The Australian Journal of
INDIGENOUS EDUCATION

ABORIGINAL STUDENTS AND MATHEMATICS: AIMS OF THE STUDY OF MATHEMATICS.

A.G. Bishop
Curriculum Section
Department of Education
N.T.

In 1954 the Australian Council for Educational Research convened a conference of curriculum officers from the various State Education Departments to consider, among other things, a desirable course of study in mathematics for Australian primary schools. The report of the conference lists the following as the expected outcomes of a desirable mathematics course:

1. Understanding of the structured relationships in particular between numbers and between spatial elements, and in general between mathematical elements.

2. Awareness of the place of mathematics in society.

3. Development of an intuitive idea of probability.

4. Favourable attitudes towards mathematical understandings and skills.

5. Awakening of an intellectual curiosity towards mathematics.

6. Ability to think and communicate effectively in quantitative and other mathematical situations encountered.

7. Development of the readiness and ability to form and test mathematical hypotheses.

8. Skill in application of acquired number and other mathematical structures in relevant settings, including the child's environment.

9. Ability to see and take an interest in the arrangement of form in the environment.

10. Ability to construct and interpret graphs, to present quantitative data in tabular form and to use simple statistical measures.

11. Practical knowledge of and the ability to use common measures.

12. Ability, in practical quantitative situations, to make sound estimates and approximations and to verify these.

13. Facility, with accuracy, in computational skills.

The above outcomes should be examined and related where possible to the teaching of mathematics in Special Schools. Experience has shown that many Aboriginal children do not manifest many of these outcomes at a level comparable with that obtained by European children. Their relatively poor performance is probably due to the fact that traditional Aboriginal culture does not value the outcomes. Aboriginal children are therefore culturally disadvantaged when it comes to learning modern mathematics.

This does not imply that they lack basic ability. Although the views of social scientists differ on what are the hereditary and environmental contributions to intelligence, there is a considerable amount of consensus to support the view that Aboriginals do not differ significantly from other ethnic groups in innate genetic potential for cognitive development. Any curriculum written for the Aboriginal student should therefore be based on the assumptions (a) that tradition-oriented Aboriginal children are at a cultural disadvantage when learning mathematics, and (b) that the children are not significantly different from other ethnic groups in their inherent ability to master mathematics.

The aims of the study of mathematics in Special Schools are basically the same as those for other schools throughout Australia. However, the interpretation of the aims to meet the particular needs of Aboriginal children is the *modus operandi* for *teachers*. For example, in outcome (1) above, teachers must be concerned with the place of mathematics in both Aboriginal and Western society. If many of the other outcomes are to be achieved, teachers must take into account the impoverished number backgrounds of the children they teach. The next section deals with home backgrounds and their significance for mathematics teaching.

MATHEMATICS IN TRADITION-ORIENTED ABORIGINAL CULTURE

Professor R.M. Berndt has claimed:

> "It has become, over the years, abundantly clear that we cannot ignore the cultural and family backgrounds of our pupils; in presenting them with a different way of life, these have to be taken into account. The early experiments in teaching Aboriginal children from traditional backgrounds, without reference whatsoever to these backgrounds (beyond disparagement), have mostly failed."(1)

If home backgrounds are important, as Professor Berndt claims, it is essential for teachers to know something about mathematics in traditional Aboriginal culture. The following is a summary of some salient features:

System of Thought.

Generally speaking, Aboriginal thought is non-scientific. This does not mean that forms of logical thinking are non-existent. As Elkin (2), points out, it is the major premise upon which the reasoning is based that is frequently different from one a European would accept.

Dreaming.

> "The Aborigine would say that the ultimate ground of the existence of everything that is lies in the Dreaming."(3)

Such a philosophy calls for no mathematical computations.

Causation.

Causal thinking is of fundamental importance in modern, scientifically-oriented societies. The Aboriginals, however, place emphasis on personal, spiritistic and magical causes, whether they be seen or unseen, nearby or at a distance. Nurcombe (4), found little evidence of causal thinking among school children at Elcho Island. Most children were at a precausal or paracausal stage. Prince (5), found a similar situation in two New Guinea areas. Both the Elcho and New Guinea children were found to differ from Canadian (European) children.

Authority.

In traditional life many phenomena are accounted for by appealing to authority. Emphasis is placed on memory and rote learning for passing on tribal traditions. These traditions are not questioned. Frequently they do not explain but rather account for phenomena. Aboriginals do not perceive a world which is orderly and

amenable to analysis. They are not continually asking the questions, "How?" or "Why?"

Time.

Aboriginals speak about the past, the present and the future. Many of their languages include tenses which are not found in English. However, time is not measured in mathematical terms. Underlying their concept of time is the 'Dreaming'.

Length, Weight, Area, Volume.

As with the concept of 'time', traditional Aboriginals have no need to quantify length, weight, area and volume with any degree of precision.

Money.

In the semi-nomadic food-gathering hordes which existed years ago, money and the concept of wealth were unknown. There was a form of economic exchange, but it was not based on a money system.

Number.

Some Aboriginal languages contain words which denote numbers up to five. Words which denote more than five are usually imprecise and can simply imply a 'big mob'. Precise ideas of equality do not exist, and hence formal operations of addition, subtraction, multiplication and division are non-exist. Notions of "two:two" making four do not really constitute a manipulation of a number system.

The above comments show that traditional Aboriginal culture was not mathematically oriented. In the culture-contact situations throughout the Northern Territory today, traditional culture is changing. While it is an aim of the Special Schools educational program to conserve aspects of Aboriginal culture, there are some aspects of Aboriginal cultures which will have to be transformed and renewed. If Aboriginals are to take their place in a modern world, they will need to develop scientific thinking and master the fundamental concepts and skills of mathematics. (This does not imply that *all* thinking must be scientific). How then can the home experiences of Aboriginal children be enriched to facilitate the development of mathematical knowledge, skills and attitudes?

RELEVANCE OF MATHEMATICS TO ABORIGINAL STUDENTS

The following is a list of suggestions for making mathematics more relevant in the home and the community:

1. Find out the games children play in the community. There may be opportunity to enrich the "number" experiences in these games and introduce new games which are rich in number experience.

2. Inject books and other reading materials into the life of the community. Encourage children to listen to the radio. In one or two areas, T.V. programs such as 'Sesame Street' are available. Where T.V. is unavailable, educational and recreational films can be screened.

3. Build on the experiences which children have in the community. For example, they handle money; teach them to think mathematically about money.

To be most effective, the teacher should begin with materials of the indigenous culture, leading the child to use them in a creative way. To achieve this, the teacher must be aware of the temptation to become a new authority figure, replacing the tribal elders. The child will seek authoritative answers as he has been accustomed to do. They should *not* be given ...

The teacher must study the local culture and use its content so that the child may understand himself, and in understanding, break away from the

traditional and authoritarian justification the tribe gives to that content. (6)

4. Work with parents. Show them the sorts of toys they can give their children. Teachers may be able to assist the managers of stores on settlements and missions in selecting games and toys to be stocked.

5. Encourage hobbies. For example, collecting rocks and shells at school could affect out-of-school activities. Children might start to classify rocks and shells as they find them. Other hobbies such as model building are rich in mathematical experiences.

6. Attempt to find real life situations in the community where mathematics is useful. Move into the community and work with parents and children to seek mathematical solutions to problems. For example, look at such matters as fencing, building, planning of yards, budgeting of money, measuring time, etc.

HOME AND SCHOOL

In conclusion, it should be noted that the home and the school are two distinctly different social systems. When children step from the world of the home into the world of the school, they are changing from a situation where mathematics is not very important to a situation where it is extremely important. It may well be that much of the mathematics a child learns is school-bound. In other words, he may attempt to think mathematically at school but revert to non-mathematical thinking in the community. If this prediction is correct, teachers cannot assume that school learning will transfer across to the community. They will need to take seriously the challenge of enriching the home backgrounds of the children they teach. Figuratively speaking, they will need to take the community into the school and the school into the community.

RELATED RESEARCH: IMPLICATIONS FOR THE SCHOOL

When an Aboriginal child comes to school and attempts to learn mathematics, teachers are faced with special problems which are, in the main, brought about by the child's growth and development in a mathematically impoverished culture. One set of research studies which highlights some of these problems deals with cognitive development in Piagetian tradition.

Marion de Lemos studied the development of the concept of conservation in Australian Aboriginal children at Elcho Island and Hermannsburg. In her empirical research she looked at the conservation of number, area, length, volume, weight and quantity. Two of her main findings were as follows:

1. The concept of conservation was found to develop later in Aboriginal children than in European children.

2. The same stages of development were found in Aboriginal children as in European children, with non-conservation being found in the younger children and conservation in the older children. (7)

Arising out of the research, de Lemos saw the following as important implications for education.

a. Much of the teaching in school is based on the assumption that children have achieved a knowledge of conservation which, according to Piaget, is the basis for all operational thinking. Indications are that this assumption is false. Children must therefore bridge the gap in their understanding of conservation before they

can understand the advanced concepts they are taught in school.

b. If children are introduced to advanced concepts before they have the pre-requisite basic understandings, it can lead to distress and negative motivation.

c. If formal schooling is based on the rote learning of concepts which children have difficulty in understanding, and without any direct activity with concrete materials, it may tend to inhibit rather than promote development.

d. It is important for children who have not achieved an understanding of conservation to engage in activities using a wide variety of concrete materials.

In a study of cognitive development in Aboriginals of Central Australia, Dasen also looked at conservation. In addition, he used spatial tests to examine orders, rotation and horizontality. His study confirmed the results of de Lemos' study with respect to full-blood Aboriginal children. Some of the educational implications of Dasen's work are as follows:

a. The development of concrete operations is seen as a pre-requisite for the adequate understanding and handling of number, measurement, time, space, speed, causality, and other 'scientific' concepts. Furthermore, it is theoretically only after concrete operations have been fully coordinated into a common, equilibrated structure, that the possibility of a further development, namely into formal thinking, exists.

Put into broad and simplified educational terms, concrete operations can be seen as indispensable for primary education and formal operations for tertiary education (although this hypothesis has recently been countered by some negative evidence) (8)

b. Early childhood development is important. Activity methods in pre-schools (and primary schools) are being devised to facilitate learning in mathematics and science. While these methods may assist children to master concepts, there is a danger if teachers become excessively enthusiastic in their attempts to accelerate learning by using the methods. The teacher's task is to maximize environmental influences through the activities and to let the child develop naturally and spontaneously. Readiness for learning is a key factor.

c. Rote learning in mathematics without an understanding of the underlying concepts should be avoided.

d. Teachers should concentrate on assessing a child's understanding of a concept rather than assessing the acquisition of related skills. Teaching should then be geared to the level the child has effectively reached. (The Curriculum Guides published by the Victorian Education Department make a feature of evaluation).

e. Dasen asserts that the present method of teaching measurement starts with such matters as feet and inches before the concept of a unit is grasped. If this assertion relates to the curricula prescribed for Special Schools, it is incorrect. In the present revised curriculum and the new Post Primary 'Social Mathematics' Curriculum course the concept of a unit is given a considerable amount of attention before formal units are introduced. Setting aside the assertion, Dasen's point should be noted. It is important to see that underlying concepts are grasped before attempting to develop more complex understandings.

f. Teachers should plan activities which involve pupils in active thinking as against those which involve memory work. 'How' and 'why' questions should feature prominently in most lessons.

g. Compensatory pre-school programs, which are designed to foster cognitive and linguistic development, should be introduced. This should now carry greater potential for development in view of the recommendations of the Bilingual Education Program.

The importance of the above factors cannot be over-stressed. Dasen's study should give teachers food for thought. He sums up by saying -

> The present study shows that, in today's situation, a large proportion of Aboriginal children do not reach the concrete operational stage. This implies that they will not be able to handle efficiently the major part of the primary school curriculum. Furthermore, it means that these children will not be able to reach the stage of formal operations, which is thought to be indispensable for secondary education.(9)

REFERENCES

1. Berndt, R.M.
1965 *Traditional Australian Aboriginal Life and the Native School.* W.A. Teachers Journal, .

2. Elkin, A.P.
1969 *Elements of Australian Aboriginal Philosophy.* Oceania 40, pp. 85-98.

3. Elkin, A.P.: *Op. cit.* p. 89.

4. Nurcombe, B.
1970 *Precausal and Causal Thinking - Concepts of Causality in Aboriginal Children.* Australian Journal of Psychiatry. 4,pp. 70-81.

5. Prince, J.R.
1971 *Precausal and Causal Thinking in Recent Contact Population in New Guinea.* Paper presented 43rd ANZAAS Congress.

6. Gay, J. and Cole, M.
1967 *The New Mathematics and an Old Culture.* New York, Holt Rinehart and Winston, p. 94.

7. de Lemos, M.
1966 *The Development of the Concept of Conservation in Australian Aboriginal Children.* A.N.U. Ph.D. Thesis,

8. Dasen, P.R.
1970 *Cognitive Development in Aborigines of Central Australia - Concrete Operations and Perceptual Activities.* A.N.U. Ph.D. Thesis, pp. 316

9. Dasen, P.R.: *Op. cit.* p. 320.

This article originally appeared in Volume 1 Number 4 (1973) pages 12-20.