ENVIRONMENTAL EDUCATION: The development of a curriculum through 'grass roots' reconstructive action.

Rob O'Donoghue, Natal Parks Board and Carmel McNaught, University of Natal, Pietermaritzburg, Republic of South Africa.

SUMMARY

The case study reported in this paper started as a research and development initiative to improve environmental education and ecology fieldwork activities. A package of resource materials and activities was developed and pilot tested with teachers. Despite highly commended workshops, however, follow-up evaluation revealed that the curriculum packages were not widely used. The paper discusses a two year action research investigation of conceptual, evaluation and adoption tensions that led to a revised approach to environmental education and curriculum innovation. The rational and centre-to-periphery orientation of the initial research and development project was replaced by a teacher support network to facilitate 'grass roots' reconstructive action. This orientation was then investigated with two groups of science teachers in rural schools. The study revealed how external support services and a sustained dialogue around the prevailing science curriculum, local environmental issues and everyday classroom activities fostered reconstructive change at a local level. The transition from an external and rational strategy of curriculum development to a networking service in support of local reconstructive action is described. Some of the emerging management and design considerations for a revised political economy (policy and action framework) of environmental education curriculum change are discussed.

BACKGROUND

One of the difficulties in conceptualizing the scope of environmental education has been the tremendous breadth of environmental issues which need to addressed. These include:

a)   An interdependent web of global threats, including issues like acid rain, global warming, the destruction of the ozone layer and the loss of tropical forests.

b)   The regional destruction of life support systems through the over exploitation of resources (habitat destruction, soil erosion, pollution etc.).

c)   Sociopolitical issues such as political oppression, rural poverty and social unrest. Obviously within South Africa, where the authors are working, the ideology of apartheid is a key environmental issue.

In this paper the environment and environmental issues are seen as an interlinked array of political, social, economic and biophysical environmental factors (fig. 1).
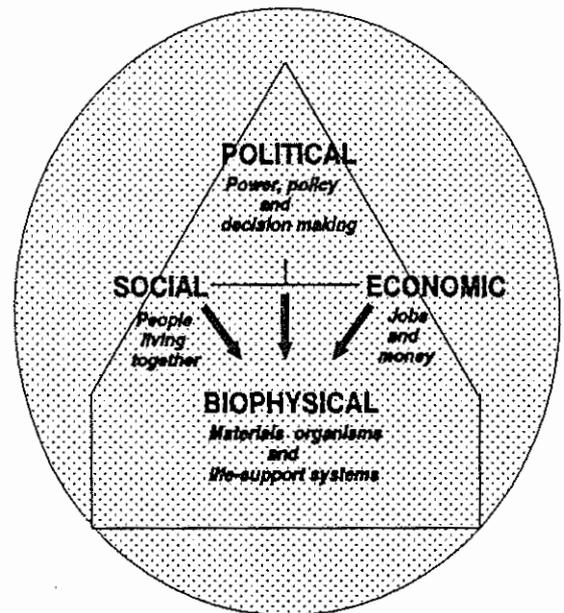

Figure 1: The scope of the environment and environmental issues.

Wide ranging environmental stress has led to both the degradation of the biophysical environment and a corresponding decline in the quality of life. One response from society has been an increasing call for environmental education. This has been initiated in many ways but often projects have failed to clarify the meaning of environmental education. A diversity of competing propositions is thus reflected in the proliferation of literature on global environmental problems (e.g. Ehrlich 1968, Meadows *et al.* 1972) and in the early popular debate on environmental education (Wheeler 1975, Carson 1978, Irwin 1984). Within this debate, environmental education has emerged as anything from an experiential fieldwork methodology to communication strategies aimed at making people more aware of environmental problems so that they change their behaviour. The international debate has produced guiding principles, policies and action frameworks for environmental education. Among the better known of these are the Tbilisi Declaration (UNESCO-UNEP 1978) and the World Conservation Strategy (IUCN 1980). Taken together, these documents contain several tensions and ambiguities. For example, the World Conservation Strategy has a strong positivist orientation

favouring the rational and objective management of change, whereas the Tbilisi Declaration is more interpretative, favouring the actualizing of local reconstructive action. Neither the scope of the environmental crisis nor the diverse nature of environmental education are clear-cut issues. In any environmental education project, working with conceptual tensions must be seen as a necessary part of the processes of curriculum change.

As the environmental crisis intensifies, institutions ranging from conservation bodies and corporate business, to governments and formal education are responding to the call for environmental education. There is thus often ample funding for the building of field centres, for the development of environmental education curricula and for the publication of resource materials. The result has been diverse environmental education projects and programmes that are seldom seen as curriculum development initiatives.

This paper, in discussing environmental education and curriculum development issues, assumes that any initiative which sets out to influence the school system falls within the ambit of curriculum development. Some the attempts to facilitate environmental education have been weak because they have been too ad hoc and loosely defined but other, more formal projects, have been equally dubious owing to a desire for objectivity within their strategies of research and evaluation.

Most environmental education projects have favoured 'scientific' approaches to curriculum development (IUCN 1980). These have usually involved external, rational and objective research processes (curriculum development), followed by dissemination / adoption strategies to communicate the new curriculum to teachers or to implant it in schools (curriculum implementation). 'Develop and implement' approaches to change have, unfortunately, proved to be surprisingly weak (Papagiannis et al. 1982, Popkewitz 1984). Their repeated failure has most often been ascribed to communication weaknesses, insufficient or poor evaluation and a lack of teacher participation (Eisner 1985). Curriculum projects have thus centred their efforts on trying to improve evaluation research and dissemination communication. This may well have been a waste of effort as many of the key failings of prevailing approaches to curriculum development can be traced to flaws in the underlying assumptions of deterministic models of change.

Popkewitz (1984) suggests that the limited successes of centre-to-periphery curriculum development projects are not a result of communication and management weaknesses alone. Their notable failure to achieve more than superficial and short term change may best be ascribed to flaws in their underlying rationale - the assumption that the management of change through external and rational processes of curriculum development is both possible and desirable. 'Social engineering' and 'centre-to-periphery' models of change

have dominated the policies and actions of curriculum development movements, especially in developing countries. Here environmental degradation has reached alarming proportions, resources (human and financia.) are very limited, and support infrastructures for more teacher-centred and participatory variations of these models are minimal.

Papagiannis et al. (1982) suggest that the policies and actions of curriculum development projects should be seen as *political economies of change*. This perspective is useful as it reveals some of the inhibiting features of prevailing models of curriculum development. Just what does the term 'political economy' of change mean? A political economy can be defined as *a production and distribution policy* (political) *for the functioning and administration of the concerns and the resources of a community* (economy). It thus involves questions about the processes of change, the perceived priorities of a community, who has access to resources and who makes decisions about resources. When reconstructive change is seen in this way one has to seriously question the validity of the policies and actions of most environmental education and curriculum development projects, particularly in less developed countries.

The case study of the Action Ecology Project was to conclude that it is neither possible nor desirable to set out, for environmental education, to manage change by rational problem solving followed by centre-to-periphery diffusion. After applying a research and development model of curriculum change, the project failed to bring about the desired curriculum reconstruction. Ongoing problem solving research was, however, to transform the policies and actions of the project and a revised framework for environmental education curriculum change was constructed.

THE EARLY CURRICULUM DEVELOPMENT PROCESS AND PROBLEMS.

The curriculum development case study, the Act.. Ecology Project, discussed in this paper (O'Donoghue 1990), set out to improve science fieldwork by developing materials for an environmental education approach to ecology fieldwork. It was a cooperative research and development initiative by the Natal Parks Board, The Wildlife Society of Southern Africa and the Environmental Education Association of Southern Africa, working in support of formal education agencies, and funded by Shell South Africa.

Environmental education and ecology fieldwork activities during school excursions to nature reserve' were investigated over a six month period in 1985. The observation of, and open-ended interviews with, school groups on environmental education and ecology

It was noted that:

a)   Pupils generally treated ecology as a body of scientific facts to be discovered in nature reserves.

b)   Fieldwork data collection frequently involved 'mindless measurement', 'hands-on' and 'minds-on' teacher-contrived work-sheets.

c)   Excursions were often dominated by 'show and tell' activities by teachers and conservation experts.

The overall impression was of a popular culture of environmental indoctrination through 'show and tell' fieldwork experiences and contrived counting and measuring to order.

These fieldwork problems were compounded by competing approaches to environmental education and ecology fieldwork. It was noted that:

a)   Some teachers treated environmental education as a values clarification exercise or as an affective methodology to counteract a content dominated curriculum, whereas others saw it as a fieldwork practical using the 'scientific method'.

b)   Most conservation staff and many other teachers treated environmental education as a communications process to 'get the conservation message across' so as to foster environmental awareness and to change behaviour.

c)   More practical problems which inhibited fieldwork were inadequate resource materials, cost, time and syllabus constraints. Teachers also lacked knowledge about the environment, had little experience of suitable fieldwork techniques for environmental education, and thus lacked confidence in their ability to conduct excursions.

These contrasting approaches to ecology fieldwork raised tensions about the nature and processes of environmental education. These issues had to be clarified as the project developed.

The solution to these fieldwork problems appeared to be a curriculum development project for ecology fieldwork. The Action Ecology Project thus set out:

(i)   To solve fieldwork problems by developing resource materials for an environmental education approach to ecology fieldwork.

(ii)   To disseminate new techniques and materials to teachers so that they could undertake ecology fieldwork with greater confidence and proficiency.

Having defined several ecology fieldwork problems, all that seemed necessary was the development and evaluation of an environmental education curriculum for science fieldwork, and then its implementation in the school system. Figure 2 illustrates the conventional research, development, dissemination and adoption (RDDA) model applied by the project.

Resource materials and fieldwork techniques were collected, developed and tested by participating teachers and conservation field staff, and the project coordinator compiled these into a resource package for ecology
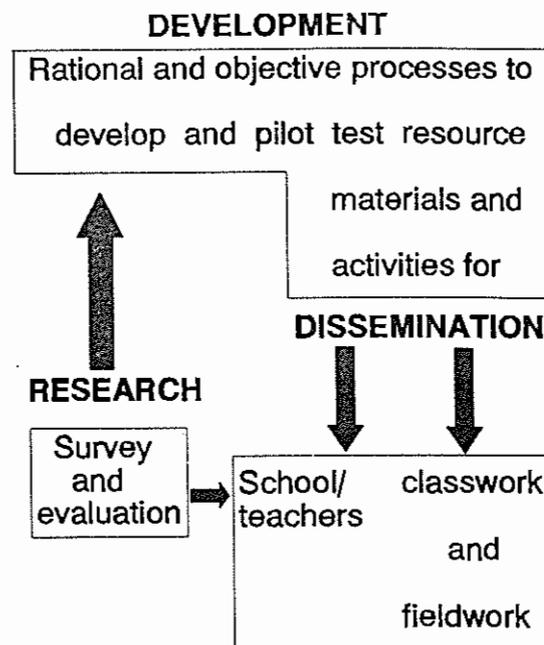

Figure 2:   The initial deterministic model (RDDA).

fieldwork.   As the materials were developed and evaluated, pilot workshops were conducted to disseminate an environmental education curriculum for ecology fieldwork.

The development of the kits was an extremely difficult task, as the project team was first confronted by conceptual tensions because of competing theories of environmental education, and then by a lack of suitable evaluation techniques. Finally, follow-up on workshops revealed dissemination weaknesses and wide-ranging adoption failure when the materials and fieldwork techniques were seldom used by either teachers or conservation field staff.

A review of the project ascribed implementation weaknesses to the sophistication of the kits and to communication problems owing to the complex language used to explain experiential learning in the outdoors. The kit was thus restructured into a systematic and very much simpler format. These revised kits were then disseminated at workshops through more practical 'hands-on' situations so that teachers actually used the new curriculum materials and techniques to solve prevailing fieldwork problems.

After two years of development and pilot disseminations, initially as an open-ended package and then as a more simple and systematic kit, the project was still failing to achieve its objectives. It was thus in danger of collapse and was still plagued with conceptual, evaluation and adoption problems. Once again, a wide ranging review of the project was undertaken. This time it took the form of an ongoing action research evaluation process to get to the root of the problems that were inhibiting the project.

The project thus became a vehicle to clarify prevailing environmental education and curriculum development

problems as well as attempting to enhance ecology fieldwork.

PROJECT TRANSFORMATION THROUGH ACTION RESEARCH

The investigation deduced that competing concepts of environmental education emerged in differing social contexts and in response to specific problems, both curricular and environmental. This realization led the project to conclude that environmental education could not function either as an alternative concept of education or as a discrete fieldwork methodology. It could, however, be seen as a necessary approach to education and thus as a focus for curriculum innovation. Environmental education was consequently treated as a *sensitizing construct* for *curriculum reconstruction* in a society under threat from environmental degradation. The important issues thus became the critical processes that clarified the need for change and the validity and functional relevance of the innovations emerging from this reconstructive action. Both of these were essentially evaluation issues within a process of change.

Stake (1977) ascribes most problems of evaluation failure in curriculum development projects to poor funding and management, but also alludes to serious conceptual and communication problems. Stenhouse (1975) had, however, previously revealed that underlying flaws in the entire curriculum development and evaluation enterprise may be at the root of these problems. He concluded that:

Evaluation should, as it were, lead development and be integrated with it. Then the conceptual distinction between development and evaluation is destroyed and the two merge as research. (p. 122).

His idea of research-based teaching (p. 141) as critical curriculum development suggests that innovation should be viewed as reflective processes of reconstructive action (action research). If diverse, intuitive, reflective and discursive critical processes (evaluation) have a central and integrated role in curriculum change, evaluation could not simply be treated as external and rational processes to establish the value and effectiveness of a curriculum project. Evaluation thus came to be seen as reflective critical processes that give both meaning and direction to reconstructive action.

As the wide-ranging failure of deterministic models of change became apparent, both in extension / development studies (Coetzee 1988) and in the curriculum development movement (Papagiannis *et al.* 1982), these fields adopted more objective-centred management and communications routines to overcome these weaknesses (Havelock 1969, Fourie 1977). These have been no more successful but have become impossibly complex. There has recently been a move towards more participatory problem solving orientations (Bonser and Grundy 1988) which have been highly productive. The initial rational and objective posture of the Action Ecology Project was replaced by an inter-subjective orientation. This revised approach was to lead to a rejecting of centre-to-periphery determinism in favour of collaborative problem solving. Through this the project resolved many of the early conceptual tensions and evaluation problems, and the issues of dissemination and adoption, simply fell away. The project, essentially, had been working to resolve problems that were symptoms of the tenuous ideological underpinnings of deterministic models of curriculum change.

A REVISED 'PARTICIPATORY APPROACH' TO ENVIRONMENTAL EDUCATION AND CURRICULUM DEVELOPMENT

The action research evaluation process had resolved conceptual, evaluation and adoption problems by overturning the model of change that had driven the early resource development process. The three problems presented earlier successively disappeared with the application of participant-centred approach to curriculum development (O'Donoghue & Taylor 1988).

This change necessitated the clarification of a revised model of curriculum change for environmental education (figure 3), and the redesign of the early curriculum packages into a pool of resource materials for adaptive redevelopment to local needs by teachers.
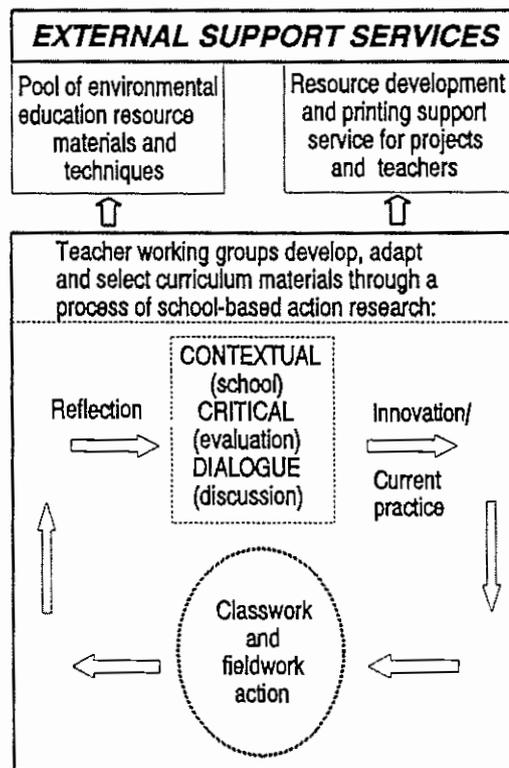
Figure 3: Curriculum reconstruction through school-based action research.

The participatory reorientation of the project initially created an illusion of change as it was not a departure from the earlier deterministic and social engineering outlook. Participatory workshops were first developed around contrived problem solving situations to enable teachers to construct what had already been determined by the external and rational processes which produced the kits. Contrived and manipulative 'participation' was not a departure from a centre-to-periphery ideology and was flawed by the same weaknesses that had plagued the project since its inception.

A clearer understanding of the flaws of a deterministic model helped the project to clarify more relevant policies and action frameworks. It still took some time but at last we came to understand that:

(i)   One cannot capture, control and manipulate the social world in a similar way as one can natural phenomena (Popkewitz 1984, p. 158).

(ii)   Meaningful change does not occur through a process of external management and innovation diffusion alone.

(iii)   The rational processes of deterministic models of innovation and change do not correspond with the way people come both to construct and to change the way they see the world.

The threatening paradigm shift did thus finally take place and the project went through a radical transformation. The clarification of a conceptual framework for a revised political economy of grass roots reconstructive action was, however, still to take some time.

A REVISED POLITICAL ECONOMY OF COLLABORATIVE RECONSTRUCTION.

The project went through a radical transformation over a period of two years of intensive action research. This change covered the methodologies that it subscribed to, the research and evaluation styles that it applied, the style of workshops, the design of the resource materials and the whole orientation of the project itself. Three trends were noted as significant in the clarification of a revised conceptual framework for environmental education and curriculum change :

(i)   Outlook (pedagogy & didactics).
        A swing from the determinism of a positivist and behaviourist perspective to an interpretive position, centred on social theory and experiential learning.

(ii)   Approach (research & workshops).
        A swing from external problem solving and resource development to a support service for teacher-centred reflection and change.

(iii)   Design (materials & management).
        A move from the external management of pretested, objective-centred packages developed by a project team, to a resource pool and a networking support service for teachers to adapt and develop resources to local needs.

A more detailed summary of these trends and the scope of this transformation is provided in figure 4:

INITIAL RATIONAL FRAMEWORK	REVISED POLITICAL ECONOMY
1. EDUCATION THEORY (Pedagogy). A positivist orientation compatible with the determinism of behaviourist theories and fundamental pedagogics.	An interpretative position illuminated by an eclectic synthesis of symbolic interactionism, phenomenology, constructivist science and critical theory.
2. TEACHING METHOD (Didactics) Structured study guides and techniques for fieldwork experiences which both inculcate the scientific method and develop a hierarchy of scientific process skills.	Experiential learning and dialogic interaction in enquiry and problem solving settings that have been developed through a process of negotiation with the pupils.
3. RESEARCH/EVALUATION A disciplined and systematic process of problem identification, research, resource development, pilot testing (evaluation as measurement) and dissemination.	Action research and sustained support to facilitate teacher resource development and problem solving through a contextual critical process of praxis (evaluation as a critical process driving change).
4. WORKSHOP STYLE One-off demonstrations, lectures and contrived situations at centres away from schools.	Sustained discussion, problem defining and resource development with teacher working groups in schools and at field centres.
5. RESOURCE MATERIALS Expert written, field tested and packaged materials and activities to be used by teachers in predetermined ways.	An expanding pool of materials and techniques written by teachers or adapted to local needs by curriculum projects.
6. PROJECT DESIGN The Action Ecology kit of resource materials and activities for an environmental education approach to ecology fieldwork.	A pool of resources for an environmental education support service.

FIGURE 4   A summary of the shifts in thinking within the action research reconstruction of the project.

The concern to evaluate the attainment of prespecified objectives (knowledge, skills and values), was seen as neither tenable nor desirable, and environmental education curriculum change became a collaborative enterprise of action-centred curriculum reconstruction. This realization led the project:

i)   To facilitate teachers in exploring, criticizing and to changing what they already have.

(ii)   To support them in expanding their repertoire by developing new approaches or by selecting and adapting ideas accumulated in the Action Ecology resource base.

The cumulative impact of these shifts in thinking was a radical reorientation of the project. This then had to be clarified and validated with groups of teachers. The revised approach to environmental education and curriculum development was further clarified through two projects to develop science fieldwork materials for rural schools in Natal, conducted in 1989 with teachers from the Science Education Project and the Urban Foundation Primary Science Project. The collaborative research process was also used to develop a support infrastructure for environmental education curriculum enrichment.

The goal of the project now became to enable two groups of science teachers from isolated rural schools to get together once or twice a month over a seven to eight month period. Each working group was coordinated by a chairperson elected by the teachers, and support services were provided by a researcher working from an environmental education field centre. Each group of teachers, including the researcher, worked as a collaborating team. There was also an exchange of ideas between the working groups as they both worked on fieldwork resource materials but for differing habitats (soil conservation / soil organisms and water / water organisms). The exciting and creative manner in which the groups operated to identify problems and to develop suitable resource materials emulated much of the earlier resource development work when the initial project team was researching techniques to solve fieldwork problems. The outcome was also a rich array of resource materials produced with the aid of modern wordprocessing equipment. These were published by the Shell Education Service (colour charts) and by the teacher support infrastructure of the Umgeni Valley Project of the Wildlife Society of Southern Africa (fieldwork reference books and work sheets). The resource materials are stored on a database for ongoing redevelopment to local needs by an expanding network of participating projects and teacher working groups.

AN EMERGING RATIONALE FOR ENVIRONMENTAL EDUCATION

The notion of 'grass roots' reconstructive action emerging from this research, treats environmental education as a stimulus to foster collaborative social processes of research, reflection and change. A rationale for this perspective emerged from the notion that the world is socially constructed (Berger and Luckmann 1967), within structures that both enable and constrain us (Giddens 1984). This position provided the potential:

(i)   To demystify complex social and historical patterns of prevailing environmental conditions.

(ii)   To bring the socially constructed perspectives of everyday life under scrutiny and ultimately into question.

(iii)   To foster a vision of the possibilities for evaluation and change.

Within this revised outlook on environmental education, various conceptual, procedural and design factors had to be resolved. An extended period of action research served to clarify five key issues for an emerging rationale of *'grass roots reconstructive action':*

i)   A revised position on the nature of science.

Scientific enquiry was seen, at the outset of the investigation, as the use of research instruments in an empirical endeavour that was both rational and objective. This positivist position was, however, successively overturned by research on the intersubjective nature of scientific enquiry (Carr and Kemmis 1986), the social construction of reality (Berger and Luckmann 1967) and on the sociology of science (Nel 1986, Woolgar 1988). It was displaced by the notion that scientific enquiry is sustained intersubjective social processes by which communities come both to solve problems and to reconstruct the way they see the world. Since scientific communities function within a variety of social traditions and world views, the important issue became supporting project participants so as to remove obstacles that might inhibit them from acting to change the curriculum. A political economy of change thus became important for each situation. These were sufficiently diverse so as to require differing types of support according to the problems and circumstances of the participating 'community of action researchers' (teachers).

ii)   A complementary outlook on communication

An information processing model of centre-to-periphery diffusion was used during the initial curriculum development process. This outlook suggests that information transfer from conservation agencies, through 'good' communication and 'clear' messages, will create the necessary environmental awareness to solve conservation problems. This competing simplification fails to see that change occurs through complex processes of critical reflection and dialogue in contexts of everyday action and social interaction. In clarifying a more appropriate communications model for the utilization of scientific research (knowledge) and the reconstruction of the way we see the world, the project came to subscribe to the notion that,

Communication is less effective than community in the utilization of knowledge. (Stenhouse 1975, p. 223)

It thus selected symbolic interactionism (Charon 1979) as a body of communications theory that corresponds with this position and the notion that scientific enquiry is a social process of intersubjective meaning making.

iii)   Change through intersubjective dialogue

The project tried to develop a research design that was compatible with science as a community process of reconstructive enquiry. This was found in Carr and Kemmis (1986) who suggest that action research is critical education science,

creating the conditions under which the participants can take collaborative responsibility for the development and reform of education (p. 211).

In doing this participants can become a critical community of scientists engaged in the intersubjective reconstruction of the way they see and act in the world (Car and Kemmis 1986, p. 121).

The value of contextual problem solving through a grounded intersubjective dialogue was noted when participant observation techniques were used in a discursive evaluation process in a local nature reserve (O'Donoghue 1988a). Wildemeersch (1985) describes how reflective dialogic processes in intersubjective situations are central both in the construction and the transformation of reality. Freire and Shor (1987, p. 148) also point to the centrality of dialogue in emancipatory change.

iv)   Environmental education and curriculum development as action research

A suitable orientation in prevailing curriculum theory (social adaptation and reconstruction) is described by Eisner (1985). One of the weaknesses of this position is, however, its assumption that the curriculum can be orientated to manage greater levels of critical consciousness and social change. The project did not consider the school and the curriculum to be a tool for the management of environmental change but rather as a critical forum for engaged cultural reconstruction as proposed by Freire and Shor (1987).

For its curriculum development strategy the project constructed an image of scientific enquiry and curriculum change as *intersubjective critical processes of dialogic transformation*. This clarification both transformed the project into a teacher support network and revealed the ideology of centre-to-periphery diffusion as a doubtful myth.

v)   The need for external moderating mechanisms.

A major problem in intersubjective situations is that the consensual outcomes of group interactions may appear as a new and unchangeable truth to the participants. The clarification of ideas may, however, have been inhibited by a lack of grounded critical reflection or by the prevailing ideology. Grundy (1987) suggests that,

It is the trick of ideology to make that which is cultural, and hence in principle susceptible to change, appear natural, and hence not open to change at all (p. 107).

For years an ideological trick within conventional curriculum development models has prevented the scrutinizing of the underlying centre-to-periphery ideology. When faced with implementation problems we have all erroneously looked to structural, evaluation and communication problems. The trick we need to use is the rigour of a critical sciences perspective, consultants who play devil's advocate and a healthy scepticism that things are not always as they seem. External moderating mechanisms were established to ensure that both the concepts constructed, and research techniques used, were well situated in a philosophical framework that was appropriate for environmental education. This was done for both the action research process with external consultants and for the networking support service with self checking and devil's advocate mechanisms applied in ongoing action.

SUMMARY

What started as a deterministic attempt to develop and implement a curriculum for an environmental education approach to ecology fieldwork has, thus, through cooperation and evaluation research, been transformed into a rich pool of resources and a networking mechanism to support the expanding critical dialogue and action of many concerned teachers. The outcome has been that environmental education and curriculum development have come to be seen as a collaborative action research process of contextual critical dialogue.

The important features of a research design to foster environmental education change appear to be:

(i)   A research team working with groups of teachers as co-researchers.
(ii)   Describing, criticising and exchanging fieldwork techniques and resource materials.
(iii)   Interpreting and discussing environmental education and environmental issues.
(iv)   Creating environmental education activities or selecting and adapting materials from the resource pool.
(v)   External moderating mechanisms to overcome possible contextual constraints.

This has brought about a radical transformation in the project. The initial structured intervention (Action Ecology) has been superseded by a support service (Share-Net) working in collaboration with classroom action researchers to enhance everyday classroom and fieldwork activities. This experience has led to the conclusion that if centre-to-periphery ideologies of innovation management persist, 'change' is likely to be no more than apparent motion, with the potential for meaningful reconstruction being subverted by the desire for management and control that have brought about much of the environmental crisis.

Thomas Popkewitz (1990) uncovered both the failings

of deterministic strategies of change and the potential for compelling alternatives when he stated:

Our methods of research emerge from our involvement in our social conditions and provide a means by which we can seek to resolve the contradictions we feel and the worlds that seem unresolved in our everyday life.

Environmental education cannot be driven by external strategic forces alone as these 'top down' initiatives can both overlook and inhibit the processes by which people grapple with and change the way they see the world.

REFERENCES

BERGER, P. and LUCKMANN, T. 1967. *The social construction of reality: A treatise in the sociology of knowledge.* The Penguin Press, London.

BONSER, S.A. and GRUNDY, S.J. 1988. Reflective deliberation in the formulation of a school curriculum policy. *Journal of Curriculum Studies,* vol. 20, no. 1, pp. 35 - 45.

CARSON, S. McB. 1977. *Environmental education principles and practice* Edward Arnold, London.

CARR, W. and KEMMIS, S. 1986. *Becoming critical: Education, knowledge and action research.* The Falmer Press, London.

CHARON, J.M. 1979. *Symbolic interactionism: An introduction, an interpretation, an integration.* Prentice-Hall, Englewood Cliffs, New Jersey.

COETZEE, J.K. 1988. *Reflections on the meaning of development:* A conceptual analysis paper presented at the biennial conference of the Development Society of Southern Africa, University of Durban-Westville, 6-8 July.

EISNER, E. 1985. *The educational imagination.* Macmillan, New York.

EHRLICH, P.R. 1968. *The population bomb.* Ballantine, London.

FOURIE, H.P. 1977. *Communication by objectives* McGraw-Hill, Johannesburg.

FREIRE, P. and SHOR, I. 1987. *A pedagogy for liberation: Dialogues on transforming education.* Macmillan, London.

GIDDENS, A. 1984. *The constitution of society: Outline of the theory of structuration.* Policy Press, Cambridge.

GRUNDY, S. 1987. *Curriculum: Product or praxis* Falmer, London.

HAVELOCK, R.G. 1969. *Planning for innovation through dissemination and utilization of knowledge.* University of Michigan, Institute of Social Research, Ann Arbor, Michigan.

IRWIN, P. 1984. The origin and development of environmental education: A world perspective. *Southern African Journal of Environmental Education,* no. 1, pp. 7 - 9.

IUCN 1980. *World conservation strategy: Living resource conservation for sustainable development.* International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.

MARTIN, G.C. and WHEELER, K.S. (eds.) 1975. *Insight into environmental education.* Oliver and Boyd, Edinburgh.

MEADOWS, D. *et al.* 1972. *The limits to growth* Earth Island Limited, London.

NEL, B.F. 1986 *The sociology of science: 'A funny kind of science'.* Occasional paper no. 16, Institute of Social and Economic Research, University of Durban-Westville, September.

O'DONOGHUE, R. 1988. *Action Ecology: Background papers for a strategy and research priorities workshop.* Natal Parks Board, Pietermaritzburg.

O'DONOGHUE, R. 1988a. *A discussion on the trial implementation of a participatory evaluation programme.* Project report EX28/10/16, Natal Parks Board, Pietermaritzburg.

O'DONOGHUE, R. 1990. *Environmental education evaluation and curriculum change: The case of the Action Ecology Project, 1985 - 1989.* Unpublished M.Ed. thesis. University of Natal, Pietermaritzburg.

O'DONOGHUE, R. and TAYLOR, J. 1988. Towards participant-centred resource development in environmental education. *Southern African Journal of Environmental Education,* no. 7, pp. 3 - 5.

O'DONOGHUE, R. and TAYLOR, J. 1990. Towards a co-operative network for environmental education. *Environmental Education Bulletin,* no. 2, pp. 2 - 5.

PAPAGIANNIS, G.J., KLEES, S.J. and BICKEL, R.N. 1982. Towards a political economy of educational innovation. *Review of Educational Research,* vol. 52, no. 2, pp. 245 - 290.

POPKEWITZ, T.S. 1984. *Paradigm and ideology in education research.* Falmer Press, London.

POPKEWITZ, T.S. 1990. *A political sociology of educational reform and change: Knowledge, power and the state.* University of Wisconsin-Madison, in press.

STAKE, R. 1977. The countenance of educational evaluation. In Hamilton *et al.* (eds.) *Beyond the numbers game: A reader in educational evaluation.* Macmillan, London, pp. 146 - 155.

STENHOUSE, L. 1975. *An introduction to curriculum research and development.* Heinemann, London.

UNESCO-UNEP, 1978. The Tbilisi Declaration. *Connect,* vol. 3, no. 1, pp. 1-8.

WILDEMEERSCH, D. 1985. *The principal meaning of dialogue for the construction and transformation of reality.* Unpublished paper, Leuven.

WOOLGAR, S. 1988. *Science the very idea.* Ellis Horwood and Taverstock, London.

ACKNOWLEDGEMENTS