

society, where the way forward is often perceived in terms of a move back to traditional values, the situation is even more complex.

## 6. AN ABORIGINAL VIEW OF REALITY

Aboriginal children grow up in a society in which the system that controls the economic realities of life are based on relationships between people rather than relationships between quantities of money, time, goods and other services as it is in the MT culture. Bain in Christie (1985, p.9) has described it as 'interactional' rather than 'transactional'. Thus, Aboriginal children are much better at talking to establish personal relationships with their teachers than they are at talking to transact knowledge inside the classroom. The environment in which people live is also grounded in such interactional relationships which extend back to the Dreamtime and relate Aboriginal people to the land and to the dominant features of the land. Hence, questions like, 'How much land?' are immaterial. Instead, people focus on the relationship between a particular group of people who are 'owned' by the land.

### 6.1 A Concern for Quality

In such a society the emphasis is not on the quantity of the relationship but on the quality. Rudder (1983) examined the classificatory systems, the evaluative systems and cognitive structures of the Yolnu people of Northeast Arnhem Land. He used the term 'qualitative thinking' to describe the way Yolnu people reflect on their

world. For example, Aboriginal people, when talking about what English speakers would think of as length - which signifies a quantitative approach to the attribute - focus instead on quality. Thus, the quality 'shortness' (gurriri) may be noted. Unlike English, that sees 'shortness' as part of a continuum that extends from 'short' to 'long', Yolnu see the quality 'shortness' as being discontinuous and so objects are either 'short' or they are 'not-short' or a non-expression of the quality 'short'. Once the initial assessment of the quality has been made the second choice is to do with describing the quality of that quality. Thus, something that is perceived as being short can be further qualified as very short or moderately short (Rudder, 1983, p.36).

Such knowledge has a place in a bilingual school for it enables children to recognize and reflect on their own particular view of reality. It may provide a bridge to English as children can add the English word to the concept of shortness already developed - though care should be taken to ensure that the situation is one that speakers of both languages perceive in terms of shortness. However, it may be inappropriate to continue to use the vernacular terms when the comparison between 'short' and 'long' is being stressed. That is a particularly Western way of looking at reality and reflects our concern with quantifying. Aboriginal people may, of course, be happy for their language to be used in this way, but such decisions need to be made after lengthy negotiation when all the participants concerned are conscious of the subtle but significant differences in the way language is used. (See MAS: Stage 1 for a more lengthy discussion on using Aboriginal terminology as a basis for acquiring the comparative measurement terms of English.)

Rudder (1983, ch.3) points out, however, that this way of classifying the world according to quality extends into the mathematical strand we call number. He claims (and my experiences would support that claim) that traditional number words for one, two and three are not the basis of a counting system but rather reflect the cardinal quality of the number. The more extensive number system (based on rulu or the group of five turtle eggs given to participants after a turtle egg hunt) that has emerged - or been recognized (Harris, J., 1982, p.169) - since the introduction of bilingual education, further supports his claim, for again it is a system that focusses on the cardinal rather than ordinal quality of the number (Rudder, 1982, p.87). Hunting (1985, p.19) queries the place of such a system in a school which aims to develop the Western understandings of number. The solution, it seems, is to recognize the system for what it is and use it when appropriate for Western mathematics. However, as such knowledge reflects the way Yolnu people view reality, it should be included in the school program as part of the strand related to Aboriginal knowledge and culture. Hopefully, it would be part of an integrated Aboriginal studies program which would thus, provide a meaningful context for the learning of such traditional mathematical relationships. If that does not occur, ethnomathematics as a separate subject, removed from a context that would provide meaning for the relationships to be studied, may well become as dreary for Aboriginal children as mathematics is for so many children in the Western world where such separation has been the norm.

## 6.2 Many Languages : Many Systems of Knowledge

However, what needs to be appreciated is that there is not just one solution for resolving all these matters for all bilingual schools in the NT. The work of Stokes (1982), Sayers (1982), Harris (J. 1980) and the collections of findings, based very largely on linguistic research, that has been gathered together by Harris (P. 1980, 1984, a & b, & 1986- in press) highlight both the differences and similarities that exist between language groups. For example, Laughren (1978) has noted that Aboriginal children who grow up in Central Australia demonstrate, at a very early age, an ability to use and respond to cardinal directions and so are able to act appropriately when someone attracts their attention by, for example, calling for them to 'Look south'. By the time they come to school they frequently indicate which direction they are moving by saying, for example, "I'm going south to the camp". While this knowledge can be capitalized on in both ethnomathematics and in learning Western mathematics it cannot be assumed that all Aboriginal children possess such precise knowledge. In my experience, while coastal children always knew where they were going they did not indicate direction in the way of children who live in or near the desert, hence such knowledge is localized.

However, other spatial knowledge inherent in the Aboriginal view of reality is quite widespread. When exploring the difficulties that many Aboriginal children experienced when working on number lines it was found in one language that a word was being used for 'after' (e.g., What comes after 3?) that was related to the speakers point of view. Thus, the word could be translated back into English

as 'before', 'after', 'previously', 'following', etc., depending on the context. This confusion has been found to be quite widespread. As well as demonstrating the pervasiveness of some aspects of Aboriginal culture, it highlights the necessity to ensure that when Aboriginal teachers are to teach Western mathematics in their own language they need to be extremely clear about just what they are aiming to achieve. It is not only that ideas are difficult to talk about in Aboriginal languages but that Aboriginal teachers must perceive what is required. Interestingly, it is only through extensive use of two languages in education that many of these conflicts and confusions have been revealed. Previously, children in English-only programs, who have been intelligently applying their Aboriginal view of the world to their newly acquired English terminology have simply appeared 'stupid' to teachers and others who frequently had little understanding of the difficulties children were experiencing in making sense of what was being taught (Harris, J., 1980).

### 6.3 Ethnomathematics and Formal Schooling

It would seem, then, that there is a place in our schools for ethnomathematics and for the teaching of aspects of Western mathematics in children's own language. Harris (J., 1980, p.149), Halliday (1974) and others support this approach. For they claim, quite strongly, that unless schools recognize the conceptual view of the world that children bring with them to school, children will find difficulty in acquiring the mathematical understandings that are inherent in the MT culture. In contrast, Davidson and Klich (1984) express concern that many of the activities, like card playing, that

appear to be mathematical, in the MT sense of the word, involve children in processing information in ways that are quite different to that of the school. The insights gained by Harris (P., 1984) on the ways Aboriginal people handle money (e.g., paper money is often simply referred to by colour of the note and the numerical value is not recognized) provides another example of how some of the artifacts of Western society, have been 'Aboriginalized' since their introduction into that culture. Davidson and Klich (1984, p.144) actually query whether such 'street' activities can have a place in classrooms where the goals of the program are not just remembering but are more to do with understanding, generalizing and applying.

Bishop's suggestion (1986, in press), which is referred to earlier in this paper, that children should be encouraged to reflect on, for example, their particular spatial orientation, provides some indication of a possible solution. Such activities that are suitable can be used in the classroom, not simply to teach MT cultural skills but to enable children to talk about, for example, what they do when they play cards and how that compares with what happens in school. As the card game described by Davidson (1979) is won by the player with the highest unit in their total score rather than the highest combination of tens and units, such consciousness raising exercises are desirable.

Crawford (1985) has taken such a verbal, problem solving approach to the mathematics program provided for the Aboriginal teacher trainees at Ernabella. It is an approach that could easily be adopted by schools. For example, children at an appropriate age who have had their own particular Aboriginal view of reality enriched

through appropriate strategies, and who have begun to develop some understanding of the Western view of reality which they can talk about in English, could be engaged in activities that would involve them in contrastive linguistics. Thus, colour classifications (Rudder, 1983; Davis, 1981), spatial understanding (Harris, P., 1986; Laughren, 1978) and measurement terminology (Rudder, 1983; MAS : Stage 1) could be compared and contrasted in ways that would enable children to talk about and thus become conscious of the difference between the views of reality encoded in the respective languages.

Nevertheless, in all these activities, teachers need to take care. Aboriginal people have been happy to have their children begin to be mathematical people in the MT cultural sense of the word through, for example, encouraging children to recognize and represent through drawing and language, the people that belong to a certain kin group. (See MAS : Transition for examples of such activities.) However, they may not be happy if the kinship system is dealt with in school in such a way that it becomes an open system in Horton's (1971, p.230) sense of the word. For Aboriginal people, the kinship system is given. To use it to encourage children to infer, predict, generalize and so forth may be considered inappropriate. By the time adults realized what was happening it could already be too late.

Thus, although Gay and Cole (1967) recommended that the 'teacher should use the Western, scientific method for comprehending, clarifying and organizing content drawn directly from the child's familiar daily experiences', after many years working in the Aboriginal context, I would now say, take care. Aboriginal mathematical knowledge has an important place in school education. It can :

provide a bridge between home and school; be part of the Aboriginal studies strand that is an integral part of any bicultural program; and provide a foundation for some learning of the technological component of the MT culture. Such activities should make this knowledge available to children at a conscious level so they can recognize it as part of their Aboriginality and realize when it is overlapping with the Western view of reality that they talk about, at times in their own language and at other times in English. However, whether traditional Aboriginal knowledge is to be exposed to the kind of so called high order cognitive processes that are an inherent part of the MT culture is something that only Aboriginal people can decide. Until they are aware of the options involved let us move slowly. Otherwise in our eagerness to open doors to the knowledge and understandings that Aboriginal people may need if they are to survive as an identifiable independent people in a modern world we may destroy the very culture that provides that identity and that gives meaning to life.

## 7. CONCLUSION

It would seem that there are no quick and easy solutions to the problems Aboriginal children experience in learning Western mathematics in school. No doubt, more children will learn more effectively when they and their families perceive a reason for doing so. In the meantime, this review of research literature in the areas of mainstream, cross-cultural and Aboriginal mathematics teaching/learning has highlighted several features that should be inherent in any approach to the teaching of the MT culture in Aboriginal schools.



These are:

Aboriginality - Aboriginal children are first and foremost Aboriginal and it is what they and their parents want them to remain. Their knowledge, language and learning styles should be used and respected while they gain other knowledge, language and skills that are added on to what is already there. Where there is conflict between ways of perceiving, talking and thinking about reality they must be presented as alternatives and children should be encouraged to see themselves as learning to be bilingual and bicultural people who will be able to act appropriately to the situation in which they find themselves.

Time - Aboriginal children need more time, particularly in the early years, if they are to gain the level of understanding necessary to provide a solid foundation on which further mathematical studies can be built.

Spatial Awareness - More use should be made of the visual/spatial orientation that Aboriginal children bring with them to school. This skill should not just be used to assist remembering but should be used to assist children to learn to talk about what they perceive and so help them develop some of the skills essential for effective school learning.

Experiences - Aboriginal children need to be involved in mathematical experiences that are not only 'real' but are 'real-life' and which enable them to adopt the roles of participants in such contexts and so begin to understand the purpose of the transactions involved.

Language - Mathematics in an Aboriginal context must be viewed as a language activity and must provide contexts that will enable children to 'learn how to mean mathematically'. This highlights again the need for appropriate experiences that will provide the meaning on to which the language can be mapped.

Two Languages - Wherever possible, particularly in the early years, children should be encouraged to talk themselves into understanding the new concepts that they are meeting, through the use of the language over which they have most control - their mother tongue. However, care needs to be exercised to ensure that teachers are developing the idea concerned and not just the nearest approximation.

Ethnomathematics - This knowledge which is encoded into the language spoken by the children must have an important role in their education. It should be seen as an end in itself and if and when possible be drawn on to provide a bridge into the mathematics of the wider world. However, care needs to be taken to ensure that such knowledge is not trivialized or in other ways harmed through its contact with the mathematico - technological culture which is inherent in the institution of schooling.

Negotiation - Key factors in the development of more effective mathematics programs for Aboriginal children are the interactions that must take place between teachers, students, parents and others about the role of Western mathematics in their children's education. Parents must be helped to become aware of the language and cognitive processes that are essential for success in school and

work alongside teachers in ensuring that children are grounded in their own heritage while being given access to another if that is what they desire. In particular, Aboriginal children must be involved in negotiation both about their own learning and as a means of achieving that learning.

Finally, Aboriginal people must decide what they want from school. An old Aboriginal man told Seagrim and Lendon:

We want them to learn English. Not the kind of English you teach them in class but your secret English. We don't understand that English but you do.  
(in Christie, 1985, p.50)

Some Aboriginal people may soon be saying such things about our mathematics programs. Aboriginal children are being taught mathematics in our schools, but they are not learning the things that matter. Such knowledge is not just to do with getting sums right though that is part of it. Rather, it is to do with the way people talk and think about what they know. The MT culture with its open view of reality presents many problems to traditionally oriented Aboriginal Australians. With it they may lose some aspects of their Aboriginality, without it they will continue to be dependent on others to teach their children and manage their projects. However, that choice is one that Aboriginal people must make. The question that educators must address is simply this, 'If Aboriginal people really want a mathematical education for their children have we the knowledge and flexibility to work with them to achieve that goal?'

B I B L I O G R A P H Y

- Austin, J. L. & Howson, A. G., 'Language and Mathematical Education', in Educational Studies in Mathematics, 10, 161-197, D. Reidel Publishing Co., Boston, 1979.
- Bell, A. W., Costello, J. & Kucheman, D. E., A Review of Research in Mathematical Education, NFER - Nelson, London, 1983.
- Berger, P. & Luckman, T., The Social Construction of Reality, Penguin Books, New York, 1966.
- Bishop, A., 'Space and Geometry', in R. Lesh and M. Landau (eds.), Mathematics Concepts and Processes, Academic Press, New York, 175-203, 1983.
- Bishop, A., 'The Social Construction of Meaning - A Significant Development for Mathematics Education', in For the Learning of Mathematics, F.L.M. Publishing Association, Montreal, 24-28, 1984.
- Bishop, A., 'Mathematics in Aboriginal Schools for Aboriginal Children', paper presented at the National Seminar on Mathematics Education for Aboriginal Children, Alice Springs, 27-31 August, 1985.
- Bishop, A., 'What are Some Obstacles to Learning Geometry', in R. Morris (ed.), Studies in Mathematics Education, UNESCO, Paris, 1986 (in press).
- Bauersfeld, Heinrich, 'Hidden Dimension in the So-Called Reality of a Mathematics Classroom', in Educational Studies in Mathematics, D. Reidel Publishing Co., Boston, Vol.11, 23-41, 1980.
- Boulton-Lewis, G. & Halford, G., 'Levels of Information Processing Capacity and Cultural Knowledge, in a Group of Aboriginal Australian Children, paper presented at the National Seminar on Mathematics Education for Aboriginal Children, Alice Springs, 27-31 August, 1985.
- Boulton-Lewis, G., & Reville Irons, R., 'Contemporary Cognitive Theories and Early Childhood Education', paper presented at ICME V., Adelaide, 1984.
- Bourke, S., 'Mathematics in the Primary Classroom: Learning Contexts and Teaching Practices', in Research in Mathematics Education in Australia, MERGA, 1982.
- Bourke, S. F. & Parkin, B., 'The Performance of aboriginal students', in S. F. Bourke & J. P. Keeves (eds.) Australian Studies in School Performance Volume 3: The Mastery of Literacy and Numeracy. Final Report, Australian Government Publishing Service, Canberra, 1977.

- Bubb, P., 'Western Mathematics and Traditional Aboriginal Children - A Question of methodology and time', Unpublished paper, Bathurst Island, N.T., 1985.
- CASME, 'Languages and the teaching of Science and Mathematics with special referene to Africa', A CASME Regional Workshop, Ghana, 1975.
- Cathcart, George W., 'Bilingual Instruction: Another variable influencing, conceptual development in young children', in Research in Mathematics Education in Australia, MERGA, 1980.
- Christie, M., 'Gupapuyngu Equivalents of English Classroom Terms', Unpublished paper, Brisbane, 1980.
- Christie, M., Aboriginal perspectives on experience and learning : the role of language in Aboriginal education, Deakin University Press, Victoria, 1985.
- Christie, M. & Harris, S., 'Communication breakdown in the Aboriginal classroom', in J. Pride (ed.), Cross Cultural Encounters : Communication and mis-Communication, River Seine, Melbourne, 81-90, 1985.
- Clark, L. A. & Halford, G. S., 'Does Cognitive Style Account for Cultural Differences in Scholastic Achievement?', in Journal of Cross-Cultural Psychology, Western Washington University, 14, 3, 279-296, 1983.
- Clarkson, P., 'Language and Mathematics in Papua New Guinea : A Land of 720 Languages', in Proceedings of the Eighth International Conference for the Psychology of Mathematics Education, 331-337, Sydney, 1984.
- Clements, M. A., 'Language Factors in School Mathematics', in Australian Review of Applied Linguistic, Vol.5, No.1, 1982.
- Crawford, K., 'A Problem Solving Approach to Aboriginal Teacher Education', paper presented at the National Seminar on Mathematics Education for Aboriginal Children, Alice Springs, 27-31 August, 1985.
- Cummins, J. & Gultson, M., 'Bilingual Education and Cognition', in The Alberta Journal of Educational Research, Vol.20, No.3, 959-969, 1974.
- Cummins, J., 'Cognitive Factors Associated with the Attainment of Intermediate Levels of Bilingual Skills', in The Modern Language Journal, University of Nebraska, Vol.61, 3-12, 1977.
- Cummins, J., Schooling and Language Minority Students : A Theoretical Framework, Evaluation, Dissemination and Assessment Centre, Californian State University, Los Angeles, 1981.

- Cummins, J., 'Disabling Minority Students : Power, Programs and Pedagogy', Unpublished paper, Ontario Institute for Studies in Education, 1985.
- Davidson, G. R., 'An ethnographic psychology of Aboriginal cognitive ability', Oceania 49 (4), 270-94, 1979.
- Davidson, G. & Klich, L. Z., 'Ethnography, Cognitive Processes and Instructional Procedures', in J. R. Kirby (ed.), Cognitive Strategies and Educational Performance, Academic Press, Sydney, 137-153, 1984.
- Davis, S., 'Colour Classifications and the Aboriginal Classroom', Unpublished paper, Darwin, 1981.
- Dawe, Lloyd, 'Bilingualism and Mathematical Reasoning in English as a Second Language', in Educational Studies in Mathematics, 14, 325-353, 1983.
- Dekker, Rijke, 'Maths for all? Just Have a Look', in L. Streefland (ed.), Proceedings of the Ninth International Conference for the Psychology of Mathematics Education, The Netherlands, 111-115, 1985.
- Dickson, L., Brown, M., & Gibson, O., Children Learning Mathematics : A Teacher's Guide to Recent Research, Holt, Rinehart and Winston, 1984.
- Donaldson, M., Children's Minds, Fontana/Collins, Glasgow, 1978.
- Ellerton, Nerida, F., 'Children's Made-up Mathematics Problems - A New Perspective on Talented Mathematicians', in Educational Studies in Mathematics, 1985.
- Fasheh, M., 'Mathematics, Culture and Authority', in For the Learning of Mathematics, F.L.M. Publishing Association, Montreal, 3; 2; 3-8, 1982.
- Faber-Morris, C., 'Language in the Learning of Mathematics and Problem Solving : A Pilot Study Report', in Research in Mathematics Education in Australia, MERGA, 26-39, 1982.
- Gay, J., & Cole, M., The New Mathematics in an Old Culture : A Study of Learning among the Kpelle of Liberia, Holt, Rinehart & Winston, New York, 1967.
- Gelman, R. & Gallistel, C. R., The Child's Understanding of Number, Harvard University Press, Cambridge, Mass., 1978.
- Gnerre, M., 'Native Language Vs. Second Language in Teaching Elementary Mathematics. A Case from the Amazon', in Proceedings of ICME V., 582-586, Adelaide, 1984.
- Graham, B., 'Can we Count on Maths?', in The Aboriginal Child at School, Vol.10, No.2, 4-10, 1982.

- Graham, B., 'Finding Meaning in Maths : An Introductory Program for Aboriginal Children', in The Aboriginal Child at School, Vol.12, No.4, 24-39, 1984.
- Gray, B., 'Helping Children To Become Language Learners in the Classroom', paper presented at the Annual Conference of the Meanjin Reading Council, Brisbane, 1983.
- Halford, G., 'Cognitive Developmental Stages Based on Information Processing Limitations', paper presented at 23rd International Congress of Psychology, Acapulco, Mexico, 1984.
- Halford, G., 'A Hierarchy of Concepts in Cognitive Development', paper presented at conference of the Society for Research in Child Development, Toronto, Canada, 25-28 April, 1985.
- Halford, G. & Boulton-Lewis, G., 'On Tailoring Mathematics Instruction to Children's Ability to Process Information', in Research in Mathematics Education in Australia, MERGA, Vol.2, 89-104, 1985.
- Halliday, M. A. K., 'Some Aspects of Sociolinguistics', in Interactions Between Linguistics and Mathematical Education, Symposium sponsored by UNESCO Nairobi, Kenya, 64-73, 1974.
- Halliday, M. A. K., Learning How to Mean - Explorations in the Development of Language, Edward Arnold, London, 1975.
- Harris, J., 'Ethnoscience and its relevance for education in traditional Aboriginal communities', Unpublished M.Ed. thesis, University of Queensland, 1979.
- Harris, J., 'Facts and Fallacies of Aboriginal Number Systems', in S. Hargrove (ed.), Work Papers of SIL-AAB., Series B, Vol.8., 153-177, Language and Culture, Darwin, 1982.
- Harris, P., Measurement in Tribal Aboriginal Communities, N.T. Department of Education, Darwin, 1980.
- Harris, P., Teaching About Time in Tribal Aboriginal Communities, Mathematics in Aboriginal Schools Project : 2, C.D.C. and N.T. Department of Education, Darwin, 1984a.
- Harris, P., Teaching About Money in Tribal Aboriginal Communities, Mathematics in Aboriginal Schools Project : 3, C.D.C. and N.T. Department of Education, Darwin, 1984b.
- Harris, P., Teaching the Space Strand in Tribal Aboriginal Schools, Mathematics in Aboriginal Schools Project : 4, C.D.C. and N.T. Department of Education, 1986 (in press).
- Harris, S., Culture and Learning : Tradition and Education in North-east Arnhem Land, N.T. Department of Education, Darwin, 1980.

- Harris, S., 'Aboriginal Learning Styles and Formal Learning', in The Aboriginal Child at School, Vol.12, No.4, 3-23, 1984.
- Hastie, R., 'Development of modified protocols to assess Piagetian conservation behaviour of W.A. Goldfields Aboriginal children', Unpublished project, Science and Mathematics Education Centre, Western Australian Institute of Technology, Perth, 1984.
- Hastie, R. M. & Treagust, D. F., 'Helping Aboriginal Children to Understand Mathematics and Science Concepts', in The Aboriginal Child at School, Vol.13, No.4, 8-17, 1985.
- Healey, Muriel, 'The Meaning of the Equivalence Sign to First Graders', in Research in Mathematics Education in Australia, MERGA, 56-65, 1980.
- Hirabayashi, I., 'A Study of Mathematics Education in Class-room Situation', in L. Streefland (ed.), Proceedings of the Ninth International Conference for the Psychology of Mathematics Education, The Netherlands, 116-121, 1985.
- Horton, R., 'African Tradition Thought and Western Science' in M.F.D. Young (ed.), Knowledge and Control, Collier McMillan, London, 1971.
- Hough, P. L. 'A Comparison of Language Used by Groups of Children and Parents to an Activity Learning Situation : A Preliminary Investigation', in Research in Mathematics Education in Australia, MERGA, 1981.
- Howson, A. G., 'Language and the Teaching of Mathematics', in Proceedings of ICME V., 568-572, Adelaide, 1984.
- Hunting, R., & Whitely, H., 'Mathematics, Prior Knowledge and The Australian Aborigine', in Research in Mathematics Education in Australia, MERGA, 13-24, 1983.
- Hunting, Robert, 'Learning, Aboriginal World View and Ethnomathematics', paper presented at the National Seminar on Mathematics Education for Aboriginal Children, Alice Springs, 27-31 August, 1985.
- Jones, P. L., 'Mathematical Language and the Learning of Mathematics in PNG', in Research in Mathematics Education in Australia, MERGA, 57-78, 1982.
- Kearins, J., 'Skills of desert Aboriginal children' in G. E. Kearney & D. W. McElwain (eds.), Aboriginal Cognition : Retrospect and Prospect, New Jersey, Hamanities Press Inc., 199-212, 1976.
- Kearins, J., 'Cross-cultural misunderstandings in education', in J. Pride (ed.), Cross Cultural Encounters : Communication and mis-Communication, River Seine, Melbourne, 65-80, 1985.



- Laughren, M., 'Directional terminology in Walpiri', Working Papers in Language and Linguistics, No.8, Tasmanian C.A.E., Launceston, 1978.
- Leeding, V., 'Contrastive Semantic Units in the Teaching of Concepts in a Bilingual Education Program', Unpublished paper, Darwin, 1976.
- Lewis, G., 'Learning Mathematical Concepts in a Second Language : Problems for the Young Child', in Australian Journal of Early Childhood, Vol.4(1), March, 33-37, 1979.
- Lewis, G., 'Premathematical Knowledge in Preschool Children', in Research in Mathematics Education in Australia, MERGA, 89-104, 1980.
- Lewis, G., 'Mathematics - how much do they know', in Links : For teachers of young children, Department of Education, Queensland, 1983a.
- Lewis, G., 'Rethinking Young Children's Thinking : Neo-Piagetian Perspectives', paper presented at SPATE, Brisbane, 1983b.
- Liebeck, P., How Children Learn Mathematics : A Guide for Parents and Teachers, Pelican Books, Middlesex, 1984.
- Lowenthal, F. D., 'Development of Language and Mathematical Concepts in Children : Is there a Relationship?', in Proceedings of ICME V., 573-575, Adelaide, 1984.
- Malcolm, I. (1980), 'Preparing Teachers for Interaction in Aboriginal Classrooms', in F. Christie & J. Rothery (eds.), Applied Linguistics Association of Australia Monograph : Language in Teacher Education in a Multicultural Society, 1980.
- Malinowski, B., 'The Problem of Meaning in Primitive Languages', Supplement 1, in Ogden, C. K. and Richards, I. A., The Meaning of Meaning, (The International Library of Philosophy, Psychology and Scientific Method), Kegan Paul, London, 1923.
- Morris, Robert, 'The Role of Language in Learning Mathematics', in Prospects, UNESCO, Vol.VIII, No.1, 73-81, 1978.
- Munro, J., 'Language and Mathematics', in Philosophical and Language Issues in Mathematics Education, Deakin University Press, Victoria, 1982.
- Mwambogela, A., 'Language Problems in Teaching Mathematics in Tanzania', paper presented to the Seminar on Development of Teaching Materials for School Mathematics, held at Mbabane, Swaziland, 12-16 March, 1979.
- Newman, M. A., 'Comprehension of the Language of Mathematics', in Research in Mathematics Education, MERGA, 1981.

- Pellerey, Michele, 'Analysis of Reciprocal Relationships between Linguistic Development and Mathematics teaching : A Psychological and Socio-Cultural Point of View', in Proceedings of ICME V., 576-578, Adelaide, 1984.
- Richardson, J. & Williamson, P., 'Towards Autonomy in Infant Mathematics? A Description of Investigation and Action?', in Research in Mathematics Education in Australia, MERGA, 1982.
- Romberg, T., 'Episodic Analysis of a Mathematics Lesson', in L. Streefland (ed.), Proceedings of the Ninth International Conference for the Psychology of Mathematics Education, The Netherlands, 122-128, 1985.
- Rudder, J., 'Qualitative Thinking : an examination of the classificatory systems, evaluative systems and cognitive structures of the Yolnu people of North-east Arnhem Land', Unpublished M.A. thesis, National University, Canberra, 1983.
- Sayers, B., 'Aboriginal Mathematics Concepts : A Cultural and Linguistic Explanation for some of the problems', in S. Hargrave (ed.), Work Papers of SIL-AAB, Series B, Vol.8, 183-199, Language and Culture, Darwin, 1982.
- Seagrim, G. & Lendon, R., Furnishing the Mind : A Comparative Study of Cognitive Development in Central Australian Aborigines, Academic Press, Sydney, 1980.
- Sinclair, Hermina, 'Young Children's Acquisition of Language and Understanding Mathematics', in Proceedings of ICME V., 7-13, Adelaide, 1984.
- Southwell, Beth, 'An Investigation into Primary Mathematics in Papua New Guinea', Research in Mathematics Education in Australia, MERGA, Vol.2, 91-103, 1977.
- Stokes, J., 'A Description of the Mathematical Concepts of Groote Eylandt Aborigines', in S. Hargrave (ed.), Work Papers of SIL-AAB Series B, Vol.8, 33-152, Language and Culture, Darwin, 1982.
- Turner, R. L., 'Language Factors in Mathematics of Students with English Speaking Backgrounds compared with those of a Non-English Speaking Background', in Research in Mathematics Education in Australia, MERGA, 201-221, 1980.
- Vygotsky, L., Thought and Language, Massachusetts Institute of Technology, 1962.
- Wall, W., 'Logic in Elementary Mathematics', in Logic and Reasoning in Mathematics Education, Deakin University Press, Victoria, 1982.
- Watson, Helen, 'Learning to Wón and Learning to Measure', paper presented at ICME V., Adelaide, 1984.

- Wishart, L., 'Language as a Factor in the Teaching of Mathematics in Primary School Infant Departments : The Acquisition and use of Polarised Comparative Terms', in Research in Mathematics Education in Australia, MERGA, Vol.2, 111-123, 1977.
- Williamson, P., 'Mathematics Language', Unpublished paper, Melbourne, 1979.
- Wilson, Bryan, 'Language and Mathematics Education : An International Perspective', in Research in Mathematics Education in Papua New Guinea, 154-165, 1981.
- Wolcott, H., A Kwakiutl Village and School, Holt, Rinehart and Winston, New York, 1967.
- Mathematics in Aboriginal Schools : Transition N.T. Department of Education, Darwin, 1982.
- Mathematics in Aboriginal Schools : Stage 1, N.T. Department of Education, Darwin, 1982.

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