The Australian Journal of
INDIGENOUS EDUCATION

SCIENCE and ABORIGINAL EDUCATION

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In our society success in science is important for students as a means to full participation, empowerment, and access to career/ further study options. Science in schools is an area of concern for Aboriginal education because of the low number of Aboriginal students who experience this success. Goal 3 of the Common And Agreed National Goals For Schooling In Australia (May, 1989) speaks of "equality of educational opportunities" and providing for "groups with special learning requirements". For Aboriginal students, academic success and cultural identity are twin priorities: achievement and success need to go hand in hand with a strengthening and deepening of cultural identity. Students' Aboriginality must not be denied by learning programs which define science purely in terms of the dominant Western culture.

In its responses to the National Science Profile (Draft) and to the National Science Statement (Consultative Draft #1) in 1992 Aboriginal Education was concerned at what it saw as an underlying (European) ethnocentricity in content and methodology.

Through a number of the Level Statements in the National Science Profile (Draft), for example, the word "science" appears to be used as a synonym for "Western science". The implication is the only kind of science, the only science that exists, is Western science. Aboriginal and Torres Strait Islander and other non-Western sciences are thereby excluded.

In his article "Aboriginal Science For The Ecologically Sustainable Future: (Australian Science Teachers Journal, March, 1991, Vol 37, No 1), Michael Christie argues that Western science "ignores the reality that all elements are given meaning by their context" (page 27) and cultivates a model in which those elements "can be manipulated as abstractions without reference to context" (page 27). Western science confines itself to

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"empirical data" (page 27) and in the laboratories and universities tends to become positivist ... only those things which can be counted exist ... all questions are expressed, analysed and responded to in terms of those things which can be measured, other elements are ignored: (page 28). Western science tends to accord things their scientific value only after they have been abstracted from their living social/political/economic context or situation. "In no sense is Western science truer than Aboriginal science - both have developed certain aspects of the truth at the expense of others ... Aboriginal science is highly ecologically sensitive, in a way which ours is not. (Page 29).

Christie then goes on to delineate four principles he feels "characterise the Aboriginal elders' contribution to our science curriculum" (page29) at Yirrkala in the Northern Territory, although he does not claim that these principles are "consciously held or advocated by Aboriginal people". (p. 29).

1. **The Context (Pages 29 and 30).** Subject matter is examined and interpreted as it is found embedded in its context. There is a classroom focus on things of immediate ecological significance to the context of students' lives.

2. **The Multiplicity of Perspective's (Page 30).** Scientific knowledge of phenomena embedded in their living context is interpreted from a network of perspectives'. In this approach empirical ("hard") data from the laboratory still has value, but provides only one perspective amongst others on phenomena which need to be understood within the context of all the variables in their environment - including the observer/scientist.

3. **Negotiation (Pages 30 and 31).** To reflect the specific details of the immediate situation each learning program is developed to reflect "where we are now. Learning activities reflect the balance of everyone's background and perspectives', and also reflect the situation "in which we find ourselves". Students are seen not as objects to be filled up with pre-determined knowledge, but as negotiating young scientists - they will still use empirical hard-data, but will negotiate as to which is most useful and relevant to the immediate situation, and how it is to be applied.

4. **The Focus on Balance.** Christie points out that every Aboriginal child is unique within his/her web of kin, clan, totemic relationships, and has a unique perspective on the world. The science curricula must balance the varying perspective's of students, and every facet of the ecology of our daily lives must be given a voice. Christie advocates that we embed our learning as locally as possible and set up a process of negotiating a balance between as many different perspective's and interpretations as possible.

In both Western and non-Western approaches to science, the following aspects can be seen as distinctive and essential:

- exploring/investigating/classifying/manipulating/testing etc. physical and natural phenomena, forces, processes, structures, functions, energy, change, etc.

- using natural forces, processes etc., physical laws and natural resources to solve problems associated with survival/existence and to enhance/enrich cultural and economic well-being.

Isolating phenomena/variables from their living ecological web of contextual relationships and empirically analysing them under "pure" laboratory conditions has its unique value, but it is distinctive and essential to Western positivistic science, it is not distinctive and essential to science in a broad cross-cultural sense. Students are expected to isolate variables to conduct "fair tests" without it being made clear to them that this is a Western approach to science that is different but not necessarily superior to other more holistic, contextual, non-Western approaches. Science programs concerned with "real life" applications, encouraging curiosity and exploration and learning science through interacting with the familiar environment, are basically relevant to Aboriginal students, many of whom will prefer learning/assessment activities which are "hands-on", and involve student-centred interactive processes within the immediate, real-life ecological context of their lives. (It is important not to over-generalise, however, as some Aboriginal students will prefer specifically Western, decontextualised learning/assessment patterns).

The concept of students as active young scientists (rather than passive recipients of rigidly preconceived forms of knowledge), who explore,

investigate, manipulate, use a range of problem solving strategies, etc, can be developed in a way that is quite inclusive of and relevant to the needs of Aboriginal students.

A crucial area for numbers of Aboriginal students is the gap between home/background values, interests, skills, etc and school requirements/structures - a gap that alienates so many Aboriginal students. Science teachers must recognise and value those home/background values, skills, interests, etc and thus provide an inclusive/relevant framework within which Aboriginal students can achieve and succeed while simultaneously strengthening their cultural identity.

The Landcare (Weather, Seasons, Growing Things) Unit in Marree Aboriginal School's Junior Primary Science program is an example of a course embedded in the local, immediate ecological context, drawing on local Aboriginal knowledge, using topics recommended by the community and with Aboriginal aspects taught by either Aboriginal Education Workers or local Aboriginal people.

This approach:

- Values Aboriginal students' background/family knowledge, skills, interests, etc and maintains and deepens cultural identity.

- Is likely to enhance/increase the achievement and success of Aboriginal students.

- Recognises and values Aboriginal and Torres Strait Islander science.

- Involves the principles for developing a science curriculum delineated by Michael Christie as discussed above.

- Develops a curriculum which "reflects local needs and aspirations within the framework of common and agreed national goals ..... through the development of an effective partnership between parents, students and teachers." (Common And Agreed National Goals For Schooling In Australia, May, 1989).

Teachers need to develop an inclusive curriculum that reflects a positive perspective of Aboriginal science and avoid one-off tokenistic lessons which reinforce stereotypes and devalue Aboriginal science, subsuming it in terms of the dominant Western culture. For example, a one-off lesson on boomerangs could reinforce some students' view that Aboriginal science is "primitive" as compared with jet planes and computers. On the other hand, an inclusive study of soil erosion and strategies to prevent it provides an opportunity to celebrate Aboriginal and Torres Strait Islander scientific contributions to land management in Australia. Peter Brindon, in his article "Science In Aboriginal Australia" (ie Australian Science Teachers' Journal, July 1988, Vol 34, No 2) describes how the first European pastoralists on the tablelands of Eastern Australia stopped the Aboriginal practice of using fire to manage the land. The end result of the pastoralists' "no-burn" policy was "massive erosion of exposed soils" (p.18) The chain of events leading from the no-burn policy to massive erosion are explained by Brindon (p. 18) - This would be of interest to many Aboriginal and non-Aboriginal students, and could productively be included in learning/assessment activities. Again, an inclusive classroom study of the implications of the Greenhouse effect on the local environment would provide opportunities to show how Aboriginal and other Indigenous communities, through their careful maintenance of a custodial relationship to the ecological context within which their lives and science are embedded, point to a way out, an alternative "conservationist" vision from which Western scientific culture has much of real value to learn. For example, numbers of Western "conservationist " scientists - such as Dr Suzuki - are now seeking to re-establish the so-called pure Western sciences in their political and ecological context, and to emphasise the custodial responsibility of Western science to that context.

Stories and library books about science/scientists must include the Aboriginal and Torres Strait Islander scientific heritage and should also include other non-Western scientific contributions, such as Asian, Arabic, etc. Stories and information about Aboriginal science could include a number of topics that would fascinate/enthuse both young Aboriginal students and non-Aboriginal students. In the Lake Condah area of Western Victoria, for example, a complex of races and walls were built by the Aboriginal community to artificially connect lakes and swamps and direct discharge through traps set in canals built for catching eels. The canals were up to 450 m long and 1 m high (Coutts et al. 1978, p 16 "Aboriginal Engineers

Of The Western District, Victoria". Research of the Victorian Archaeological Survey 7). This Aboriginal community made optimal use of the "topography of the area", understood "the hydrology of the lake and used it to full advantage", used basalt as a building material in a way that was "logical and resourceful", and their construction, "of these complex fishing systems without the aid of surveying aids is a tribute to their ingenuity". (Coutts et al. 1978, p 31)

Library information/books/stories/ must not include material that is stereotyped, ill-informed or racist, and all stories/teaching about Aboriginal and Torres Strait Islander must make clear to students that Aboriginal and Torres Strait Islander science is different but not inferior to western science. The achievements of Aboriginal and Torres Strait Islander science must not be interpreted/classified in terms (eg. "the Stone Age") of the dominant Western culture.

In his article "Material Culture In Traditional Aboriginal Society, Fiction and Fact" (The Australian Science Teachers Journal, May, 1986, Vol 32, No 1), Sandy Scott points out that "applying the terms primitive and stone-age" to Aboriginal and Torres Strait Islander culture is "to transfer a classificatory system from European culture development to the Australian scene. It is assumed that cultural progression through the iron age, etc, as occurred in Europe represents the norm for all cultural development. However, as noted by White (White, J.P., 1977. Crude, Colourless and Uninteresting? etc, in J. Allen, J. Golson and R. Jones (eds.), Sunda and Sahul, pp 13-50, Academic Press, London), such *'Eurocentric models are clearly inadequate for this part of the world'* (p 25), and we should not measure humans' progress by the increasing complexity of their tools" (Scott, 1986, page 10).

Scott points to the following as some indicators of Aboriginal and Torres Strait Islander cultural development:

- the stability of the population in its pre-contact state.
- the balance between humans and their environment.
- leisure time to develop art, complex social/spiritual systems, etc., with an extraordinary continuity of social adjustment and spiritual life.
- a probable high level of health - probably higher than that of many groups in Western society through the centuries.

It also needs to be appreciated that Aboriginal and Torres Strait Islander culture was not materially orientated. Nevertheless, Aboriginal and Torres Strait Islander scientific applications/technology were not confined to the spear, boomerang and stone tools, as is still assumed by many non-Aboriginal Australian. (This is not to imply the scientific knowledge involved in these instruments was not valuable in its own right). Scott points out that Aboriginal and Torres Strait Islander science/ technology used a sophisticated range of techniques and structures "more adequate to meet day to day needs" (page 10). These include:

- weirs, fish traps, canals, races, fish nets up to 45 m long, 1 m wide with a 75 mm mesh, and bird nets between 45 and 90 m long and 18 m deep (page 12).
- complex processes for removing toxins from the seeds of Cycads and Macrozamia (page 12).
- the use of fire for land management (page 15).

Peter Brindon, (in the same article as that mentioned above) lists a number of Aboriginal and Torres Strait Islander scientific achievements, including:

- the use of fire "to soften and so facilitate the manipulation of wooden staves, to oxidise pigments, to temper brittle stone and to dispose of the dead", as well as "an extensive use of fire as land-management tool". (page 18)
- an extensive use of plant resources as natural medicines (page 19).
- sophisticated methods of stone working (page 19).
- in more recent times David Unaipon's shearing handpiece with its revolutionary straight-line shearing action, and Eric Willmot's constant mesh gearbox (page 20).

In conclusion, the emphasis in contemporary scientific thought on the inter-relationship between phenomena, organisms and the environment provides an opportunity for science teachers to devise learning programs which celebrate Aboriginal and Torres Strait Islander science's deep understanding of and responsibility towards these living environmental/ecological inter-relationships. Learning/ assessment activities can be negotiated that are inclusive/relevant Aboriginal students through studying subject matter within the complex

web of living inter-relationships that forms its ecological context, using "real-life" situations in the immediate, local environment and emphasising the student - centred, interactive approach advocated earlier.

We need to develop truly inclusive science programs that foster cross-cultural perspective's on Western and non-Western science from an early age, and assist students to be open-minded/receptive to differing cultural/scientific viewpoints without discounting them. Developing this skill will not undermine the value of Western science for students, but enable them to appreciate it in more depth by seeing it in appropriate relationship to its context. Students should begin to see that, while Western science has enormous value, its methodologies are not a guarantee of absolute truth and do not always provide the clearest or most balanced understanding, when compared with Aboriginal and Torres Strait Islander and other non-Western sciences. In particular both Aboriginal and non Aboriginal students should begin to see that in isolating phenomena from their living ecological, cultural/political contexts, Western science tends to become irresponsible in relation to those contexts, whereas Aboriginal and Torres Strait Islander science remains responsible in a custodial relationship to the living context/environment within which phenomena are studied.

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