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Potential Lessons for Teaching in Multilingual Mathematics Classrooms in Australia and Southeast Asia

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Multilingual classrooms are the normal learning contexts for most children throughout the world. However not all such contexts are identical. This distinction is not always made in the literature. In this paper the multilingual context for classrooms in many urban classrooms in Australia is described before exploring a possible model that might be of use in guiding the teaching of mathematical language. Some extensions are considered that might be applied to other multilingual classroom contexts.

Key words: Mathematics and language; Multilingualism; Teaching contexts; Teaching; Home background; Learning

Introduction

We do live in exciting times that are at the same time confusing, in a world that is changing, as it always has of course, but now under the influences of globalisation. And yet there are some things that do not change in the majority of our classrooms. We still have a teacher and students communicating with each other, mainly verbally, in a learning environment. The question is how do we advise our school teaching colleagues to develop an environment that will promote insightful learning of mathematics? In this paper I wish to reflect on a long term project in which I have been thinking about the learning and teaching of bilingual children in mathematics sessions.

The breaks in shared understandings are the interesting moments in students' learning. These are moments, when the breaks are resolved, that learning often occurs. Hence the identification of such moments is clearly critical for quality teaching. Such breaks may be of a cultural, social, or a cognitive nature such as a language misunderstanding, or some mixture of

these. The learning that takes place may be conceptualised in any one, or a combination of these three contexts. In this paper, as it explores the possibilities of finding teaching strategies that enhance the seamless flow of understanding in mathematics classrooms, a cognitive conceptualisation of the impact of the language context will be central, particularly for English Language Learners (ELL) in Australian classrooms.

A Language Use Model for Mathematics Classrooms

The role of language in mathematics learning has gradually become a feature of mathematics education research over the last three decades (Austin & Howson, 1979; Ellerton & Clarkson, 1996; Ellerton, Clements & Clarkson, 2000; Halliday, 1978; Pimm, 1987). This linkage is now seen as a crucial element in mathematics learning and teaching. Its significance is also recognised to a degree by practitioners. Hence it is discussed in mathematics teachers' professional conferences, as well as in curriculum documents (e.g. Irons, 2003, embedded in Queensland mathematics curriculum).

Since deep conceptual development in mathematics is dependent on an appropriate understanding and use of the academic language of the subject, this academic language needs to be taught. The suggested model in the literature is a guide as to how teachers should encourage students to use language during the process of mathematics learning (e.g. Clements & Del Campo, 1987; National Council of Teachers of Mathematics, 1989). This model suggests that teachers encourage their students to progress through different forms of language (see Figure 1). In the model the casual / informal language of students, and the corresponding contexts with which they are familiar, and within and from which their language draws its meaning, are used by the teacher to begin a discussion of a concept, procedure or issue. Frequent use of idioms quite specific to a particular age group, and perhaps specific to a city (and may be a school), are markers of such informal language. Shorthand, abbreviated language features in conversations when informal language is in use. Such a language form might not be capable of exploring extensively the nuances of the mathematics under discussion. As the discussion progresses, students are encouraged by the teacher to move from the casual / informal to a more structured standard form of English. This form of English is that often used between adults and students, and between adults. It is often the form of English that would be acceptable for a presentation in the English language classroom. Although in verbal

conversation it is common for speakers to not use full sentences, in the casual form this feature is high. In the more structured form, the frequency falls and there is a rise in speakers using full sentences. When using the written language, the use of informal jottings decreases as students move into a more structured form of their language. Finally the precision of academic mathematical language is introduced that clearly shares much with structured English, but has been developed to allow a sharing of mathematical thinking (Barton, 2008b; Pimm, 1987). Hence students will be guided to be careful how they use such words as 'half' (not just 'part of a cake', and certainly not 'taking the biggest half'), as well as being encouraged to use specialist mathematical words such as 'ellipse' and 'parallel'.

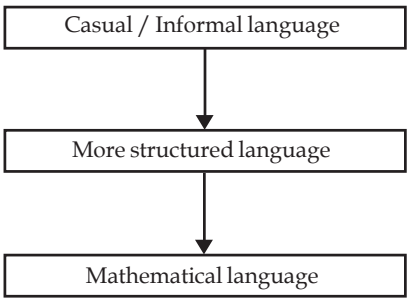

Figure 1. Language model for mathematics classrooms.

Within Australia this approach to teaching can be identified in curriculum documents with the encouragement to use 'everyday language' or 'conventional language' when introducing new concepts. But there is far more use made of terms such as 'language precision', 'difference to everyday language' and 'symbolic context of language' in the documents (Queensland Studies Authority, 2004; Victorian Curriculum and Assessment Authority, 2002). The impression is gained that although there is some recognition of the suggested flow of language use shown in Figure 1, the emphasis is far more on progressing speedily through the model to the formal language of mathematics.

An inspection of the mathematics education research literature suggests that although the simple language usage model (Figure 1) is evoked as the appropriate way language should be used, there is no evaluative study to ascertain whether indeed teachers are following this approach. Preliminary classroom based observations suggest that many teachers are more inclined to follow a more traditional pattern of teaching by starting with the definitions of key words (e.g. 'congruence' in a grade 2 mathematics classroom), and then provide exemplars in the hope that meaning for the formal language is built up within the student group. This is the reverse of what the model advocates.

Although the model in Figure 1 provides useful guidance for teachers, it is limited, as are all static diagrams that try to capture the essentials of a dynamic situation. But it is surprising that the model has not been elaborated to reflect the fluid manner in which both teacher and students use language. Preliminary observations suggest that in classrooms where there was a downward flow of usage (Figure 1), there were many examples of switches between the different forms of language. One way to partially capture this dynamism is to use double-headed arrows (Figure 2). As well it seems the intermediary category is at times omitted. Hence a teacher might ask students to describe in their own words the edges of a long straight stretch of roadway. After much discussion, the teacher and students agree the key notion is that the edges are always the same distance apart. Then the quite formal term of 'parallel' may be introduced. But at that point, the teacher and/or students may well revert to more casual language as an evaluative device to check the consistency of the central idea through the flow and intermingling of multiple forms of the English language. In other words although the overall thrust of teaching of language usage is downwards, as shown in the model in Figure 1, in the end the students need to be conversant with all three language forms shown.

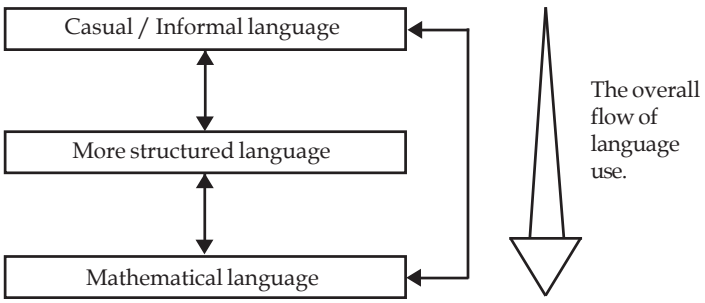

Figure 2. First modification of the 'language model for mathematics classrooms'.

An Elaboration of the Language Use Model for Bilingual Contexts in Australia

Although there is agreement of the important impact of language on the learning of mathematics, there is little recognition of the multilingual contexts of classrooms. The notion of the multilingual context of many classrooms can itself be misleading, if not nuanced carefully. In fact there is not such 'a' context. This term should be used as a plural term covering many different context**s**, something that has not been noticed in the mathematics education research literature. Some of these contexts, elaborated elsewhere in more detail (Clarkson, 2004a), are:

- monolingual teachers teaching a mixture of monolingual and multilingual students,
- monolingual teachers teaching classes of multilingual students all speaking the same languages,
- multilingual teachers teaching multilingual students in a language different to any of their first languages, and
- multilingual teachers, multilingual students who share a language.

Although Australia is often thought of as a monolingual country, even by Australians, it is far from this. For example there are more than 240 nationalities, and at least 180 languages in use to some degree in Melbourne, the second biggest city in Australia. Across Victoria, one of the states of

Australia, about 17% of the population were born in non English speaking countries. In some areas of that state, such as the state parliamentary electorate of Thomastown, 66% of residents speak a language other than English at home. These figures are duplicated in Sydney and to a lesser extent in other large Australian cities. In these cities language groups are spread across suburbs. Hence it is not surprising that many classrooms have students from 4 to 5 language backgrounds, and some have 10+ languages or more represented. This language complexity results in a far more complicated teaching / learning context.

To perform well at school, students have to master the teaching language, which is normally the dominant societal language, English in the case of Australian students. In a comprehensive review, Slavin and Cheung (2005) argue that the recognition of bilingual learning contexts is crucial for student learning. But even more importantly, it has been shown that bilingual students perform better if they also learn to use their first language as one of their possible solution strategies when doing academic work (e.g. Cummins, 1991; Cummins et al, 2006; Baker & Hornberger, 2001), no matter what the first language is. Hence the naive but attractive view that students should only use the dominant teaching language of the classroom, and that there should be no encouragement for the use of other languages students may speak at home since this will cause interference during the learning process and hence lower performance, is simply not supported in the research literature.

Over the last 25 years research has shown that when bilingual students who are competent in both the dominant teaching language and their home language do perform better in mathematics than other students, and the difference can be attributed to the language impact (Adler 2001; Clarkson, 1992; 1995; Clarkson & Dawe, 1997; Clarkson & Galbraith, 1992; Cocking & Meste, 1998; Jean, 2006; Moschkovich, 2002; Secada, 1992). This continuing work is also showing the many reasons why bilingual students choose to switch between their languages when doing mathematics (Clarkson, 2006).

Lin and Martin (2005, p.90) note, "The dynamics of the interaction for learning and teaching bilingually are under-researched." This is surprising since, as Ackerman, Heafner and Bartz (2006) note when summarising the literature, "Research identifies many factors affecting student achievement, however the greatest determinant of student achievement is the influence of teachers" (p.6). The lack of research on teaching in multilingual classrooms

also applies to mathematics. Clarkson (2004) reviewed the four main research journals in mathematics education (ESM, JRME, FLM and MERJ) for the years 2000 through 2003, and then extended this for issues published up to 2006. He found that although there are now many reports on bilingual students learning mathematics, there were very few reports on the teaching of such students. These were descriptive studies and none attempted to exploit models based on research of teaching. However the following four notions from these studies are worth noting:

- Teachers should encourage the different types of language, such as informal talk in students' first language leading to more formal mathematical talk in the language of teaching.
- Tracing the language paths of students in such complex multilingual situations is critical.
- Informal or exploratory talk inevitably occurs in the students' first languages. This can often lead to 'broken communication' when the teacher does not share the students' first language. Hence helping students to move to the more formal mathematical talking and writing, which often involve a switch to the language of the classroom, can be fraught with unknown linguistic setbacks.
- Teachers need to use academic mathematical language in verbal discourse, and promote an expectation that students will come to use such language. The results suggest the students do in the end use formal mathematical language if they see the teacher using it consistently.

In a first attempt at problemitising and thus addressing this deficit in research on teaching, it is instructive to consider again the commonly used model (Figure 1) and its adaptation (Figure 2). Further modification is needed once the bilingual contexts of classrooms are recognised as important (Figure 3).

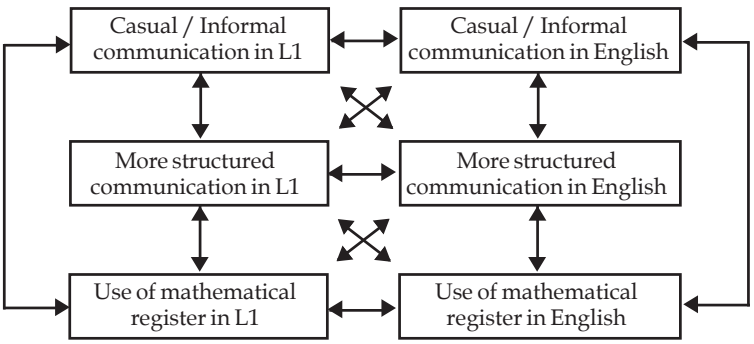

Figure 3. A model for language use in mathematics learning for multilingual students.

In this model the double-headed arrows indicate most interactions between the language forms that teachers could encourage students to use. Some potential interactions are not displayed. There is no linkage between the top left and bottom right cells, a linkage that is probably not very useful. Some interactions shown may be better indicated with broken lines, or indeed not at all. For example it may be that the bottom left hand cell for some languages is essentially empty for some students if they are not conversant with the mathematical register in their first language. In this case the arrow would be deleted. However Clarkson (1996, 2006) has shown that some English Language Learners (ELL) (Vietnamese) students in Melbourne have a fragmentary knowledge of the mathematical register in their first language. Similar findings have been found with Iranian students studying in Melbourne (Parvanehnezhad & Clarkson, 2008). Even so, when faced with solving mathematical problems, such students at times did use their non-English language, for a variety of reasons. In this context a dotted line may be better. However it seems that few teachers knew that their students used their non-English language when doing mathematics (Clarkson, 1995).

Clearly there is need for research to explore which linkages, in particular contexts, the teacher should encourage. A cautionary episode is related by Halai (2004). Working in Pakistan with a teacher and students who spoke Urdu as their first language, and English as the official teaching language, the teacher had encouraged students to switch between their languages at

the informal stage (to move from the top left hand cell to the top right hand cell). However because students were confused with some of the informal English language idioms the teacher used and they did not understand, the students further understanding of the mathematical problem was compromised as they were encouraged to move down the right hand side of the model.

Ideas on Beginning the Implementation of Such a Model in Australian Classrooms

It is one thing to know the theory that comes from research. It is another matter as to how these results will be implemented in a worthwhile manner in classrooms. For the present discussion, three points might well be worth considering: engaging with the language complexity of classrooms, engaging the bilingual students' communities, and engaging the students cognitively with their languages.

One first step may be to encourage teachers to map out carefully just what languages are spoken by students in their particular classroom. In the past there has been some mapping of languages for a school. But if the students' languages are important in students' learning, then the individual teacher needs to know what opportunities, not difficulties, are available in their classroom. Since competence in language is important, in this mapping exercise teachers could make some assessment of this, and not just assume that if a language is spoken at home, then the student must be competent in the home language.

When earlier in this paper I was discussing the casual / informal form of language of students, I suggested that this would be embedded in "the corresponding contexts with which they [the students] are familiar, and within and from which their language draws its meaning … Frequent use of idioms quite specific to a particular age group, and to perhaps specific to a city (and may be a school), are markers of such informal language." To my mind if teachers are to engage students using 'their' language, then the teachers will need to engage with the students' communities. In a monolingual community, particularly one in which the teacher grew up, this process becomes almost automatic. It is something that teachers just naturally do, at least when they are teaching language, history, and other humanity subjects. With an emphasis now on 'real life' mathematics and

ethno mathematics (Barton, 2008a), the students' community is also coming into play for mathematics (Clarkson, 2006b; Sullivan & Lilburn, 2002). However this process becomes more complex, but is necessary, if the notions of the students' languages are to be taken seriously for the learning of the students. Hence the contexts of the non English languages will need exploration by teachers. The work of the Canadian Multiliteracies Group, although not in mathematics, seems to be very useful to start[1].

The final issue of engagement for the teacher is to take seriously the role that language does play in the learning of mathematics. Hence teachers will need to consider the forms of language they encourage their students to use (see Figures 1, 2 and 3). However this goes beyond aiming to learn specific mathematical vocabulary, although that is crucial. It also means wrestling with the more fundamental issues of mathematics in learning the language of explanation, justification and argument (Clarkson, 2004b).

Implications for Elsewhere – Maybe?

The impact of language on mathematics learning has been an issue taken up by researchers from South East Asia (Chan & Mousley, 2005; Leung, 2008; Lim & Chan, 1993; Rahman, Yusof & Mason, 2005; Wong, Taha, & Veloo, 2001), although as in Australia the emphasis has been on learning rather than teaching. However I return to the first two sentences of this paper. Clearly we do live in a globalised world. This has at times been taken to mean that the all encroaching culture of the west should be taken for granted and then we would be happy. But we know now that as soon as the apparent hegemonic march of these processes begins to impact, localised reactionary forces are set in play that resist. The privileging of a students' L1s, even when it comes to learning mathematics, can be seen as part of this counter local process. However this also gives me pause in suggesting what for example teachers in this region should do, based on what might be useful in Australia. But these teachers might be interested in what is happening in Australia, and then judge for themselves as to whether there are useful strategies, techniques, etc that might be employed in their context. As an aside, the impact of globalisation also needs to be addressed by those of us preparing mathematics teachers in many other ways as well. This is a matter not just related to the issue of language use (Atweh, Clarkson & Nebres, 2003).

[1] http://www.multiliteracies.ca/

The use of what language(s) in the classroom is also a political matter. The very fact that various governments have decided, and indeed changed their minds from time to time (e.g. Clarkson & Indris, 2006), attests to this issue being more than just a discussion focussed solely on what is best for the students, based on the issues of cognition. We must be aware of that. However as educators we also need to have a voice and clarify issues, which on the surface, are counterintuitive. Hence as it turns out, encouraging students to be competent in all their languages, and using them all effectively for academic purposes, including solving mathematical problems, is a more complex teaching situation than having students just using the dominant teaching language of a classroom. And yet it is of benefit to the students if they are encouraged to engage in the more complex cognitive endeavour. We as teachers need to respond to this situation, and indeed use it to our students' advantage.

Perhaps one possibility for teachers in this region to explore is the model in Figure 3. However in many classrooms through this region, students may well speak 2 or 3 languages before they begin school and have to start using the dominant teaching language, as happens in Papua New Guinea (PNG). Hence a further adaptation of the model may be necessary (Figure 4).

Again it will be important within particular areas to explore whether there are cells that are of little use to teaching mathematics. The bottom left hand cells should not be ignored. Interestingly in the 1970s/80s it was assumed that village vernaculars in PNG would be of little use in teaching mathematics. However with the ongoing work of the Glen Lean Ethno Mathematics Centre[2] in PNG, extending the monumental work that Glen Lean did of categorising more than 500 PNG counting systems, to a deeper understanding of the number systems (e.g. Matang & Owens, 2006), measurement systems, spatial ideas, and how they can be used in teaching (e.g. Muke, personal communication), has clearly shown that for many PNG schools the bottom left hand cell may well be of real importance for students learning, particularly in their first two years before the dominant teaching language of English is introduced. However, assuming that having students engaged in their own mathematics, embedded in their home languages and hence that of their own communities, is appropriate for countries in this region, just what it means to implement this in your classrooms is an open question, but one that could be very worthwhile in addressing.

[2] http://www.uog.ac.pg/glec/index.htm

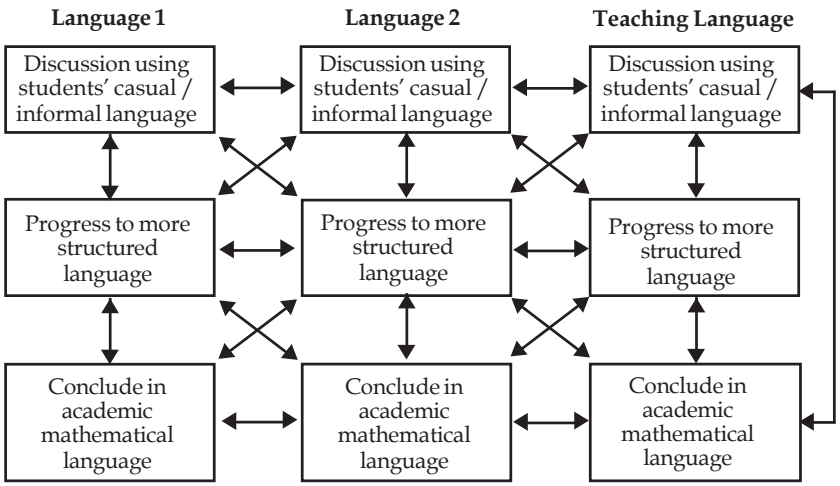

Figure 4. Adaptation of the language use model for multilingual students.

Summary

The heart of the argument here is to contribute to quality teaching of mathematics by focusing on a key aspect of learning mathematics that takes students to the central notions of this subject. If students are not aware of how they are to use language to think creatively with these ideas, then in all likelihood they will see the subject matter as only sets of facts and skill procedures to learn by heart which have little relevance to their own everyday lives and their future contributions to society. We need to help teachers to develop teaching strategies that will encourage students to explore, debate and think deeply with mathematical ideas. If this approach to learning mathematics is established in primary school, then there is a real foundation for secondary students to go forward with enthusiasm into tertiary studies. I believe that these notions may well be of use elsewhere.

Note:
This paper originated as a keynote address at the International Conference on Science and Mathematics Education (CoSMEd) 2007 held at SEAMEO RECSAM, Penang from 13 - 16 November 2007.

References

Ackerman, T., Heafner, T., & Bartz, D. (2006, April). *An examination of the relationship between teacher quality and student achievement*. Paper at conference of the American Educational Research Association, San Fransico.

Adler, J. (2001). *Teaching mathematics in multilingual classrooms.* Dordrecht: Kluwer.

Atweh,B., Clarkson,P., & Nebres,B. (2003). Mathematics education in international and global contexts. In A. Bishop, M. Clements, C. Keitel, J. Kilpatrick & F. Leung (Eds.), *Second international handbook of mathematics education* (pp.185-232). Dordrecht: Kluwer.

Austin, J., & Howson, A. (1979). Language and mathematical education. *Educational Studies in Mathematics, 10*, 161-197.

Baker, C., & Hornberger, N. (2001). *Introductory reader to the writings of Jim Cummins.* Clevedon: Multilingual Matter.

Barton, B. (2008a). Cultural and social aspects of mathematics education: Responding to Bishop's challenge. In P. Clarkson & N. Presmeg (Eds.), *Critical issues in mathematics education: Major contributions of Alan Bishop* (pp. 121-134). New York: Springer.

Barton, B. (2008b). *The language of mathematics.* New York: Springer.

Chan, Y., & Mousley, J. (2005). Using word problems in Malaysian mathematics education: Looking beneath the surface. In H. Chick & J. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the Psychology of Mathematics Education* (Vol. 2, p.217-224). Melbourne: International Group for the Psychology of Mathematics Education.

Clarkson, P.C. (2006a). Australian Vietnamese students learning mathematics: High ability bilinguals and their use of their languages. *Educational Studies in Education, 64,* 191-215.

Clarkson, P.C. (2006b). Rhyming and folk tales: Resources for mathematical thinking. *Australian Mathematics Primary Classroom, 11*(4), 18-23.

Clarkson, P.C. (2005). Two perspectives of bilingual students learning mathematics in Australia: A discussion. In D.Hewitt & A.Noyes (Eds.), *British Congress of Mathematics Education Conference Proceedings* (pp. 33-40). Warwick UK: British Society for Research into Learning Mathematics.

Clarkson,P.C. (2004a). Teaching mathematics in multilingual classrooms: The global importance of contexts In I. Cheong, H. Dhindsa, I. Kyeleve & O. Chukwu (Eds.), *Globalisation trends in science, mathematics and technical education* (pp. 9-23). Brunei Darussalam: Universiti Brunei Darussalam.

Clarkson, P.C. (2004b). *Researching the language for rational explanations in mathematics teaching and learning*. Paper presented at the conference of the Australian Association for Research in Education, Melbourne. Retrieved from http:/www.aare.edu.au/index.htm

Clarkson, P.C. (2004c). Multilingual contexts for teaching mathematics. In M. Hoines & A. Fuglestad (Eds.), *Proceedings of the 28th conference of the International Group for the Psychology of Mathematics Education* (Vol.1, pp. 236-239). Bergen, Norway: International Group for the Psychology of Mathematics Education.

Clarkson, P.C. (1996). NESB migrant students studying Mathematics: Vietnamese and Italian students in Melbourne. In L. Puig & A. Gutierrez (Eds.), *Proceedings of the 20th conference of the International Group for the Psychology of Mathematics Education* (Vol.2, pp. 225-232). Valencia, Spain: International Group for the Psychology of Mathematics Education

Clarkson, P.C. (1995). Teaching mathematics to NESB students. *Prime Number, 10*(2), 11-12.

Clarkson, P.C. (1992). Language and mathematics: A comparison of bilingual and monolingual students of mathematics. *Educational Studies in Mathematics, 23*(4), 417-429.

Clarkson, P.C., & Dawe, L. (1997). NESB migrant students studying Mathematics: Vietnamese students in Melbourne and Sydney. In E. Pehkonen (Ed.), *Proceedings of the 21th conference of the International Group for the Psychology of Mathematics Education* (Vol.2, pp. 153-160). Lahte, Finland: International Group for the Psychology of Mathematics Education.

Clarkson, P.C., & Galbraith, P. (1992). Bilingualism and mathematics learning: Another perspective. *Journal for Research in Mathematics Education, 23*(1), 34-44.

Clarkson, P.C., & Idris, N. (2006). Reverting to English to teach mathematics: How are Malaysian teachers and students changing in response to a new language context for learning? *Journal of Science and Mathematics Education in South East Asia, 29*(2), 69-96.

Clements, K., & Del Campo, G. (1987). *Beginning mathematics*. Melbourne: Catholic Education Office.

Cocking, R., & Mestre, J. (1988). *Linguistic and cultural influences on learning mathematics*. NJ: Lawrence Erlbaum.

Cummins, J. (1991). Interdependence of first- and second-language proficiency in bilingual children. In E. Bialystok (Ed.), *Language processing in bilingual children* (pp.70-89). Cambridge: CUP.

Cummins, J., Cohen, S., Leoni, L., Bajwa, M., Hanif, S., Khalid, K., & Shahar, T. (2006, April). *"I'm not just a coloring person": Cognitive engagement and identity investment in multilingual classrooms*. Paper presented at the conference of the American Education Research Association, San Francisco.

Ellerton, N., & Clarkson, P.C. (1996). Language factors in mathematics teaching and learning. In A. Bishop, K. Clements, C. Keitel, J. Kilpatrick & C. Laborde (Eds.), *International handbook of Mathematics Education* (pp. 991-1038). Dordrecht: Kluwer Academic Publishers.

Ellerton, N., Clements, M.A., & Clarkson, P.C. (2000). Language factors in mathematics education. In K. Owens & J. Mousley (Eds.), *Research in Mathematics Education in Australasia 1996 – 1999* (pp. 29-96). Sydney: Mathematics Education Research Groups of Australasia.

Halai, A. (2004). Teaching mathematics in multilingual classrooms. In M. Hoines & A. Fuglestad (Eds.), *Proceedings of the 28th conference of the International Group for the Psychology of Mathematics Education* (Vol. 1, pp. 240-243). Bergen, Norway: International Group for the Psychology of Mathematics Education.

Halliday, M. (1978) *Language as social semiotic: The social interpretation of language and meaning*. London: Edward Arnold.

Hutchins, P. (1970). *Clocks and more clocks.* New York: Aladdin.

Irons, C. (2003). *Numeracy – What now, what next?* Retrieved on 2 December 2005 from http://education.qld.gov.au/curriculum/area/literacy/docs/numeracy-cal-irons.doc

Jean, J. (2006). *Relationships between the degree of bilingualism and mathematical word problem solving*. Paper presented at the Hawaii International Conference on Education, Honolulu. Retrieved from www.hieducation.org/EDU 2006.pdf

Kleinfeld, J. (1998). The use of case studies in preparing teachers in cultural diversity. *Theory into Practice, 37*(2), 140-7.

Leung, F. (2008). Chinese culture, Islamic culture and mathematics education. In P. Clarkson & N. Presmeg (Eds.), *Critical issues in mathematics education: Major contributions of Alan Bishop* (pp. 135-150). New York: Springer.

Lim, S. & Chan, T. (1993). A case study comparing the learning of mathematics among Malay pupils in primary national schools and primary national schools. *Journal of Science and Mathematics Education in South East Asia, 16*(2), 49-53.

Lin, M., & Martin, P. (2005). *Decolonisation, globalisation: Language-in-education policy and practice.* Clevedon: Multilingual Matters.

Martin, P. (2005). 'Safe' language practices in two rural schools in Malaysia: Tensions between policy and practice. In M. Lin & P. Martin (Eds.), *Decolonisation, globalisation: Language-in-education policy and practice* (p.74-92). Clevedon: Multilingual Matters.

Matang, R. (2006). Rich transitions from indigenous counting systems to English arithmetic startegies: Implications for mathematics education in Papua New Guinea. In F. Favilli (Ed.), *Ethnomathematics and mathematics education* (pp. 107-118). Pisa, Italy: Tipografia Editrice Pisana.

Moschkovich, J. (2002). A situated and socio cultural perspective on bilingual mathematics learners. *Mathematical Thinking and Learning, 4*(2&3), 189-212.

National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards.* Reston USA: NCTM.

Pimm, D. (1987). *Speaking mathematically: Communication in the mathematics classroom*. London: Routledge.

Parvanehnezhad, Z., & Clarkson, P.C. (2008). Iranian bilingual students' use of language switching when solving mathematical problems. *Mathematics Education Research Journal, 20*(1), 51-80.

Queensland Studies Authority (2004). *Mathematics: Years 1 to 10 syllabus.* Brisbane: Queensland Studies Authority.

Rahman, R., Yusof, Y. & Mason, J. (2005). Mathematical knowledge construction: Recognizing students' struggle. In H. Chick & J. Vincent (Eds.), *Proceedings of the 29th Conference of the International Group for the*

Psychology of Mathematics Education (Vol. 1, p.221). Melbourne: International Group for the Psychology of Mathematics Education.

Secada, W.G. (1992). Race, ethnicity, social class, language, and achievement in mathematics. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp.623-660). New York: Macmillan.

Slavin, R., & Cheung, A. (2005). A synthesis of research on language reading instruction for English language learners. *Review of Educational Research, 75*(2), 247-281.

Sullivan, P. & Lilburn, P. (2002). *Good questions for math teaching: Why ask them and what to ask, K–6.* Sausalito, CA: Math Solution Publications.

Thomas, J. (1986). *Number '" maths.* Melbourne: Child Migrant Education Services.

Victorian Curriculum and Assessment Authority (2002). *Mathematics curriculum and standards framework 2.* Melbourne: Victorian Curriculum and Assessment Authority.

Wong, K. Y., Taha, K., & Veloo, P. (2001). Situated sociocultural mathematics education: Vignettes from Southeast Asian practices. In B. Atweh, H. Forgasz & B. Nebres (Eds.), *Sociocultural research on mathematics education: An international research perspective* (pp. 113-134). Mahwah, NJ: Lawrence Erlbaum.

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