PME, 2000). Similar conditions apply, for example, to conferences of the European Society for Research in Mathematics Education (ERME, 2000) and to the conferences on Mathematics Education and Society (MES, 2001).

As with conferences, the leading international journals in mathematics education predominantly publish in English, although some of these will also publish articles in other 'world' languages, such as French or Spanish. Book publications, reasonably, show greater linguistic diversity than journals. Even here, however, the number of languages in which mathematics education research is published is small compared with the number of languages used in mathematics classrooms or the number of languages in existence in the world (several thousand). Furthermore, the few languages in which significant amounts of research are published are mostly European in origin. It is notable that in a number of recent encyclopaedic summaries of international research in mathematics education (e.g. Bishop *et al.*, 1996; Grouws, 1992), non-English-language research is cited much less frequently than research published in English.

The privileging of English (and certain other European languages) in this way is presumably justified pragmatically. English is the language of academia and, it is argued, it would be impractical to organise international conferences or journals with many different languages. Nevertheless, researchers from English-speaking backgrounds have a great advantage. As an English speaker myself, I am aware that writing and reading research for an international audience is more straightforward than for many of my colleagues for whom English is an additional language. Similarly, I have an advantage in presenting my work at international conferences and in the discussions that follow my own or other colleagues' presentations. It ceases to be remarkable how many researchers work in additional languages. The use of English makes it possible for me and my English-speaking colleagues *not* to learn to work in other languages.

The privileging of English (and to a lesser extent a few other languages) has at least two consequences. Firstly, as discussed above, a preference for European languages in general, and English in particular, leads to the privileging of research published in those languages, especially English. There is no inherent reason why research published in English is academically better than research conducted and published in any other language. This situation, which is legitimised by the structures and practices of the research community, gives an advantage to researchers who have English (or to some extent other European languages) as a mother tongue. Co-incidentally, these are the languages of many of the more powerful, wealthy nations of the world.

Secondly, if language is connected to the practice of research and forms of reasoning are different in different languages, then by privileging a small minority of languages some ways of making sense of the world are favoured over others. Again, the cultures that prevail are those of the powerful, wealthy nations. Ironically, speakers of less favoured languages must by necessity learn more favoured languages, giving them access to different ways of reasoning and an understanding of what that might mean. If these insights must then be communicated in English, however, their richness is lost. Thus, some aspects of the community of mathematics education research are linguistically discriminatory. The next section deals with the same issue in the practice of research by considering two published conference research reports as case studies.

The practice of research in mathematics education

The language(s) of mathematics teaching and learning are considered relatively rarely. 'Language and mathematics' is commonly one of the headings used in categorising research (see, for example, Bishop *et al.*, 1996; Grouws, 1992; Owens and Mousley, 2000). Much of this work, however, concerns aspects of monolingual classroom interaction or mathematical language. There is little which addresses questions of multilingualism (including bilingualism) in the teaching and learning of mathematics. Given the prevalence of students learning mathematics through an additional language in most parts of the world, whether in immigrant communities or indigenous minorities, it is surprising that there is not more research investigating the many issues this raises for teachers and learners. An explanation may be that the majority of research in mathematics education takes place in the North ('developed countries'), often in countries which are portrayed as linguistically homogeneous (though this is not at all the case), while multilingualism tends to be seen as more of an issue for the Southern countries ('developing countries'), which are often those countries with fewer resources to devote to educational research.

Where research has been conducted into issues of multilingualism in mathematics teaching and learning, it generally falls into two main groups: quantitative, outcomes-based research (e.g. Dawe, 1983; Clarkson, 1991a, 1992; several studies in Cocking and Mestre, 1988; see also Secada, 1992) and qualitative, classroom-based research (e.g. Adler, 1999, 2001; Setati, 1998; Moschkovich, 1999; Barwell, 2001). I have selected two conference research reports to serve as case studies, one from each of the two broad approaches mentioned above. By considering two papers which *do* address multilingualism in mathematics education, I raise issues and questions of relevance for all research into the teaching and learning of mathematics.

From the quantitative approach, I have selected Clarkson and Dawe (1997) and from the qualitative, Adler (1995). Both are taken from PME conference proceedings and both report work by researchers who have published several papers and articles on multilingual issues in mathematics education (e.g. Clarkson, 1983, 1991a, 1992, 1996; Dawe, 1983; Adler, 1997, 1998, 1999), including two monographs (Clarkson, 1991b; Adler, 2001). PME conference proceedings were chosen

because it implies that both papers were written to similar criteria and for a similar audience. A drawback is that both papers are limited to eight pages and therefore lack detail on the larger projects from which they are drawn. For background context, I have therefore supplemented the papers with other relevant work by the authors.

In examining these papers, I seek to uncover assumptions and practices which legitimise or reproduce linguistic discrimination in mathematics education research more generally However, I wish to be clear that my purpose in examining these two studies is not to criticise personal views and attitudes nor, least of all, the competence of the researchers concerned. Rather, it has been to explore hidden assumptions and practices critically which may be present in much, if not all, research in mathematics education and which make up the ideologies and structures that can lead to linguistic discrimination. The issues highlighted, therefore, are likely to be issues in many research contexts, not only in those involving multilingual students

Clarkson and Dawe (1997)

The research reported in Clarkson and Dawe's (1997) paper was conducted in two cities in Australia with large multilingual populations. A key theoretical background to their work is Cummins' threshold hypothesis (Cummins and Swain, 1986; Cummins, 2000) that relates linguistic proficiency of bilingual students to academic achievement. The paper looks at the following three questions.

(1) Do students use their first language (L1) when attempting mathematical problems?

(2) Is there a relationship between language competence and mathematical performance?

(3) Why do students swap languages during their work?

The paper reports analysis of data collected from 252 students from 18 schools, from 24 different language backgrounds. The students were all taught in monopolist classrooms in which English was the language used. The sample focused on 93 students of Vietnamese language backgrounds and 48 of English-speaking backgrounds. The data consisted of scores from the following tests: an English language competence test, a Vietnamese language test, a mathematics test of symbolic items with no words in an alternate-answer format, a mathematics test of short extended answer word problems and a mathematical test of open-ended items (more than one correct answer).

The question of language use appears to have been investigated through observation (this is not made clear in the paper). The authors report that:

> an important percentage [...] did [use L1] for each of the mathematics tests (p. 155)

To investigate a possible relationship between language competence and mathematical performance, the authors used language test scores to partition their samples.

First, the English language scores of the 'English speakers' were partitioned into thirds. The cut-off scores were then applied to the 'Vietnamese students' The Vietnamese students were also partitioned into two groups based on their Vietnamese language scores, divided by means of the median. This process allows Vietnamese-speaking students to be classified as having:

> relatively high competence in both their languages [.] relatively low competence in both their languages, and students who had high competence in one of their languages (p. 156)

Analyses of variance were then carried out to investigate the effect of language competence on the mathematics test scores. The results showed significantly lower scores for the 'low competence in two languages' group, as well as higher (but not significantly so) performance by the 'high competence in two languages' group, which the authors argue is in line with Cummins' hypothesis.

Finally, to investigate why students swap language, a sample of students was interviewed:

> on how they completed three or four mathematical problems, in particular what language did they used [*sic*] in the process, and why. (p 159)

Although the interview data is not presented, the authors suggest some factors based on early analysis, including level of difficulty of the problem, affective response and memory.

In many ways, the paper challenges linguistic discrimination, demonstrated in the first instance by its focus on multilingual students, as well as by the finding that bilingual students with high competence in two languages outperformed monolingual students. In addition, the authors argue as a result of their work (following Cummins and Swain, 1986) that students' first language plays a role in their learning of mathematics and it is therefore important that bilingual students maintain and develop competence in their first language. They conclude by contending that both teachers and curriculum writers need to be more aware of the role of first language in mathematics teaching and learning (p. 160), thus placing the onus on the education system to respond to the needs of bilingual students rather than the other way round. There are, however, a number of assumptions and practices which are evident in the way the research was conceived and conducted which may lead to linguistic discrimination

English as the norm

In several ways, Clarkson and Dawe's (1997) paper positions English as the default language. The multilingual students who participated in the study are referred to as 'Non-English-Speaking Background' or NESB Students' language background is identified through the country of origin of the students' parents, of which thirty-four countries:

> were predominantly at least non-English speaking. (p. 154)

English is also used as the norm for partitioning the multilingual students on the basis of English language com- petence It is the scores of the 'English speakers' that are then used to label the multilingual students as high, medium or low competence. The English language test is referred to as an 'English language competency test', whilst the Vietnamese equivalent is referred to simply as a 'Vietnamese language test', implying English is a language in which students have

competence, whilst Vietnamese is a language students either have or do not have.

Assumption of homogeneity

Multilingual populations, especially from migrant communities, are likely to be highly heterogeneous, reflecting students' diverse experience in two or more languages. In Clarkson and Dawe's (1997) paper, it is not clear, for example, how long the Vietnamese students have been learning English or living in Australia. It is possible that the students categorised as highly competent in two languages have lived in Australia since birth and come from households including a native English speaker as well as a native Vietnamese speaker. Such households might be more affluent and provide more support for the students, both financial and motivational. Students categorised as having low competence in two languages might be recent arrivals in Australia and may come from poor households including no native speakers of English and possibly native speakers of languages in addition to Vietnamese.

My purpose in suggesting these scenarios is two-fold. Firstly, they highlight an assumption of homogeneity which arises in part as a result of taking a quantitative approach. This assumption leads to all students from Vietnamese backgrounds being seen as generally the same, distinguishable by means of their measured linguistic competence. Secondly, they point to the importance of diverse social and political factors in students' school attainment (see Secada, 1992). Such issues are not addressed in Clarkson and Dawe's (1997) paper (possibly due to its presentation at PME, a conference with a predominantly psychological focus). The same arguments also apply to the 'English speakers'. What is the difference, for example, between a student who speaks predominantly English but also a little Vietnamese, and a student who speaks predominantly English, but also a little French?

Written tests

There are a number of issues relating to the use of written tests as the main instruments in the study, a widely-used practice in mathematics education research. No account is given of the effect of the language of the mathematics instruments. The processing of language in mathematics test items has been linked with attainment of multilingual students (e.g. Prins and Ulijn, 1998). Clarkson and Dawe (1997) also used a test "with no words" (p. 154), though the absence of words does not imply the absence of language, since the students have studied mathematics predominantly in English. Furthermore, written tests of linguistic competence only test an extremely limited form of competence, that of language tests. Such tests are likely to test forms of language use more familiar to students from monolingual backgrounds and, indeed, from particular socio-economic backgrounds (Heath, 1983). Competence of multilingual students is likely to be different (Cummins, 2000). There are also likely to be differences in students' general orientation towards testing. Students from cultural and linguistic minorities may, for example, take longer to see tests as situations where they must display linguistic or mathematical competence and that these displays are important in the school context (Secada, 1991).

Adler (1995)

The research report by Adler (1995) contrasts in many respects with that of Clarkson and Dawe (1997). Her research is qualitative in nature and comes from a wider project, one that:

> seeks a critical understanding of the complexities of teaching mathematics in multilingual classrooms through teachers' knowledge of their practice. (p. 208)

The paper consists of the narration and discussion of an incident in the classroom of a teacher in the project, named Sue, who seeks to use a participatory-inquiry approach in her teaching. The majority of the students in the class are not native English speakers, unlike Sue who is "white and English-speaking" (p. 211). Thus, English is the 'language of learning and teaching' (Adler, 2001, p. 23), suggesting that Sue's is a monopolist classroom. Adler (1995) sets out the classroom incident along with the teacher's comments from subsequent interviews. During a class feedback session, Joe, for whom English is an additional language, is asked to explain his work. Sue perceives that he is struggling with the (English) language of the explanation and intervenes, 'deflecting' the issue by commenting on how Joe has labelled a diagram. Adler (1995) goes on to develop the description further, moving on to a more general discussion of some of the theoretical issues involved, highlighting a tension for Sue between engaging with 'communicative difficulties' and with mathematics.

As with Clarkson and Dawe (1997), there are elements of Adler's (1995) paper which both challenge and reproduce linguistic discrimination. Discrimination is challenged through addressing issues of multilingualism in the teaching and learning of mathematics. Furthermore, Adler's participatory, reflective approach allows the teacher to develop her practice through participation in the research, including how she deals with multilingual issues. Potentially, therefore, the approach will lead to more effective learning situations and opportunities for Sue's students. A participatory approach also allows issues relating to the multilingual nature of the class to emerge for teacher and researcher, rather than making preconceived assumptions about the 'problems' multilingualism might cause. By developing tensions as they are for Sue, Adler avoids making generalisations about the 'trouble' with multilingual classes or multilingual students. Some aspects of Adler's (1995) approach, however, do depend on discriminatory assumptions and practices.

Assumption of homogeneity

It is noticeable that the students' voices feature only slightly in the paper. Joe appears in transcript excerpts, but the dominant voices in the paper are those of Adler and of Sue, the teacher. Admittedly, the research focuses on *teacher* development in a multilingual context. This focus can perhaps lead to the relegation of the students to the status of background. The paper portrays the class in fairly general, homogenous terms. We are told that:

> the vast majority of pupils are black and not native English-speakers (p. 211)

Although Adler refers to the diversity of the class, we can get no sense of this diversity. More detail is given in longer papers (e.g. Adler, 1999), including some of the languages used, as well as some information of the types of schools involved, but the classes are still portrayed in fairly general terms. There is a sense that language is an issue for the teacher to deal with, but not for the students.

English as the norm

The diversity in the classroom becomes relevant in the light of Adler's (1995) summary of the emerging issues of communicative competence in the class, which include the following.

1. Pupils sometimes struggle to formally explain their thinking.
2. Pupils are often unable to communicate and engage each other effectively (p. 212)

My questions here concern the nature of communicative competence, explanation, thinking and engagement. From my Whorfian perspective, all these practices may be influenced by the different linguistic practices within the students' experience, including their experience of other languages with which they are more familiar. Their different languages have associated with them different modes of explaining, of communicating or engaging. Students' diverse linguistic and cultural backgrounds also imply different meanings for the words that are used by all participants.

Adler's observations implicitly suggest that the nature of such linguistic practices and meanings is universal or even that the linguistic practices and meanings of English are the norm. Can Adler say, for example, that:

> pupils are [ ] unable to communicate [ ] effectively (p. 212)

Or is it rather that they do not appear to communicate effectively according to the standards Adler is familiar with? According to this argument, it is possible that English, or the linguistic practices and meanings of English, is being privileged in Adler's analysis of the classroom incident.

Linguistic discrimination in mathematics education research

Consideration of the two papers has highlighted a number of issues for mathematics education research. Neither paper could be labelled as wholly promoting or challenging linguistic discrimination. Indeed, that was not the purpose of my analysis. Rather, through examining an example of the published work of two experienced researchers, I sought to raise issues of wider concern to researchers in mathematics education. These issues included:

- the privileging of English as the default language in multilingual classrooms;
- the problematic use of written, quantitative instruments in assessing students from widely different cultural, linguistic and social backgrounds;
- the assumption that students from particular language backgrounds are a homogeneous group;
- the issue of differences in linguistic practices and meanings that arise from researching in multilingual, multicultural classrooms.

These issues could serve to legitimise or reproduce similar attitudes and consequences. In Adler's (1995) study, for example, the analysis was developed in part with the teacher. The privileging of English linguistic practices or meanings may therefore perpetuate a prevailing attitude in Sue's classroom, with the potential for teaching and research to devalue other languages and linguistic practices. Similarly, although Clarkson and Dawe (1997) argue from their results that students need support in their first language in studying mathematics, and that this is the responsibility of the education system, their characterisation of students as having low competence in two languages could have potentially negative consequences for students of Vietnamese background. Their study could be interpreted as showing that linguistic minority students should be taught in English with no support for other languages.

All students come from diverse backgrounds, have different experiences of language, of mathematics and of education and, therefore, have very different interpretations of what happens in their mathematics classrooms. What, then, can mathematics education do to address the issues raised here? I hope by means of this article to stimulate further discussion on these issues in this journal.

Note

[1] An earlier version of this article was presented at the Third Mathematics Education and Society Conference and appears in the proceedings (Barwell 2002a).

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