EDUCATION FOR ENVIRONMENTAL LITERACY TOWARDS PARTICIPATORY ACTION RESEARCH IN THE SECONDARY SCHOOL SCIENCE CURRICULUM IN LESOTHO

THESIS

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ABSTRACT

The dependency of educators in Lesotho on externally developed curriculum theories and concepts is fundamental to issues of relevance of the school curricula. This study set out to develop the meaning of environmental literacy in the context of three secondary schools and to explore appropriate teaching methods for the development of this concept in the science curriculum. The participatory action research process involved a team of four science teachers, including the researcher, in partnership with an environmental centre.

We progressively developed the meaning of environmental literacy by monitoring teaching innovations in the classroom, holding meetings and workshops and attending conferences where we shared classroom findings and reflected on our emerging understandings based on classroom experiences. Data collection involved: audio-recording of classroom lessons, interviews with teachers and students, audio-visual recording, classroom observations and students' questionnaires.

The research process made apparent the complex nature of the process of clarifying and developing environmental literacy in this context. Classroom activities planned to inform the team's understanding of the meaning of environmental literacy and develop appropriate teaching methods encountered constraints associated with the education system and the legacy of colonialism. These contextual constraints crystallised the need for the education system to be transformed in order to make schools more conducive environments for the development of students' environmental literacy. While initially teachers were reluctant to engage in critical reflection, the research process did encourage the team to revise and expand their understandings of both environmental literacy in the science classroom, and the action research itself.

The emerging meaning of environmental literacy in this context and how it may be developed among students does not involve a definition with prescriptive, effective teaching methods, but provides insights and understandings gained by the participants in their engagement with a reflective process of reconstructing meaning. I have come to understand environmental literacy during the study to be a process that should draw strongly on the local knowledge and understandings into the science curriculum, through participatory process-based curriculum development models.

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PREFACE

When I cast my thoughts back to the time I began this study I recall my first encounter with Eureta in 1994 and our hours-long conversation on environmental education in her car as we drove to Graaff-Reinet to attend my first EEASA conference. This proved to be the prelude to a much longer research journey together, as she became the supervisor of this work. EEASA conferences thereafter became an important link through which the teachers participating in this study interacted with the community of environmental educators in Southern Africa. EEASA and SADC-Environmental Education networks provided opportunities for the findings of this study to be critiqued, and for Noel Gough and Jim Taylor to read and comment on aspects of this work.

My involvement in environmental education networks (LEINET, Lesotho Mountain Research Group, Environment Desk) in Lesotho during the research project was useful in engaging me in critical discussions on environmental issues and problems. My participation in the curriculum development process in Lesotho led to encounters with educators, with whom I often engaged in critical debates on issues concerning the relevance of the curriculum. Perhaps this study did in some ways help shape the curriculum, as I shared some of my research insights at these meetings.

I am grateful to Pulane Lefoka, Janet Stuart, John Gay, Lehlohonolo Phafuli and Neville Pule for giving up their time to read and comment on my writings; the comments and the literature they provided me with was of great value. I cannot forget the valuable contributions of the Institute of Education staff on action research at our first research team meetings. I thank you all.

I am indebted to the Government of Lesotho for funding this study, the financial contribution made by SADC-ELMS through a short-term contract, in response to my request for funding towards this project, and the Masianokeng Environmental Centre for hosting the research team meetings.

I wish to extend my gratitude to Eureta Janse van Rensburg for her supervision of this study: her faith in me was the basis of my strength and power to move ahead in spite the obstacles I

encountered. I cannot forget how, at one time in her house, she suddenly asked me to present at a conference my ill-formed idea which I raised when talking about the relationship between politics and environment in Lesotho. She has given me the space to toss around and develop my ideas: this was in sharp contrast to my experience of educators who crave to shape and normalise the behaviour of others in ways that accord with their own interests. We need teachers of her calibre in Lesotho as we enter the next millennium, and part with a century characterised by ideological impositions associated with colonialism, which has subjugated the wealth of Basotho's knowledge systems.

I have had the privilege of taking this very long research journey with my wife, Selloane. With incredible patience and understanding she withstood my preoccupation with the research into the late hours of the night and on weekends. I especially thank her for introducing me to Ntate-moholo Machobane whose ideas changed the face of this study. My entire family and friends gave me the support I needed for the completion of this work. Their good wishes made this work a collective effort rather than my individual initiative. I recall how my father would remark "*re* tla o hopala" (*we* will remember you): words which reflect *their* unique form of contribution to this project and *their* trust that it was worthwhile. This charges me with a responsibility to demonstrate the worthiness of this study to them. Within this context, 'worthiness' can only mean an ostensible contribution to the improvement of the Basotho's quality of life and their attainment of sustainable living. It is my trust that this study will contribute to the attainment of this.

To the many others who participated in and contributed to this project, I salute you. In particular I thank the teachers who participated in this study. Your efforts will always remind me that *letsoele le beta poho* and I have no doubt that we have made it!

To conclude, I am reminded of a dream I had at the time of this research, which I consider as representative of the grim reality that further research work in Lesotho must address, if curriculum development research is to have any relevance within this context:

> *I saw crowds of Africans, men and women crowding in a town; they were queuing to buy food from shops - I saw some buying Kentucky Fried Chicken. They were employed workers, and were on break; strong and able-bodied but weary from hard labour. I was amongst them, mingling with them - I bought and tasted some of the*

'food' they ate, but could not swallow the first bite - I spat it out. These crowds did not seem to worry about what they ate: they had to fill up their stomachs before time was up. At a distance in an open market, there were many more Africans - they were queuing to buy food from a non-African business man; he was cooking and selling an African dish - papa.

This dream sharply brings to my mind thousands of men and women in Lesotho who have been dislocated from their environments into urban centres to seek employment as cheap labourers. The extent to which the education system can contribute to reversing this trend is, in this context, the measure of its relevance.

Khotso.

CHAPTER 1

CONTEXT AND THEORETICAL FRAMEWORK OF THE STUDY

Ntlafatsa motho, motho o tla ntlafatsa naha[1]
(Machobane 1996 pers. comm.)

The present predicaments of Africa are often not a matter of personal choice: they arise from an historical situation. Their solutions are not so much a matter of personal decision as that of fundamental social transformation of the structures of our societies starting with a real break with imperialism and its ruling allies
(Ngûgi wa Thiong'o, 1996:xii)

1.1. INTRODUCTION

In this chapter I analyse the context of the study with reference to the following areas: education system, curriculum development model, science curricula and environmental education. I also in this chapter and the next, describe the theoretical framework of the study.

By drawing on Agenda 21 (UNCED, 1992) and the National Environmental Plan (Lesotho, 1994) I argue that the present study is in line with international and national calls for environmental education. I also highlight early in this chapter systems of meaning which I regard as important in shaping the orientation of the present study. These include the local perspectives which I canvassed in order to discuss the relevance of the existing curricula content in Lesotho.

In further analysis of the education system in Lesotho I examine the prevailing teaching and learning methods from a post-modern and critical perspective. From this perspective I argue against the present traditional ways of teaching and the existing curriculum development model in Lesotho, and for an exploration of more transformative curriculum development strategies. I describe the present curriculum development model as European in origin and argue that Europe

[1] These words may be loosely translated to English as: *Develop a person and a person will develop environment.* Machobane explains that he developed this 'slogan' in response to the 'development' programmes which stressed approaches such as tree planting to prevent soil erosion in Lesotho, rather than focus on development of the capacity of people to live in a sustainable way in their own environments.

is the centre where curriculum innovations - including the Lesotho science curricula - originate from, with the National Curriculum Development Centre (NCDC) in Lesotho as the periphery. I further argue that the NCDC can in turn be perceived as the centre which develops and disseminates the curricula to schools, which thus serve as the periphery in relation to the Centre. I also analyse the science curricula with respect to the concepts of integration and teaching methods. I associate the integration of three disciplines (Chemistry, Biology and Physics) within Junior Science with the notion of a *holistic* view of environment and further allude to the apparent shift from integration to disintegration within the teaching of science as reflected in the Science syllabi.

I demonstrate that the curriculum development model that is presently employed to develop the science curricula excludes the majority of teachers and students who are directly engaged in the processes of teaching and learning, and I argue for a change of the model to a more participatory and school-based process of curriculum development. From the examined literature it appears that the dissemination of new ideas about the science content, the teaching methods and the associated materials from the centre (NCDC) to the teachers in schools often encounters contextual obstacles such as constraints of time, lack of teaching facilities and teachers' failure to make proper use of distributed equipment. I argue that these obstacles may be associated with the present curriculum development model.

By drawing on records dating back to the 1970s, as well as recent environmental education policy documents, I show that the present concerns about the failure of the school curricula to address environmental problems in Lesotho are important but not new.

In my conclusion to this chapter I briefly discuss the relevance of the research method employed in the present study.

1.2. BACKGROUND OF THE STUDY

Subsequent to the United Nations Conference on Environment and Development (UNCED, 1992), Lesotho produced a National Environmental Plan in 1994 (Lesotho, 1994). UNCED had called on all countries to pursue sustainable development strategies, drawing on Agenda

21 as a blue-print to guide national planning processes. In terms of Agenda 21, "education is critical for promoting sustainable development and improving the capacity of the people to address environment and development" (UNCED, 1992: 221). As part of the UN community Lesotho is a signatory to international conventions, including Agenda 21. Lesotho's plan to implement Agenda 21 marked a concerted effort to redress previous failures to integrate environment and development, and to demonstrate the country's commitment to sustainable development. Environmental education at all levels of education was listed as a priority in this plan (Lesotho, 1994). However, at the time of writing, environmental education in Lesotho is still in its infancy. This state of affairs is a primary motivation for the present study. I hope that the findings of this study will stimulate and inform environmental education curriculum development initiatives in Lesotho, where I am involved in curriculum development and teaching.

As a first step towards this, it is necessary to address the concept of environmental literacy in the context of the environmental dilemmas facing Lesotho. [For an outline of Lesotho's environmental problems see Gay *et al.* (1995), Gysae-Edkins (1994), Khalikane (1988), Lesotho (1994)]. In a special study for the World Conference on Education for All, environmental literacy was defined as "the elementary knowledge, skills, and motivation for people to participate in the solution, and anticipation, of environmental problems, and so make their own contribution to sustainable development" (Haggis, 1991:53). In terms of this definition and of widely accepted policy statements that have emerged from international conferences (e.g. UNCED, 1992; UNESCO, 1980; IUCN, 1980), the following are argued to constitute the core of environmental literacy: knowledge, critical thinking, problem-solving and decision-making skills in the context of the actual environments in which people live, as well as active participation in the solution of environmental problems. In accordance with the international literature I assume one aspect of environmental literacy to be the ability to understand environment and environmental issues in a *holistic* way, i.e. as an interconnectedness of biophysical, economic, political and socio-cultural contexts (EEPI, 1994; Haggis, 1991). In a formal pedagogical sense this implies an interdisciplinary approach to teaching (EEPI, 1994; Haggis, 1991; Stevenson, 1987; UNCED, 1992).

Haggis (1991) reported that the World Conference on Education for All observed that science

education has a valuable role to play in education about the environment, the reason for this being that science education provides "a conceptual framework for managing the biosphere (forests, soils, air, water, chemicals, energy, biological diversity and the human population) and the technosphere (human habitats, industry, transportation etc.)" (Haggis 1991:54). The second dimension of this study was therefore to explore appropriate experiences for learning in the Junior Science curriculum, in accordance with the emerging meaning of environmental literacy.

The Lesotho Junior Science curriculum (Examination Council of Lesotho, 1995) is in theory based on an interdisciplinary approach. It comprises topics from Biology, Chemistry and Physics, and teachers are advised to identify related topics in the different disciplines and correlate them in their teaching. The curriculum also makes provision for some 'social' topics, which can contribute to the development of a conceptual framework for environmental literacy, as described above.

However, simply addressing the content of the Science curriculum may not be sufficient to encourage the development of environmental literacy. Teaching strategies and the learning experiences they give rise to are also important aspects of a curriculum. According to my own observation when teaching in Lesotho, the teaching and learning strategies which were predominantly used in the science classrooms encouraged rote-learning and were teacher-centred. Talukdar (1995a, 1995b) made similar observation in other schools in Lesotho. Students relied heavily on textbooks and the teachers' lesson-notes, which they rote-learned and reproduced. Constructivist theories (Bodner, 1986; Bodner, Metz and Tobin, 1997; Pope and Gilbert, 1983) contrast rote learning with meaningful learning (Ausubel, 1968). The former occurs when a new concept is arbitrarily committed to memory without linking it with the learner's pre-existing conceptual framework. Drawing on the ideas of Wertsch and Bakhtin, O'Loughlin (1992:812) argues that teacher-centred strategies may send messages to students that only the teacher's knowledge counts, and that students lack the power to interpret events or construct critical understanding. The teaching and learning strategies which encourage rote-learning and disregard the knowledge of learners seem inappropriate for developing certain elements of environmental literacy as outlined above, such as decision-making skills in the context of the students' own environment, and active participation in the

solution of environmental problems.

This study therefore does not only clarify from a developmental perspective the meaning of environmental literacy within this particular context, but also investigates teaching strategies which could be appropriate in teaching for environmental literacy in the Junior Science curriculum. The clarification and investigation proceeded in a collaborative manner, involving a small group of Junior Science teachers from Lesotho. The hope was to develop a better understanding of some of the complexities of and issues involved in developing an environmental education curriculum. In the next section I describe how the literature that I read contributed to the sense of "understanding" that informs the project.

1.3. MY ORIENTATION TO AND THE THEORETICAL FRAMEWORK OF THE STUDY

The systems of meaning that shaped my orientation to the project include the following: post-formal thinking (see Kincheloe & Steinberg, 1993); a post-modern perspective (as outlined by Doll, 1989); socially critical theory and pedagogy (see Firth, 1996; Lather, 1986; Nielsen, 1992), the principles of contextual theology (Cochrane, 1996; Institute for Contextual Theology, 1994; Kaufmann, 1994; Villa-Vicentio, 1994; West, 1993); and emancipatory action research (McKernan, 1991). These diverse systems share common elements pertaining to the notion of social transformation.

Post-formal thinking is concerned with subjugated knowledge, ways of knowing that have traditionally been excluded from the conversation of mainstream educators. As Kincheloe and Steinberg (1993:298) put it:

> One of the main features of post-formal thinking is that it expands the boundaries of what can be labelled sophisticated thinking. When we begin to expand these boundaries, we find that those who were excluded from the community of the intelligent seem to cluster around exclusions based on race (the non-white), the class (the poor) and gender (the feminine).

Often contrasted with modernity, the post-modern label is "the code name for the crisis of confidence in the Western conceptual systems" associated with an emerging "exciting time of

openness and questioning of the established paradigms" (Lather, 1991:34.7). Modernity is associated with formal Newtonian thought (Kincheloe and Steinberg, 1993; Doll, 1989) based on a cause-effect, hypothetico-deductive system of meaning. This worldview favours a perception of reality, environment and change as simply ordered and uniform rather than complex and chaotic; harmonious rather than discordant; cumulative or incremental rather than transformative; it also advocates the achievement of efficiency through pre-set ends (objectives) rather than explored ends. I assumed that this modernist perspective informed and shaped teacher-education and curriculum development models in Lesotho. This assumption was based on inter alia my observation that teacher training emphasised mechanical approaches to curriculum development and teaching, exemplified by the formulation of objectives in line with pre-set ends, and valuation or closure to establish whether the ends had been achieved.

Thus, informed by the ideas of Doll (1989), I thought that it was necessary to shift to a new paradigm within which, for example, the ends set before curriculum implementation (e.g. lesson objectives) were merely guidelines to be transformed in the process of implementation (i.e. teaching and learning) along with the students' understandings, the teachers' understandings and the course material, rather than fixed expected outcomes. From this perspective, the traditional teaching approaches of transmission of knowledge or production of predetermined behaviours may have to be superseded by a focus on the development of processes of learning that are participatory, reflexive and socially critical (see Janse van Rensburg and Lotz, 1997; Lotz and Olivier, 1998). The emphasis on lesson closure (within which the presented content is usually repeated) may be replaced with approaches that encourage students to develop their own alternatives and insights in the light of the presented content. Doll (1989:249) has associated curriculum development with a shift from the modernist concept of change as cumulative or incremental, to a transformative kind of change which concerns "a change in view, in perspective, in methodology. It permanently alters one's relationship to nature, to life, to the environment, to learning".

The transformative potential of socially critical theory lies in its emphasis on the socio-political nature of knowledge. As Greenall Gough and Robottom (1993:305) put it, "knowledge is seen as constructed through social interaction and thus as historically, culturally, politically and economically located; it has its meaning in the action of projects whose significance is in

specific historical, political and economic contexts". Critical pedagogy is complemented by constructivist theories of learning which explain that we construct knowledge in our minds as our preconceptions relate with new knowledge (Bodner, 1986) and through interaction with others (Bodner, Metz and Tobin, 1997; Vygotsky, 1987). Pedagogically constructivist theories have influenced the development of student-centred learning approaches, based on the assumption that

> knowledge cannot be transferred intact from the mind of the teacher to the mind of the learner. The constructivist model therefore requires a subtle shift in perspective for the individual who stands in front of the classroom. A shift from someone who "teaches" to someone who tries to facilitate learning; **a shift from teaching by imposition to teaching by negotiation.** (Bodner, 1986:876) (My own emphasis in bold.).

Kincheloe and Stainberg (1993:299) have referred to a constructivist theory that is informed by critical theories and postmodernism as "critical constructivism". Socially critical theories stress that constructed knowledge is not neutral, but rather value-laden, shaped by the interplay of socio-cultural and political forces. Drawing on Habermas (1968), Bacchus (1990: 298-299) refers to this view of knowledge as "critical emancipatory knowledge". Lather (1986:259) refers to "emancipatory knowledge" that uncovers contradictions in society and thus creates opportunities for transformation. Equally important is recognition of the relationships of dominance and submission which underlie knowledge (Bacchus, 1990; Foucault, 1977; Firth, 1996). Knowledge and power are inextricably linked, and others may be controlled in the sharing of knowledge.

Principles of contextual theology (e.g. Cochrane, 1996; Institute of Contextual Theology, 1994; Kaufmann, 1994; West, 1993) include liberation, empowerment and social justice. Liberation theology (e.g. Villa-Vicentio, 1994) may be seen as a form of contextual theology and a branch of critical theory. Cochrane (1996:4) has described doing contextual theology as an "encounter with the environment in which we operate - wrestling with it and taking it seriously". Nielsen (1992) has described 'contextualisation' as a form of critical theory, a "historicised critical theory" through which we can critique society and ideologies as we "start from where we happen to be historically and culturally, from a particular kind of frustration or suffering experienced by human agents in their attempt to realise some historically specific project of 'the good life'"(1992:278). This requires the text users to acknowledge their own historical, cultural

and political contexts, to allow themselves to be transformed by them and in turn to transform them (Cochrane, 1996:4).

Such encounter with the local environment enables those who do theology to respond to and liberate themselves from oppressive elements in their society. Exploring the pedagogic implications of liberation theology, Kanpol (1996) has provided a view of a teacher as a "political agent of social change" who perceives of the classroom as an "active area of transformation" (Kanpol, 1996:111, 112). Drawing on the attributes of the great Jewish prophets who dismantled oppression and exploitation, Kanpol has described a teacher as one who "is not only gut-wrechingly critical of social surroundings...but also passes on a message of transformative hope, enlightenment, joy, love, mercy and forgiveness that is often missing in critical educational discourse" (Kanpol, 1996:112).

From this perspective the educator's role in the classroom is to create a dialogue between the learners' own experience and the curriculum content. Teachers create spaces for their own voices, learners' voices and the voice of the content prescribed by the syllabus. Critical pedagogy is helpful for understanding the nature of these voices (Firth, 1996, Kanpol, 1996), their socio-historical make-up and the environment that shaped them. Kanpol comments,

> through understanding one's own voice and others' voices, teacher and students can begin to act as change agents to alter present oppressive social and structural conditions that shape, constitute, and restrain different voices. (1996:106).

The classroom thus becomes a "terrain of struggle" (Kanpol, 1996:108).

A pedagogy that promotes social transformation and sustainable development would encourage students to voice their views and reflect with others on issues of emancipation, equity and social justice in their own environment (see Robottom and Hart, 1993:25). One useful teaching strategy involves participatory and emancipatory action-research processes (see McKernan, 1991; Walker, 1991; Winter, 1989) informed by critical theory. The participatory approach to research processes becomes essential when history shows that collective action is usually more productive than individual effort in political struggles (Robottom and Hart, 1993:25). The

concept of participation to address a particular social problem is part of Basotho culture and is reflected in the proverb, *Lets'oele le beta poho*[2]

Participatory learning processes often also include the notion of *"empowered educators"* assuming that they can *"empower"* learners (see Janse van Rensburg, 1995:5 for a critique of this assumption). Engagement with participatory action research *"contextualises"* the curriculum to respond to issues and risks within the contexts of teaching (see Lotz and Olivier,1998). It is a process within which educators exercise power to assist learners to exercise power (Firth, 1996). Participatory action research involving teachers and students assumes that knowledge is not static and that 'empowerment' is an ongoing process. Through engagement with the recurring cycles of action and reflection, shifting understandings may emerge.

Action research is also an opportunity for reflection-in-action within which environmental educators can monitor and evaluate their own practice reflexively (see Shon, 1987). In this sense, there cannot be 'empowered educators' who hold an 'objective' understanding. Rather, drawing on critical theory, educators would be critical of their own understanding and of that held by others, as it emerges from a particular historical and social location. A particular understanding represents a perspective from a particular point in the web of reality.

How the theoretical framework outlined above interacted with my other understandings and the goals and the processes of the present study will become clearer in the following sections and chapters.

In the next section I discuss the education system in Lesotho, drawing on a number of local perspectives.

1.4. ANALYSIS OF THE EDUCATION SYSTEM

In considering the development of an environmental education curriculum in Lesotho, the context of Lesotho's adoption of a Western-style education system and its dependence on external support for its maintenance and development needs to be considered. This section

[2] This proverb may loosely translated to English as: *A crowd arrests a bull.*

develops a Lesotho-centred[2] critique of the origins and impact of the education system in Lesotho by drawing on critical and post-colonial theories.

Modernism, associated with the scientific revolution of the 16th and 17th centuries, the Industrial Revolution and the Enlightenment (see Blake, 1996; Lather, 1991; Littledyke, 1996), was introduced to Lesotho with the arrival of the missionaries in 1833 and reinforced by nearly a century of British colonial rule (1868-1966). British school curricula functioned as the powerhouse of modernism in Lesotho. From a modernist perspective scientific rationality is the appropriate basis for social reform (Blake, 1996). It may be argued that school curricula in Lesotho have largely functioned, without much success, to foster the values and assumptions of scientific rationality as the basis for development. These would include a belief in absolute truth attainable through the application of the scientific method, a belief in the empirical and rational as the fundamentals of true knowledge, and a belief in the standardisation of knowledge and its production (see Gough, 1993; Littledyke, 1996).

It could be argued that the British school curricula and missionary school system did not improve the quality of life of the many Basotho. Machobane, one of the best qualified products of the education system, observed the irrelevance of the Lesotho curriculum to the majority in the 1940s. This led to his decision to burn all his academic certificates and to establish the historic *Mants'a tlala college*[3] in 1957 (Machobane 1996 pers. comm.). This initiative thrived but subsequently foundered amid the post-colonial political rivalry of the 1970s. In the 1970s, several years after the end of colonial rule, many educators were still dissatisfied about the school curriculum's potential to improve Basotho's quality of life. Curriculum development records from the 1970s document local educators' concerns at the time that the school curricula *"wean[ed] the child from his roots"* and failed adequately to prepare learners to survive in their

[2] The concept 'Lesotho-centred' is adapted from the concept of 'African-centredness' as used by Ani (1994:24) in her book *Yurugu*, and means a way of viewing reality that analyses phenomena using the interests of the people of Lesotho as a reference point.

[3] Machobane's concern was that the majority of Basotho at the time, including himself working as a sub-editor of a newspaper (Leselinyana) which was owned by the Paris Evangelical Mission Society, were experiencing a serious food shortage and he associated the plight with the education system. '*Mants'a tlala*' may be literally translated to English as: '*One that/who eliminates starvation/hunger*'. The college, he explains, prepared people to be independent and produce food for themselves.

own environment. The associated problem was that *"school leavers disappear to towns"* (Institute of Education, 1975). The education system has for decades contributed to rather than prevented people's migration to urban centres, the breakdown of life support systems of rural communities, the notion of unemployment, and concomitant violence and crime.

About two decades after the end of colonial rule, in the 1980s, leading educators were still dissatisfied with the impact of the established education system in Lesotho (see Schorn and Blair, 1982). The education system did not integrate local traditional knowledge and culture (Mokhosi, 1982; Moletsane, 1982) and brought about *"frustrations, materialism and an unhealthy competition"* (Mokhosi, 1982). The early 1980s were also marked by the first comprehensive survey of the education system in Lesotho (Education Sector Survey Task Force, 1982). As a result of this survey educational objectives were re-formulated in relation to development and the skills required for development. These included problem-solving skills, scientific and technical abilities and socio-cultural values. The education system has been primarily preparing an increasing number, but still a minority, of Basotho to become what Gay *et al.* (1995) have called a *"bureaucratic bourgeoisie"*; individuals with a guarantee of high status occupation, relatively high salary levels and social mobility. Mokhosi (1982) made a similar observation in the early 1980s and associated this problem with the educators' adherence to mainly the *"academic curricula"* and *"Western concepts"*. Apropos to this view is the importance given to English in the curriculum as an indicator for good education and a subtle marginalisation of the local language, Sesotho, from the curricula, as evidenced in reports that *"Sesotho is not spoken and written as well as it might be"* (Education Sector Survey Task Force, 1982:91).

The English language is the medium of instruction in schools and a pass in English language is a condition for passing two important national examinations at the end of Junior and Senior secondary education levels respectively. This convention, which is rooted in the British colonial era (see Education Sector Survey Task Force, 1982:3), ignores the fact that viable local knowledge is *'held by local communities in different languages in diverse epistemological frameworks'* (Shiva *et al.*, 1997) and that the compulsory use of English as a medium of instruction in schools hinders communication in the classroom (e.g. Education Sector Survey Task Force, 1982:12,91; Talukdar, 1995a, 1995b) and could subjugate valuable

knowledge constructed in Sesotho. From this perspective it is not surprising that the school curriculum is largely silent about local forms of knowledge and tacitly lowers their status and value. On the whole the ambitions and aspirations that Lesotho hoped to realise since taking political control of its education system from the colonial powers in 1966 have not been achieved. Nieuwenhuis also states:

> Whatever the reason may be, the fact is that education in Lesotho has not succeeded in pushing Lesotho into the technological era as was envisaged at independence.(1996:36)

Perhaps this is a direct result of the Lesotho educators' adoption of models and theories that appear to be viable in other contexts, and their failure appropriately to integrate imported knowledge systems into the local context.

At the same time education is not addressing the varied and complex environmental problems in the country, including severe land degradation, unemployment, and abject poverty (see Gay, Hall & Dedorath, 1990, Gay, Gill & Hall, 1995; Gysae-Edkins, 1994; IUCN, 1994; Khalikane, 1988; Lesotho, 1994; Weisfelder, 1997) and political instability (see Matlosa, 1997, Weisfelder, 1997). In trying to uplift the standard of education and address Lesotho's problems the Ministry of Education and Manpower Development has largely relied on donor agencies for support.

In 1996 approximately 90% of Lesotho's education budget for capital costs (buildings, vehicles and furniture) was financed through donor funding. The latter has included agencies such as the International Monetary Fund, the European Economic Community, the Overseas Development Agency, the World Bank, the British Council, and the German, Danish and Irish Governments (Niewenhuis, 1996). From this perspective, it could be argued that Lesotho has never really exercised its own political power to shape and develop its curriculum since it gained political 'independence', as these donor agencies have influenced and continue to influence the development of education programmes. Niewenhuis argues that such donor support implies that *"education development programmes must be developed in collaboration and consultation with donor aid countries and agencies"* (1996:112).

The general failure of Lesotho's education for modernity points to anomalies within the dominant paradigm. In the light of these anomalies, to use Kuhn's (1970) concept, a *'revolution'*

or *'paradigm shift'* needs to be considered. This consideration informed my own perspective as I engaged with the concept of environmental literacy within the context of the present study.

It could be argued that an important dimension of a paradigm shift with respect to the education system in Lesotho would involve a transformation of the curriculum development model, as it guides the development and nature of content and the processes of teaching and learning. In the next section I have attempted to develop a critical analysis of the curriculum development model that is presently used by school curricula developers in Lesotho to develop secondary school science curricula. This provides an important background against which the participatory action research method employed in the present study must be understood. I further discuss Lesotho Secondary school science with reference to the content of the subject and the teaching methods employed.

1.5. ANALYSIS OF THE SCHOOL CURRICULA

1.5.1. The Established Curriculum Development Model.

The present system of education in Lesotho could be interpreted as centralised. The school curricula for both primary and secondary education levels are designed and co-ordinated centrally by the National Curriculum Development Centre (NCDC). These curricula are implemented in all schools in the country.

According to the presently established curriculum development model, the various stakeholders in education - including churches, parents, business and various government sectors periodically - formulate national educational goals at a national seminar as a basis for new curricula. Drawing on the national goals the NCDC works with the subject panels to frame the curriculum aims. The panel for secondary school science, for example, is comprised of three secondary school science teachers representing three regions of the country (North, South, Central), one NCDC subject specialist, a representative from National Teacher Training College (NTTC), a representative from the National University of Lesotho (NUL), a representative from the National Health Training Centre (NHTC), a representative from the School Science Project (SSP), one representative from the Ministry of Education

Inspectorate, and a representative from the Lesotho Mathematics and Science Association. My two colleagues at the University of Lesotho who are involved with the in-service programme for teachers informed me that in their experience as members of the Science Panel, the representatives of teachers and institutions did not consult with their respective constituencies (Fieldnotes 06-11-96).

The subject panel is mandated to co-opt people or institutions they may find appropriate for reviewing the curriculum (Curriculum Review Committee - CRC). The CRC may include specialists from NUL, LCE, the school inspectorate, NCDC and others. The subject panels translate the curriculum aims into general objectives, from which the specific objectives are formulated by the panel. Drawing on the specific objectives, a scope and sequence chart is drawn, to determine the range and details of the subject content. This scope and sequence chart also helps in mapping out the syllabus. The newly developed curricula are trial tested in selected schools prior to implementation (Lerotholi, 1996). To avoid duplication of content across disciplines regular NCDC in-house seminars are held. Two teacher representatives from the subject panels may participate in the seminars.

Despite its ostensible inclusion of a range of stakeholders and its regular review procedures, the curriculum development model described above may be interpreted as characteristically *'social engineering'* and *'centre to-periphery'* in so far as it attempts to control and manipulate the social world (O'Donoghue and McNaught, 1991). The NCDC, the subject panels and curriculum review committees involved are the centre that shape the science curriculum, and the rest of the teachers and the society are the periphery to which the curriculum is disseminated. Within this model the majority of parents and teachers make no meaningful contribution to the shaping of the curriculum content and the teaching methods; and although learners are at the centre of the learning process only a small number of students in selected schools are superficially involved during trial testing of the curricula. Yet it must be remembered that the collective centre of educational policy and curriculum development in Lesotho, the NCDC and its associated bodies, in turn constitutes the periphery of the European curriculum contexts from which the current science curricula originate.

Further analysis of current secondary science curricula in Lesotho is provided in the next

section, in which I discuss the origins and nature of secondary school science curricula in Lesotho.

1.5.2. Secondary School Science

The missionary school system which prevailed in Lesotho for almost a century with the support of the British government did not accord much importance to science curricula development. The Education Sector Survey Task Force, in the first comprehensive report on Lesotho's education system since the end of colonial rule, described the primary focus of the early missionary schools as:

> the acquisition of literacy, the study of the Bible, the spiritual teaching of the church and participation in the Christian community. European cultural values and behaviour were also emphasised through such practices as adopting European eating and living habits, taking a European name at baptism and wearing European clothing. The missions also taught practical skills, for the early missionaries were self-reliant, building and making most of their churches, homes and furnishings.... (Education Sector Survey Task Force, 1982:1-2)

After gaining its political freedom from colonial rule in 1966 Lesotho turned to Britain for the development of its education system. Science education became a priority in Lesotho, resulting in the development of science programmes (see Ministry of Education, 1995; Education Sector Survey Task Force, 1982; Talukdar, 1995a). This section analyses changes that have occurred in the secondary school science curriculum in Lesotho since the 1970s from the perspective of the potential of the subject to develop students' environmental literacy. This analysis is made with reference to the concept of the integration of knowledge and the teaching methods.

Integration of Disciplines

In accordance with the definitions of environmental literacy outlined earlier, the ability to understand the environment and environmental issues in a *holistic* way (Haggis, 1991; EEPI, 1994; UNESCO-UNEP, 1978) is essential. The concept 'holistic' in environmental education refers to a way of seeing the world as an interconnectedness of the biophysical, the economic, the political and the socio-cultural contexts in which people are involved (Haggis, 1991; EEPI, 1994; UNESCO-UNEP, 1978). In a formal pedagogical sense this may imply an

interdisciplinary approach to teaching (EEPI, 1994; Haggis, 1991; Stevenson, 1987; UNCED, 1992). It may be argued that within the Junior Science section of the secondary school curriculum, the recommended integration of the three traditional disciplines, Biology, Chemistry and Physics (Examinations Council of Lesotho, 1995) can support such interdisciplinary teaching and the development of environmental literacy.

Though the topics from the three disciplines within the Junior Science curriculum are separate in prescribed textbooks and the syllabi, it is recommended that teachers link them in their teaching. As stated in the syllabus, "these subjects are offered herein as separate topics in the different disciplines. Teachers are, however, advised to identify related topics in the different disciplines and correlate them in their teaching" (Examinations Council of Lesotho, 1995:69). There is currently no information on the extent to which teachers in Lesotho integrate different disciplines.

The interdisciplinary or integrated teaching approach within the science curricula at Junior Secondary level in Lesotho may be traced to 1973, when the Lesotho Introductory Science Improvement Programme (LISIP) was introduced in schools. However, the use of the concept in subjects other than science has been noted in the 1969 curriculum records of the Lesotho Environmental Studies Programme, and was derived from the British Curriculum (Institute of Education, 1969). It is also noteworthy that as in the case of the present study, the concept was used in the context of environmental education.

LISIP was adapted from the West Indian Science Curriculum Innovation Project, which in turn was based on the Scottish Integrated Science Scheme and the books *Science for the Seventies* (Education Department, 1973). In terms of the curriculum development model in place, then the process of introducing LISIP involved the following strategies: piloting of the new curricula in selected schools (eleven of them); training of science teachers in the pilot schools by overseas experts who had experience with integrated science curricula development; development of teaching materials based on the materials from the West Indies; implementation of the curricula in the pilot schools and supervision by (overseas) experts; further training of teachers and materials development in preparation for the expansion of the teaching of the subject to other schools.

By 1977 all secondary schools in Lesotho offered LISIP. The teaching facilities included (imported) laboratory equipment, teachers' guides and textbooks for pupils which were written in collaboration with Botswana and Swaziland, hence "BOLESWA" textbooks. However, this programme was riddled with problems. There was a general lack of resources, while teachers complained that the curriculum had too much content, and that the science textbooks were too difficult for their students (Lerotholi 1995 pers. comm.).

The implementation of the Five Year Comprehensive Secondary Education Programme in 1984 led to the reform of LISIP into Junior Science (Lerotholi 1995 pers. comm.). In 1985, Junior Science was implemented in schools and by 1989 science textbooks for all three levels of secondary schooling were written. In the process of reform, some science teachers' views on LISIP were sought and taken into account. The reform process led to revision of the content and learning experiences set out in the LISIP syllabus and the revision of LISIP textbooks. However, there has not been a radical change from LISIP to Junior Science in terms of the objectives, content, learning experiences and approaches to teaching and learning (Lerotholi 1995 pers. comm.). The major change has been the shift of emphasis from the philosophy of integration of disciplines to 'dis-integration', reflected in the way the content is organised and presented in the syllabus and pupils' textbooks. The reasons for this shift were that many teachers expressed discomfort or incompetence in respect of teaching disciplines for which they were not trained, and that separate disciplines would allow for more content and compatibility with separate science disciplines at the senior secondary level (Lerotholi 1995 pers. comm.; Talukdar, 1996a: 21-22). However, as already mentioned, science teachers are still advised to integrate disciplines within the present Junior Science curriculum (Examination Council of Lesotho, 1995), but this is no longer binding.

It is noteworthy that the following stipulations in the LISIP syllabus, relating to the philosophy of integration of disciplines (Examination Council of Lesotho, 1983), have been excluded from the subsequent Junior Science syllabus (Examination Council of Lesotho, 1995): "Questions will be set on the assumption that the syllabus is one integrated science and links will therefore be made across the traditional subject boundaries. Questions will not divide the syllabus into biophysical science and the biological science components"

(1983:23). Further, the following objectives have been excluded: "awareness of the inter-relationship of the different disciplines of science" and "awareness of the relationship of science to other aspects of the curriculum" (Examination Council of Lesotho, 1983:24).

Teaching Methods

It is often argued that the lecture method is predominantly used in the teaching of science in Lesotho secondary schools (e.g. Talukdar 1995a, 1995b). Talukdar's (1995a) research findings suggest that time pressure and a lack of facilities for undertaking practical work contribute to excessive use of teacher-centred methods by science teachers. He has argued that the present science textbooks have a strong emphasis on practical activities, and on the students discovering answers from the practical work for themselves, and that this has raised some problems for teachers due to the lack of appropriate materials in schools and the limited time for undertaking practical work (Talukdar, 1995a). He has attributed the paucity of facilities for teaching science effectively in Lesotho to poor management in schools and a lack of adequate funding (Talukdar, 1996b). This situation does not reflect any improvement on conditions that prevailed over a decade ago, in the early 1980s.

In 1983 a team of inspectors comprising members of NCDC and the staff of the inspectorate conducted a formal inspection of 52 secondary schools (Ministry of Education, Sports and Culture, 1983: 12-15). Their observations during the school visits included the following:

- *"The old fashioned lecture method dominated in most lessons observed".*
- *"Most schools were very poorly equipped. Many laboratories lacked very basic facilities such as running water and heating devices. It is this state of affairs which seemed to be the reason why teachers did not do practical work in their laboratories".*
- *"A number of laboratories were used solely to store the school property such as coal, cement, building material etc"*
- *"Very expensive equipment like microscopes were lying on the tables covered in dust"*
- *"Useful equipment was still packed in boxes and not being used".*

A similar observation regarding the teaching materials had been made earlier, in 1982, by the Education Sector Survey Task Force in their report on the conditions of the teaching of secondary school science, wherein they stated: "a major problem in the teaching of science is

lack of science equipment and materials for conducting laboratory investigations and experiments" (Education Sector Survey Task Force, 1982:92). Such conditions may be attributed, in part, to the present curriculum development model for curriculum innovation, which has remained largely the same over decades. The new ideas and rationale about science content, teaching methods, and appropriate materials for teaching the subject, largely emanate from curriculum experts who then work with a few teachers (in pilot schools) to develop curricula before disseminating them to other teachers. Since the rationale for curricula change did not emanate from the majority of teachers who implement the curricula, and since the contexts within which they work are varied and complex, yet seemingly assumed to be homogenous and simple, these curricula are therefore undermined by contextual factors such as time pressure, lack of teaching facilities, expensive teaching resources not being used and laboratories being used as storerooms.

In the following section I discuss some developments in environmental education within formal education in Lesotho.

1.6. ENVIRONMENTAL EDUCATION INITIATIVES IN LESOTHO

1.6.1. Introduction

The following account illustrates that as early as the 1970s some educators in Lesotho had developed a strong concern about the relevance of the education system and its failure to address local environmental problems and concerns. The introduction of the Lesotho Environmental Studies Programme (LESP) became a mode of critique of the established education system, which was perceived by these educators as inadequate in addressing the immediate needs of the Basotho. Similar concerns are still held about the environment and the education system. These are reflected in the education and National Environment Policy documents formulated after the Rio conference.

1.6.2. Some Early Developments: Lesotho Environmental Studies Programme

The concept of environment within formal education in Lesotho may be traced to 1969, when an *ad-hoc* group of educationists met to interpret the meaning of the *Social Studies Programme* in the context of Lesotho. In 1967 some African countries had called for the introduction of Social Studies in the school curriculum. In Lesotho the interpretation of Social Studies resulted in the adoption of a British pattern and hence the *Lesotho Environmental Studies Programme* (LESP). An environmental studies committee was formed in 1971. It included at least one person each from the Ministry of Education, the University, teacher training colleges, secondary schools and primary schools. The initial role of this committee was to "undertake studies of possibilities that the villages offer as 'laboratories'. Local experts such as tin-smiths, potters, basket makers were identified and mechanics" (Institute of Education, 1977). By 1972 a full time staff was seconded by the Ministry of Education to co-ordinate the LESP project. Primary education became the focus of environmental studies initiatives because, as the educators argued, many people ended their formal education after primary school.

In a Seminar on Environmental Studies held in 1975, environmental studies was defined as "an integration of subjects other than skill subjects; that is History, Geography, Current Affairs, Science (nature-study), Hygiene and Philosophy, and Agriculture (gardening)". LESP was perceived as a shift from "subject orientated education to a child centred approach". In addition the areas of worship, village, farm, trade and justice were proposed to form a core of LESP. Thus, LESP was understood to be about more than just the *'biophysical'* aspect of environment. The environment of a child was understood to be broad and integrated, as the following extract illustrates:

> Taking into account the potential of the Lesotho environment including the ability of children and their teachers, activities will be developed around easily available reference points. Provisionally the areas of worship, village (locally), farm, trade and justice will form a core. The area of worship will mainly help the child identify himself, village, farm, trade and justice will familiarise the child with a person's place in the environment. As indicated earlier, skills will be emphasised....(Institute of Education 1975)

The concept of integrated teaching and learning was perceived as an essential dimension of LESP. This teaching approach has also been stressed in more recent literature about environment (Haggis, 1991). Below is an extract from the early records on LESP.

> Right from the beginning when the Lesotho Group met, they decided to follow the British pattern of primary school teaching, hence its title, Lesotho Environmental Studies Programme. This meant, inter alia, that an integrated approach will be pursued; that is, a topic will be selected, children will be encouraged to ask questions, record, experiment where necessary, and generally learn in an atmosphere of enquiry and activity. An example of these topics is being developed at present; 'water and the Basotho'. To a traditional teacher the first would seem scientific and the latter social. Under water questions arise on the uses of water in transport, agriculture, how to measure quantities of water, health, and many other facets. Similar questions arise about the Basotho, how they move about, their means of livelihood, that is, agriculture, health etc. and many others. This group is satisfied that what they are doing agrees with the syllabus....(Institute of Education, 1969)

Within this programme school subjects were viewed critically, and their relevance questioned. The next extract illustrates how the educators involved questioned the relevance of the subject content taught in schools. They associated LESP with the development of local books based on the Basotho's local concerns and problems.

> To the child, primary school is a place where you learn about exotic things such as English, Sesotho Grammar, a Rhodesian boarding a train to work, somebody called minister so and so in Maseru, Photosynthesis; the list is endless. Their local environment is not important...we took this feeling as a challenge. To meet the problem of the learning children in Lesotho, it was felt books based on the environment should be produced...an example is 'Moeketsi the son of Matholoane'. This is basically a story based on some aspects of history. The aim of the originator is to highlight the pride of the Basotho in the face of being challenged by foreigners.... (Institute of Education,1977)

In similar vein, the parochial perception of a teacher was critiqued, and the concept expanded to include *'indigenous experts'* from the child's own environment, the village. Perhaps this emanated from the increasing marginalisation of these previously useful members of the society from the terrain of education, by the advancement of modernity. An associated concern of these educators was the importance that was given to towns and the silence about traditional villages in the curricula, which they believed tacitly promoted migration to urban centres.

> Furthermore in each village there are indigenous experts who could be used. These people are particularly important in revealing academically the potential of villages. Up to now exciting examples in textbooks come from urban areas. In fact, even

> important excursions are to towns. No wonder our school leavers disappear to towns. (Institute of Education, 1975)

To conclude, the foregoing account shows that environmental concerns in the context of the curriculum may be traced to the early 1970s. The proposed environmental studies programme developed a critique of the education system. The core of the critique concerned the failure of the established education system to assist children to survive in their local environment. It seems that these early 'voices' on environmental education remained largely on the periphery of the mainstream of the formal curricular initiatives that have occurred since the 1970s, as there is no evidence of the existence of programmes similar to the one described above within the mainstream of the curricula.

1.6.3. Recent Developments

More recently there has been a reiteration that education should play a greater role in addressing the problems of environmental degradation and the absence of sustainable development in Lesotho. The education system has responded to this challenge, perhaps more rigorously than previously. Recent developments have included the following.

In 1992 a Basic Education Clarification Seminar (National Curriculum Development Centre, 1994) was held to review the Primary School curricula. The importance of environmental issues was stressed and it was strongly recommended that environmental education and development issues be incorporated into the basic education curriculum. Section 1.3 of a report on the Clarification of National Goals for Basic Education Conference states that the Primary School curriculum should aim to: "Help learners understand, appreciate and conserve their local and national environment as well as to be aware of environmental interactions" (National Curriculum Development Centre, 1994:13).

In 1994 a National Action Plan (Lesotho, 1994) to implement Agenda 21, following the Rio Summit Conference in 1992, was prepared. In this plan, the inclusion of Environmental Education at all levels of education was listed as a priority area for attention. In the following year, 1995, a National Seminar on Clarification of Policy on Secondary Education and

Localisation of Ordinary Level (Ministry of Education, 1995) was held. The central objective of this seminar was to explore strategies of localising the Senior Secondary curricula, currently developed and administered in Britain, as a result of the colonial ties between the two countries. A strong recommendation was also made for secondary education to include Environment and Development issues. Section 3.3.2 of the report on this seminar states:

> Recognising the importance of the environment and the dangers attached to environmental degradation, the effects of these to human population, animals and plants, the seminar recommended that: Secondary education must instil and promote awareness, knowledge and understanding on environment, its importance to mankind, interaction with environment, care, protection and conservation of the environment. (Ministry of Education, 1995:22)

More recently in 1997, a comprehensive National Environment Policy was developed. In addition, a special unit has also been established under the Office of the Prime Minister, the National Environment Secretariat (NES), to monitor and co-ordinate all national initiatives focused on the environment. Section 4.26 of the National Environmental Policy for Lesotho (1997) provides the following guiding principles for an Environmental Education and Public Awareness programme:

> Integration of Environmental dimensions into formal educational programmes at all levels raises environmental awareness and concern across a wide spectrum of society. (National Environment Secretariat, 1997:31)

In terms of these recommendations and the current environmental problems in Lesotho, it seems appropriate to clarify the meaning of environmental literacy and develop teaching strategies for environmental literacy within Junior Science.

Following the 1995 Seminar described above, an overall review of the Secondary School curriculum was launched, beginning in 1995. The piloting of the new curriculum for the first year of Secondary School (Form 1) occurred in 1998 and will be followed by implementation in 1999. A similar phased implementation will be employed for the other four levels (viz Forms 2,3,4 and 5). This process is therefore expected to be completed by the end of school year 2003. In this regard specific attention is being given to the following five subject areas: Agriculture; Health and Physical Education; Home Economics; Sciences (Physical and Biological); Social Sciences (Geography, Development Studies).

As a member of the United Nations community Lesotho is a signatory to international conventions, including Agenda 21 (UNCED, 1992). The recent environmental education rhetoric in the country may be seen as a response to an UNCED resolution that education is critical for promoting sustainable development and addressing environment and development issues. It is hoped that the clarification of the meaning of environmental literacy in the context of secondary school science will contribute towards making science teaching and learning more responsive to local environmental issues and problems. The meaning of environmental literacy from the literature is discussed in the next section.

1.7. ENVIRONMENTAL LITERACY AND SCIENCE EDUCATION

1.7.1. Introduction

Scientific literacy and environmental literacy are important concepts in current debates about science curricula reform. Whilst some educators see the meaning of scientific literacy and environmental literacy as overlapping (e.g. Papadimitriou, 1996; Roth, 1992) the concepts have also been presented as distinct (Disinger and Roth, 1992; World Conference on Education for All in Haggis, 1991). For example, Disinger and Roth argue that: "scientific literacy appears to be built on a mechanistic paradigm, whereas environmental literacy is based on an ecological paradigm"; that is, environmental literacy concerns transcendence of the boundaries of science education to study "the interrelationships between natural and social systems; the unity of mankind with nature; technology and the making of choices; and development of learning throughout the human life cycle" (1992:167). Perhaps what is important about the emergence of these concepts in science education curricula is that they represent a growing concern among many science educators that science teaching is not adequately responding to 'everyday life' problems and environmental issues encountered by learners (Lijnse, Eijkelhof, Klaassen and Scholte, 1990; Papadimitriou, 1996; Robottom, 1991) and that science is rather contributing to environmental problems and the destruction of "indigenous technologies" (Prakash and Richardson, 1999).

Below I discuss ways in which the concept of environmental literacy has been used in the literature and explore its relevance in the context of science education, based on the following

concepts: environmental literacy, associated views of knowledge, teaching approaches, and sustainable development.

1.7.2. Environmental Literacy

According to the literature the concept of environmental literacy was coined by Charles Roth in 1968, in the United States (Disinger and Roth, 1992). In 1992, Disinger and Roth expressed concern about the lack of a precise definition of the meaning of environmental literacy and attempted to provide some generalising 'attributes of the environmentally literate'. They associated environmental literacy with the ability to take "action"; describing action as a distinguishing characteristic of the concept since it was coined. They further defined environmental literacy in terms of three levels. The highest level, the 'operational' level, draws upon 'four strands': affects, behaviour, knowledge and skills. This perspective on environmental literacy seems to be informed by behaviourist theories of learning which dominated the education system in the United States in the 1960's. From this perspective a concise definition of environmental literacy was essential for guiding the formulation of clear objectives of learning, to determine people's behaviour before the educational process occurs. Roth himself writes:

> With such a clarified definition and goals in hand, we will all be better able to evaluate the potential of proposed programs to achieve the goals and to determine the degree to which existing programs are succeeding. (1992:8).

This attempt, however, tends to simplify complex social interactions by rationalising them in abstraction and predetermining them from a decontextualised position. This rationalist orientation typically seeks to essentialise and universalise knowledge so that it is applicable to all humanity. Similar perceptions of the meaning of environmental literacy appear elsewhere in the literature (e.g. Buethe and Smallwood, 1987; Haggis, 1991). For example, Haggis reported that at the World Conference on Education for All environmental literacy was defined as:

> the elementary knowledge, skills, and motivation for people to participate in the solution, and anticipation, of environmental problems. And so make their own contribution to sustainable development.... (Haggis,1991:53).

A post-modern perspective on science and environmental education brings to question an 'objective' pre-determined meaning of environmental literacy, and embraces a contextualised, reflective, participatory process through which the teachers' and learners' "multiple subjectivities (including their own and those of people who call themselves scientists) interact in the social construction of consensual (intersubjective) understanding of 'reality'" (Gough:1993, 621). Employment of participatory action research (see Section 1.3) may enable a reflexive co-construction of the concept. Through engagement within the recurring cycles of action and reflection, shifting understandings of environmental literacy may emerge: action research lays a basis for reflection-in-action (see Shon, 1987), through which the participants develop, monitor, and evaluate their own practice and understanding of environmental literacy reflexively. From this point of view environmental literacy is perceived as one perspective from a particular point in the web of reality, held as long as it can transform the society to live in a sustainable way.

1.7.3. Associated View of Knowledge

The understanding of scientific knowledge is often seen as essential for environmental literacy: Buethe and Smallwood (1987) evaluated teachers' levels of environmental literacy by undertaking a survey to test their recognition and conceptual understanding of scientific (energy) concepts; the World Conference on Education for All stressed the importance of science education in providing for the management of the biosphere and the technosphere. From this perspective environmental education involves the teaching of fundamental scientific concepts in order to 'raise' environmental literacy among all citizens. The tendency to stress the value of science (or pre-determined science concepts) over other forms of knowledge may be seen as reductionist and positivist, and informed by modernist assumptions of understanding environment 'objectively' (see Gough, 1993, LittleDyke, 1996 and Robottom, 1991 for a critique of the dominant role of science in environmental education). Positioning science at the centre of environmental education results in a loss of the "political edge" of environmental issues, and reduces environmental problems to "technical problems susceptible to technical solutions of the kind that science is competent in supplying" (Robottom, 1991:20). Viewing science education and environmental education as story-telling practices, Gough (1993) draws on Harding (1986) to argue that the privileging

of science in environmental education and science education is a longing for 'one true story', which has given rise to 'narrative strategies' that seek to equate 'scientific facts' with 'reality'. He writes

> There can be little doubt that the narrative strategies of modern science have helped to raise our awareness of the nature and extent of numerous environmental problems. But these problems may themselves have resulted from modern science's construction of stories in which the story-maker or –teller is 'detached' from the earth.... (1993:610).

Our 'attachment' with the earth gives rise to multiple stories. This illustrates that knowledge and environmental issues are "socially constructed and subject to reconstruction through historical and social processes" (Greenall Gough and Robottom, 1993: 310). Through the lens of socially critical theory (Nielsen, 1992) environmental issues are manifestations of repressive social practices that are generally perceived as legitimate. Most environmental problems are, as Robottom and Hart (1991: 10) put it,

> political (rather than natural) in character: the majority of environmental issues involve 'quality of life' or 'need concerns', and are settled through the processes of negotiation, manoeuvring, persuasion, the offer of inducements, the exertion of influence....

Others may see issues differently. The point is that environmental problems are not objectively existing physical phenomena, but rather social constructions whose meaning and significance depend on the context and changeable human interests.

1.7.4. Associated Teaching Approaches

Typical teaching approaches for fostering environmental literacy discussed in the literature are constructed around the following concepts: 'interdisciplinary' (*Connect*, 1999; Haggis, 1991; Prakash and Richardson, 1999; Roth, 1996), 'action-oriented' (Disinger and Roth, 1992; Haggis, 1991), 'problem-solving' (Haggis, 1991; Prakash and Richardson, 1999), 'holistic' (Haggis, 1991), 'crossing typical boundaries of science education' (Disinger and Roth, 1992), 'transdisciplinary' (Chen, 1997) and 'integrated' (Papadimitriou, 1996; Prakash and Richardson, 1999). Papadimitriou, for example, reports a case study in which an 'integrated approach' was employed to 'infuse' 'drinking water' into a science (chemistry) course, in order to develop the students' 'environmental awareness'. In Lesotho, secondary

school curriculum developers have for many years attempted to promote an 'interdisciplinary' worldview among students through the teaching of secondary school science (see Section 1.5.2).

The popularity of constructivist theories in science education discourse has brought to question the traditional teaching methods in which the teacher's role is to impart knowledge to learners, who were assumed to be 'empty-vessels' (see Section 1.3). This development in science education has informed a new role for a science teacher who creates opportunity for learners through interactive student-centred activities. This trend is also notable in environmental education literature (e.g. Aleixandre and Gayoso, 1996; ETE Instructor Notes, 1998; Lijnse et.al., 1990).

From a critical perspective (e.g. McTaggart, 1997:30; Robottom, 1991), many of the emerging teaching approaches in science education in response to the environmental crisis may be described as 'technical activities' which may not significantly transform the broader 'practice' of education to allow for more sustainable living ways. A search for a socially transformative teaching of science has drawn on critical perspectives informed by post-modernism discourse (e.g. see Gough, 1993; Littledyke, 1996). Gough, for example, draws on the "stories" of Australian Aborigines and Native Americans to explore a post-modern approach to teaching science and environmental education. He argues that whilst the 'narrative structures' (or epistemological frameworks) of these stories may be incompatible with science, they clarify that knowledge is socially constructed; they alert us to "the failure (of modern science) to accept that the creation of meaning in the world is a human and communal responsibility" (1993:612). Examining ways in which these narratives were constructed, he argues, may inspire a reconstruction of science narratives, by using myths and metaphors, that are more sensitive to nature.

1.7.5. An Associated Perspective on Sustainable Development and Local Knowledge

In Lesotho the school curricula and teacher education programmes are silent about Basotho's local knowledge. This is a direct result of the impact of the British school curriculum and the missionaries' teachings. Gay, Gill and Hall (1995:6) explain:

> As part of the wider European missionary effort, the French Protestant missionaries believed that Christianity and the fruits of Western civilisation went hand-in-hand. Only in this way could the 'heathen and uncivilised' nations be uplifted to a higher standard. Teaching Basotho not to trust the ancestral spirits or local doctors; and the initiation rites, marriage by cattle and a host of other practices were against the law of God, the missionaries were quiet but insistent revolutionaries.

In their limited and limiting view of what counts as acceptable knowledge, the missionaries were not unique. Modern-day concepts such as sustainable development are often informed by similar authoritarian perspectives. From the perspective of liberation theology, however, the science educators would realise

> that society as well as reality is often seen in different ways by different people. They recognise that the dominant understanding of reality gives expression to the views of the dominant class and that this is not the only way of viewing reality. It is also not an objective (value-free) understanding of reality (Villa-vicentio, 1994:189).

Based on this view the concept 'sustainable development' has to be examined from perspectives other than those informed by externally imposed or dominant knowledge systems. It will embrace life support systems that evolve within and are adaptable to people's own socio-historical contexts. The clarification of sustainable development would therefore not attempt to "to speak to all humanity across all time and cultural space, but to a particular group determinately situated at a reasonably specific time" (Nielsen, 1992:278).

Local knowledge is held by local communities in different languages in diverse epistemological frameworks (Agrawal, 1995; Shive, Jafri, Bedi, Holla-Bhar, 1997:58). An example would be biodiversity related knowledge for healing and farming. In recognising that environmental literacy does not necessarily mean reading and writing the World Conference on Education for All have stressed the value of "traditional wisdom about environmental protection and conservation" contributed by the 'illiterate' (Haggis, 1991: 45). The United Nations Commisions on Sustainable Development that monitors the follow-up of the decisions of the 1992 UNCED recorded in Agenda 21, also observed the value of 'traditional knowledge' in promoting sustainable development (*Connect*, 1996).

An emphasis on local knowledge as dimension of environmental literacy does not constitute a reification of this knowledge or an argument that it is always appropriate in a particular form.

One needs to recognise that "to ground knowledge in social practices is to ground it in contexts shot through with relations of power, which themselves may be highly conflicting" (Blake, 1996:62) (see Section 1.3). This suggests that local knowledge forms, too, are not neutral and may be riddled with competing political interests (e.g. see Agrawal, 1995). Drawing on school-based case studies in Australia Greenall Gough and Robottom have referred to a dimension of this knowledge as "working knowledge", describing it as "transitional rather than transmissional, generative/emergent rather than preordinate, opportunistic rather than systematic, and idiosyncratic rather than generalisable" (1993:309).

This view of knowledge brings to question a perspective that knowledge is universally relevant, which underpins the modern practices of developing 'universal' course content and textbooks as the primary sources of knowledge (Greenall Gough and Robottom, 1993). In science education this latter perspective has resulted in textbooks that are concerned with "...the kinds of subject-matter that is amenable to being treated as an 'object of mastery', such as speculative definition and relatively secure and stable propositions and 'law'..." (Gough, 1993:617). This context has given rise to initiatives to integrate scientific with indigenous knowledge (e.g. Agrawal, 1995; EEASA, 1999; Yakubu, 1994). This development paves new ground for science educators to explore locally responsive ways of teaching science.

1.7.6. Conclusion

I have argued that the rationale for and the meaning of the concept of environmental literacy were originally informed by behaviourist assumptions. The reviewed definitions of the concept reflect an attempt to provide an abstracted 'universal' meaning. This study will explore a contextual meaning of the concept. New developments in environmental and science education, informed by critical theories and the foregrounding of indigenous knowledge, provide useful resources for reconstructing the meaning of environmental literacy, in the context of science teaching. It is expected that the employment of participatory action research in this study, discussed in Chapter 2, will evolve the meaning of the concept of environmental literacy through a reflexive process of clarification, and develop the

participants' insights about associated appropriate teaching methods, in the context of science education.

1.8. CONCLUSION

In this chapter I have attempted to describe the context of the present study by discussing the historical development and relevant aspects of the present status of the education system, curriculum development, the science curricula and environmental education initiatives in Lesotho. I have argued that the education system in Lesotho is part of its colonial heritage and can be criticised for being inappropriate for Lesotho. It can be argued that the education system is in fact 'de-skilling' or 'de-developing' the Basotho rather than developing them to better survive in their environment. I further argued that problems concerning the teaching and learning of science may be associated with the present curriculum development model in Lesotho, which excludes the majority of teachers and students from the process of curriculum development and pays little attention to the complex and varied contexts of teaching.

Referring to literature on Lesotho Environmental Studies Programme and to recent environmental education policy documents I argued that environmental education initiatives and calls for the change of curricula to meet the needs of the Basotho may be traced to the 1970s. The concern of the educators who initiated LESP in the 1970s was that the curricula be transformed through the *integrated approach* to knowledge, and by drawing on *indigenous experts* to include local forms of knowledge within the curriculum.

More recently, in the 1990s, the general trend of environmental education initiatives within formal education in Lesotho seems to be the addition of topics within separate subjects. According to my experience at curriculum development meetings and workshops for primary and secondary schools, environmental education is interpreted as the teaching of ecology topics and the study of prevailing environmental issues. Another approach which presently features only at a theoretical level is the notion of environmental education as a new and separate subject to be added to the curricula. These approaches reflect the modernist tendency to favour cumulative or incremental rather than transformative changes in the curriculum (Doll, 1989). Contrarily, a post-modern approach to environmental education within school curricula would

imply a change in the approach to teaching the subject (i.e. teaching the existing subjects with/from an environmental perspective), rather than the addition of more content. For example, educators may engage in a dialogue with those affected by environmental problems (including the students in the classroom) in order to reach a hitherto unexplored terrain of understandings of our environment. Such a dialogue may emerge from participatory action research processes, within which students and teachers may critically investigate and reflect on the environment as they engage in a sharing relationship.

This project is concerned with science curriculum development. The research method employed in the present study, discussed in the next chapter, could be viewed as curriculum development process which presents an alternative to the established curriculum development model, in that through this method we took the initiative, as teachers of science, to address our own concerns about the environments and the teaching of science at school level, rather than wait for NCDC to initiate change. In the following chapters I will illustrate how our employment of action research became *"a contextualised social process"* (see Lotz and Olivier, 1998) through which we could respond to our needs and concerns.

CHAPTER 2
RESEARCH PROCESS AND METHODOLOGY

2.1. INTRODUCTION

Action research regards as important the experiences, understandings and values of participants in a project. Therefore this report will provide critical accounts of the perspectives of all four participants in the research project (the research team). I have used pseudonyms to distinguish the voices of other members of the team (Limpho, Lebu and Map). My use of 'I', 'me' ,'my' or my actual name to refer to myself in the presentation is an attempt to make my own voice 'audible' and to acknowledge the subjective nature of my views. Whilst my own voice may appear to be the one that largely critiques, questions and explores possible interpretations of the various accounts of members of the research team, this was in many cases achieved through my conversation with others. This style of presentation contrasts with that of the 'positivist' tradition (see, e.g., Winter 1989:27-37) within which the author strives for objectivity by attempting to detach or distance self from the research issues, and hence refers to self as 'the researcher' or as 'one'.

Action research was chosen as the most appropriate method for this study because it enabled me to work collaboratively with the participating teachers as a team to improve practice (see, e.g., Walker, 1991; Wals, 1994). The small scale of the study allowed for the in-depth exploration of complex issues and situations (such as curriculum development) associated with multiple-imbedded case studies (Yin, 1984).

In this chapter I discuss the origins of the project, the formation of the research team and their introduction to the project and action research. I then discuss the team members' reflections on action research theory prior to trying out the method in the classroom. This will be followed by accounts of the team's reflections on action research after they had employed the method in the classroom, with particular emphasis on the four moments of action research, the number of cycles completed and our attempt to extend the research process. There will also be reflection on the process of analysis.

2.2. GETTING STARTED

I began this research by reading a wide range of literature on action research. This literature included accounts of participatory action research in Lesotho by Stuart (1987); of action research projects by Walker (1991) and Clarke (1992); and writings by Winter (1989), Oja and Smulyan (1989) and McNiff (1993). My focus on reading led to more and more reading and I developed a reluctance towards, and even some fear of getting started with fieldwork. In retrospect, it appears that this probably emanated from an assumption that the text I was reading would map out for me the correct route to follow during the study. I did not realise then that in action research, "paths are made by walking" (Stuart, Morojele and Lefoka, 1997). At that time, however, a number of factors came into play that motivated me to get started. These were in particular a dream that I had, my personal encounter with, Stuart (pers. comm., 1995), Malone's article (1994), as well as support from my supervisor.

Early in 1995 I had a night dream. At the time I had this dream, I was preoccupied with a seemingly endless process of reading in my belief that it was essential for the research project. I was also somewhat lacking in confidence to get started with the research project:

> *I was on top of a very tall mountain with some people, holding a big book in my hand. This book was my power and my strength and I could not part with it. Suddenly the book fell out of my hands and I helplessly watched it tumble down the mountain slope. I saw it get smaller and smaller, until it became a tiny shiny spot at the foot of the mountain. Just when I thought I had my eyes fixed on it, I saw many other similar spots; they were rooftops of houses scattered in the valley. I hastily started to find my way down the mountain and ran at full speed to retrieve the book. This turned into a long journey through a dense and scary forest; when I got to scary places I ran faster. As I took a turn at the end of a slightly steep path, I suddenly met with an old African man sitting down by the side of the path. He was black and had grey hair and beard. He appeared to be filled with wisdom and even to know everything about me. He used some English words when speaking to me. As we were talking he assured me that I was not lost, and that I had not lost any treasure: 'Stop running!' he said, 'Don't you know that your journey is the knowledge and the wisdom you are looking for'.*

I had a conviction that the dream was 'speaking' to my situation. My deeper analysis of the dream led me to conclude that the dream was a revelation about the 'book-based' dominant order of knowledge production and acquisition. The old man gave me the strength to release myself from the grip of authority I had believed was invested in the literature and get started

with the project. His words of wisdom helped me to 'travel' my 'research journey' more slowly and in a more relaxed way, and more conscious of my surroundings. I took seriously the idea of writing notes on my daily feelings and experiences, including my dreams. My encounter with Janet Stuart (pers. comm., 1995) and with the poem by Karen Malone (1994) in the same year corroborated my dream and developed in me a conviction to stop reading and get on with research. In my discussion with Stuart (pers. comm., 1995) she convinced me that I had read enough about action research and that it was time to get started. A poem by Malone based on her own participatory action research persuaded me that research was like a journey and that I had to get started, with the courage explore the unknown.

> If I had seen the cracks I may have fallen in
> If I had seen your tears I may not have cried
> If I had strained to hear I may have missed the silence
> If I had tried to enter I may have never been invited
> If I had sought the true story I may have never changed
> (Malone, 1994:33)

2.3. THE ESTABLISHMENT OF THE RESEARCH TEAM

I first introduced the research to teachers in August 1995. I approached five teachers of Junior Science in four different schools to share the concept of the research project with them, and invited them to participate in the project. These were schools that I could easily reach and thus be in a position to communicate with teachers regularly once the teachers were involved in the project. At my first meeting with each of the teachers, at their respective schools, I emphasised the need to explore more effective ways of teaching science and to direct the teaching of science to the environment, and I explained the idea of using 'participatory action research' to achieve this.

I mentioned to each of them the concept of teachers as researchers, and explained that there would be opportunity for them to develop skills for undertaking research, action research in particular, if they participated in the project. I stressed to them the salient differences between action research and the research that I referred to as 'traditional'. I mentioned the long and undesirable tradition of researchers 'using' teachers as mere 'sources of data' rather than working with them as participating partners in research projects. I briefly outlined the action research moments (see section 2.5.1) and how the teacher might participate at each moment.

I also explained that the project was a joint venture with an Environmental Centre (Maseru) and that it was also part of my studies at Rhodes University. I described my role as a 'facilitator' of the research who would: make relevant literature available to the teachers; read and summarise some articles which were relevant for the research team and distribute the information to the participating teachers and provide the teachers with literature on teaching and learning theories, relevant teaching resources and the necessary advice. I also introduced the concept of 'research team' as a label for the group of people participating in the project. The five teachers that I met all said they were interested in the project (Fieldnotes, August 1995). I later sent a letter (Fieldnotes, October, 1995) to the five teachers, inviting them to attend the first planning workshop.

I wrote the letter in collaboration with Masianokeng Environmental Centre (MEC). A letter written by Stuart (1987) for a similar purpose helped me formulate my own (see Appendix 1). In the letter I told the teachers: "You should bear in mind, however, that our main focus is to try to formulate our own generalisations that are based on reflection and analysis of our own problems and practice in teaching Junior Science. Our role (i.e., of the Environmental Centre and myself) is to facilitate your doing this, not to impose any pre-conceived ideas of our own". Enclosed in this letter was a hand-out by Wood (1988) explaining the process of action research, also recommended by Stuart for its simple but comprehensive explanation (pers. comm., 1995). In retrospect, the theory we (especially, I) read from the literature during the entire research period, guided rather than directed my role. Walker (1991: 50, 90) has also stressed this approach in her study. In further preparation for the workshop I interviewed the five teachers on matters relating to the Junior Science curriculum and on the concept of environment (Fieldnotes, November, 1995). I used some of the information from the interviews to stimulate discussion on the environment and on teaching strategies at the workshop (see chapters 3 and 5). Only three of the interviewed teachers attended the planning workshop and subsequently became members of the research team.

The formation of the research team was an important aspect of the participatory action research adopted in the study. The research team could work collaboratively to improve practice (see, e.g., Walker, 1991; Wals, 1994) by developing and monitoring, on an ongoing

basis, such changes as might occur within their teaching strategies and their understandings of environmental literacy. To remind the team members that the project was a collective effort I wrote the proverb *Lets'oe le beta poho* on the cover page of all our workshop reports.

The people and institutions that the team associated with in the context of the research process included the following: an environmental centre; other secondary school teachers, critical friends at EEASA conferences and local workshops; resource persons from an Institute of Education; Department of Energy - Ministry of Natural Resources; a local farmer and philosopher; National Curriculum Development Centre; Rhodes University (supervision of the research project). For the purpose of this study the phrase 'research team' is used to refer to the three science teachers who participated in the research project, referred to by pseudonyms, as Lebu, Limpho and Map, and myself. Where the resource persons have been quoted verbatim they have been acknowledged by their actual names, with their permission.

Table 2.1 below shows the profile of the research team during their participation in the research in 1996-7:

Table 2.1: Profile of Members of the Research team

Research team member	Case-study class level	Students per class	Workload per week*	Subjects taught	Years of teaching	Studies (part-time)	Training
Limpho	Form C	48	30periods	Math & Science	6yrs**	yes (Distance learning psychology & university entry exam)	College (local)
Map	Form A	48	30periods	Science	20yrs	none (intends to)	College (local)
Lebu	Form C	30	33periods	Chemistry, Biology, Science^	8yrs	none	Univer. (local)
Tsepo	na	na	na	na	4 years	yes (through the present research project)	University (local& External)

Key

* The workload of thirty periods per week is the normal workload recommended by the Ministry of Education. However, in my interview with Limpho, she explained that these periods are "too much for us" (fieldnotes, 17-05-96).

** Limpho taught for two of these years as an unqualified teacher, before she attended a teacher training college.

^ Science here refers to primary school science. Lebu also taught standard 7 in his school.

na not applicable.

Table 2.2 gives some background information about the institutions within which individual research team members were based. Limpho and Map were based in Church-owned schools in Maseru city and Lebu was teaching at an International School, located within the premises of the university, about 40km from Maseru city.

Table 2.2: Information About the Institutions Associated with the Study

Research team member	Status	English Language of students as described by the teacher	Management	Location	Involvement of the Head teacher/director of the institution
Limpho	Secondary School	'problem'	Government	Urban	Minimal
Lebu	Secondary School	'not a problem'	University	Peri-urban (University Compound)	Minimal
Map	Secondary School	'problem'	Church	Urban	Minimal
MEC	Environmental Centre	na	Church/School/ Irish Govern (sponsor).	Urban	Direct
Tsepo	Principal Researcher	na	na	Urban	na

2.4. INTRODUCING ACTION RESEARCH TO THE RESEARCH TEAM

As I have said, action research was first mentioned during my interview with the teachers in August 1995. The method was subsequently introduced in detail to the participating teachers at a planning workshop in February 1996, and further discussed at the meetings of the research team in August 1996 and January 1997. Researchers with experience in action research from the National University of Lesotho (Institute of Education) were invited to share their perspectives on this method, and were present at three of the meetings of the research team. A team of three action researchers from the Institute of Education were present at the first workshop and presented a session titled *'Using Action-Research to improve the teaching of Junior Science'*. This presentation was participatory and stimulated debate and discussion.

In the following account I present some of the salient issues concerning action research that were debated and discussed at our meetings. I will then discuss the views of the team members on action research, shortly after the first workshop and will conclude the section by

outlining the goals of the research project which I shared with the research team at this workshop.

2.4.1. Sharing Ideas about Action Research

In our first workshop the roots of action research were traced to the work of Kurt Lewin (1946) and others in the Western world (United States of America) which was undertaken about 50 years ago as a problem-solving method with the potential to emancipate deprived communities from their social problems (see Stuart, Morojele and Lefoka 1997; Winter, 1989; McKernan, 1991). In the educational context the application of action research was traced to Britain in the 1960s where the method was employed by educators such as Elliott (1981) and Hopkins (1985). The first application of this method in Lesotho was dated to the early 1980s when a British educator, Janet Stuart, then lecturing in the University of Lesotho, employed the method in 1984-5 within the teaching of Development Studies. Sharing her experience, a resource person from the Institute of Education explained:

> In Lesotho it was started by a certain Janet Stuart who I think some of us know, who was a Development Studies lecturer at the University. She even used this concept with the Development Studies teachers....She introduced it to some of her colleagues at the university and then it was taken up by the Institute of Education and we went on using it in the Primary schools, we introduced it to some of our colleagues at the Faculty of Education and we introduced the concept to the National Teacher Training College. We have even gone as far as introducing the concept to the Lesotho Non-Governmental Organisations.... (Pulane Lefoka, February 1996)

It can be argued that the trickling down of the idea of action research from Britain to Lesotho reflects the continuing dependence of Lesotho on Britain for curriculum development and innovations, which is at least in part attributable to the history of colonial rule.

The notion of teachers participating **in** action research was stressed in the first workshop, as opposed to an external person or an 'expert' undertaking research **on** teachers. From this perspective the view that curriculum research was a specialist occupation was challenged.

> One wishes to improve practice or personal understanding. Inquiry is carried out by the practitioners themselves, in other words it's the classroom teacher first and not somebody from the National Curriculum Development Centre or the Ministry of Education or the University. It's the practitioners themselves who clearly define the problem...Exactly what kind of problem do we have at school level: Are we

> concerned about students littering around the school campus? And if that is the problem can it be solved by a University lecturer who comes and studies about the environment? Not necessarily.... (Pulane Lefoka, February 1996)

In Britain a challenge to the conventional view that curriculum research was a 'specialist occupation' occurred in the 1970s with the emergence of the 'teacher-researcher movement' pioneered by Lawrence Stenhouse (see McKernan, 1991).

The basic model of the process of action research, with its various moments (i.e. problems identification; making a plan of action to solve the identified problems; implementation and monitoring of the action) within a cycle were also discussed using a number of examples at the first workshop. We agreed that action research starts with a general idea/problem/concern, which may be followed by the formulation of a hypothesis which helps the researcher to focus on the identified problem. In addition we discussed the concept of 'collaborative action research' as opposed to action research undertaken by an individual. We found the former appropriate for the present project. We also discussed the importance of colleagues observing each others' lessons, of testing the hypotheses by drawing on various sources of data or triangulation, and of researchers learning to listen to one another in a constructive way. After the first workshop we tried out the method in our teaching of science. However, I found that many of these theoretical features and aspects of action research discussed at the workshop were not that salient and distinct when we employed the method in the contexts of the classroom. We employed the method flexibly, responding to contextual factors such as limited time and workload.

In the next section I discuss the views of the three members of the research team on action research following the workshop. This section needs to be understood in the light of the established curriculum development model in Lesotho (see section 1.5.1), as it suggests a new possibility for curriculum development within this context.

2.4.2. The Research Team's Early Perceptions on Action Research

Shortly after the first planning workshop I evaluated the workshop by interviewing the team members. During the interview I also solicited their views on action research by asking them

a question: "How did you feel about the activity on action research?". In this section I discuss their reflections on the activity, and show how in some cases their pre-knowledge interacted with the new action research theory.

Lebu argued that action research sounded similar to the 'problem-solving method' he learned about at in-service workshops for teachers.

> Interview (February 1996)
> Tsepo: What have you found most useful (at the first planning workshop)?
> Lebu: We could say the information from the people, who were acting as resource persons, especially people giving us information on **action research.** Um, even though somehow I found the information almost **similar** to what the, we have been going through as a **problem solving method** and is coming up with problem, and its coming up with ideas - how to solve problems and so on. So it was very similar to what we have already been doing in some of the workshops which we attended. **So there was nothing new except now the word or the thing was called action research. So I, that's where I think I have to try to find out also what is the difference there**. (Emphasis added.)

Lebu's account suggests that he was already familiar with the cyclical process of problem solving. From this viewpoint, he easily *accommodated* the theory of action research, as it related to his pre-knowledge (See Bodner, 1986). This pre-knowledge also led him to assume that he knew almost everything about action research. Further, during this interview, Lebu expressed confusion over the actual meaning of research.

> Interview (February, 1996)
> When I was first told about action research, I thought it was somehow different. That's why I even asked [at the planning meeting] that I thought when people talk of research, they are referring to something where you have to go with questionnaires, do this, write the report, which is, what I think research is all about...so the action research I found it as Problem Solving.

In addition he disliked the idea of keeping a diary when undertaking action research or the problem solving method. Rather he preferred an 'informal' sharing of views with colleagues to a written record.

> Interview (February, 1996)
> ...these methods, action research, problems solving methods, **some people would like to write down that**, today you done these, or you have had these experiences and so on. But **that's making me not relaxed in my work**, when you have to write oh well,

> I felt down today because this happened. But, **I can always think about it without writing it down**. I can say this happened in my class and this makes me feel sad or depressed or excited, those experiences. And now **they say** write them down. That's what makes it research. But now I don't feel relaxed. **I don't feel relaxed now when I have to go to class and bearing in mind, I have to write down something on these**. But doing the work **naturally** you think of what happened, you think of experiences, you think of our problems and how to solve them. **You can discuss with the colleague informally** and you get over the problem like that, not necessarily to write them, record and now you report. (Emphasis added).

At this early stage of the project Lebu associated research with a lot of writing which he said made him uncomfortable. Three reasons could be advanced for Lebu's preference for an informal and verbal sharing of experiences:

a) recording classroom experiences involves a lot of work;

b) it was not part of Lebu's daily routine or practice to write his daily experiences in a diary;

c) the idea of writing a report was imposed upon him by me and perhaps not to his own immediate and apparent advantage. This may be noted in his statement *"they say write them (experiences) down...but now I don't feel relaxed"*.

Lebu appears to have found the suggested approach to the research project burdensome, as research team members were expected to prepare written reports on their findings, so that they could share them with other teachers at workshops. As a participatory project the research required members to collect data, read, write, analyse data and prepare a report. This could explain Lebu's decreased participation in the research later after his experience with the first cycle.

Unlike Lebu, Map and Limpho did not indicate that they had any experience or knowledge similar to action research. In my interview with her, Map suggested that she was ready to undertake action research. She sounded keen to try out the method in the classroom and seemed content with the action research theory shared at the workshop.

Contrary to Lebu, who thought that he already knew about action research, Map seemed eager to learn more about the research process in practice.

> Interview (February, 1996)
> Tsepo: How did you feel about the activity on action research?

Map: I feel very interested and I would like, I would like to see that done actually, um, I would like to see whoever is undertaking that involving us teachers, to know how to go about it.
Tsepo: Do you think you are ready to undertake action research?
Map: Yes ntate, I want to know how to go about it, I feel I like it very much.

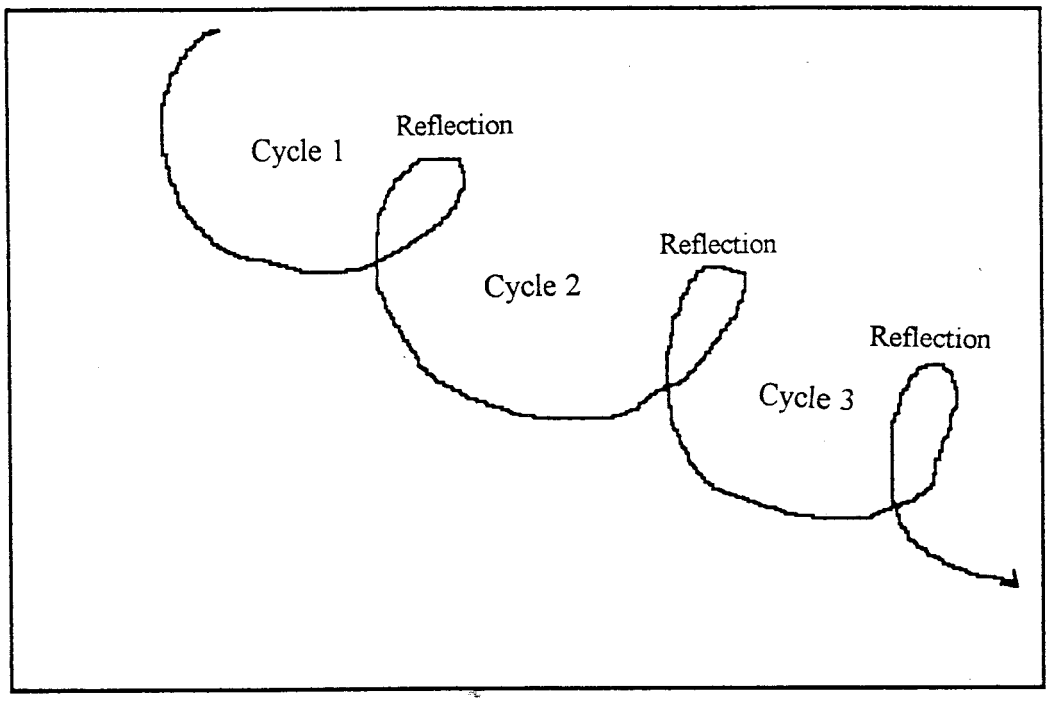
Limpho thought that action research was the most useful thing she had learned about at the first workshop. Whilst she struggled a bit recalling the vocabulary used at the workshop during the interview, she too seemed to find the theory of action research discussed at the workshop sensible. The following extract illustrates this:

Interview (February, 1996)
Tsepo: What have you found most useful?
Limpho:The, what do you call it, or is it the method of research. Know what you have to do, like find what did you call it, is it the action research?
Tsepo: Action research, yes.
Limpho:Knowing things like finding the general idea, what problem is, how can you solve it. You know how to make hypothesis, planning, you know those stages of problem solving, I liked it.

The teachers' introduction to action research theory at the workshop might have influenced their orientations to the research in the following ways: Lebu seemed to have regarded the project as involving engagement in a familiar activity; Map wanted to learn more about action research in practice; while Limpho's perspective that action research theory was the most useful thing she learned at the workshop suggests that she might have been looking forward to trying out the method in the classroom.

My own theoretical understanding of action research at that time, which was also reflected in the research proposal, was that action research proceeded through recurring cycles, each 'broad' cycle consisting of all the four moments: planning, acting, observation and reflection (e.g. McNiff, 1993; Oja and Simulyan, 1989; Winter, 1989). Drawing on literature describing the experiences of other action researchers (e.g. Ashwell, 1992; Stuart, 1987), I proposed that the study should proceed through at least three cycles, each involving the four moments mentioned above. The spiral model of action research, developed by Stuart (1987) based on the ideas of Elliott (1981), was the basis of my image of the action research process, and I shared it with the team at our workshops (see Figure 2.1 below).

Figure 2.1: Spiral model of action research



Our subsequent employment of action research in the classroom was guided by the following research goals which I had formulated and shared with the research team.

At the end of the planning workshop, in February 1996, I provided the participants with a draft research proposal for the project and requested them to read it critically and to provide me with comments. The provisional title of the research proposal was "Action research in Lesotho Science Curriculum: Towards Education for Environmental Literacy". The goals of the research were to:

1. *develop the meaning of environmental literacy in the context of Lesotho in collaboration with a small group of Junior Science teachers;*
2. *explore how Junior Science may be taught in accordance with the emerging meaning of environmental literacy.*

The research team directed the research project to the questions in the following ways. The first aim involved extended discussions among the research team members, drawing on our experiences and insights and literature on environmental education. To address the second

aim the team jointly developed, implemented and reflected on innovative teaching strategies that we perceived to be appropriate for the development of environmental literacy in the teaching of Junior Science.

In August 1996, after the first action research cycle the team (three members), with Limpho no longer participating in the project, reviewed the research goals. In our review, which was guided by a questionnaire (see Appendix 2), one member indicated that the goals of the research were "clear to a few", whilst two members said that the goals "were a clear focus, shared by all". We revisited the project proposal to remind ourselves of the goals of the research.

2.5. TRYING OUT ACTION RESEARCH IN THE CLASSROOM

Each of the three participating teachers selected a class of students for study (See Tables 1 and 2). In this section I reflect on the team members' experience of action research in the classroom with respect to the following areas: engagement with the four moments of action of action research; data collection methods; number of cycles completed; the attempt to extend the number of cycles and data analysis.

2.5.1. Reflection on the Four Moments of Action Research

Planning

The research team collaboratively clarified the meaning of environmental literacy through focus group discussions (Anderson, 1990) at the beginning of the project. The first meeting of the research team focused on developing a working definition of environmental literacy, which was developed further by the team during the research process. At the beginning of each cycle we attempted collaboratively to plan activities to teach for environmental literacy in the Junior Science curriculum. However, such lesson planning meetings proved impossible to co-ordinate with the full team, and often involved meetings between me and individual teachers at their respective schools.

Action

Planned teaching activities were tried out in the classroom.

Observation

In collaboration with individual teachers at their respective schools, I observed/monitored the possible learning and teaching changes and outcomes. I urged the teachers to keep a diary of their experiences and observations, on which to draw during the reflection meetings. As a research facilitator, I used a variety of data collection methods, the main ones being:

- a narrative note - taking of lesson observations and fieldnotes (Cohen and Manion, 1994; Marshall and Rossman 1989) to collect data about the teaching activities and their outcomes. By fieldnotes I refer to a record of anecdotes, of subjective impressions, of intriguing comments by research team members and people with whom we or I shared our research findings, as well as descriptive accounts of lessons immediately after observation.
- audio tape-recordings of meetings and lessons (Clarke, 1992), to stimulate recall when the research team reflected on the teaching activities used. Audio-visual recording was used for a similar purpose (Clarke, 1992) on one occasion (i.e. Map's lesson);
- I interviewed the team and students and administered short questionnaires to them (see Cohen and Manion, 1994) as the need arose during the research process. I interviewed students in small groups rather than individually, and only after agreement with the teacher. Permission was sought from the schools' authorities for collecting and using data involving children.

Teaching situations were thus investigated using different methods so that various points of view could be corroborated to develop a coherent picture about them (see Cohen and Manion, 1994; Winter, 1989).

Reflection

During the reflection meetings we shared our findings and developing insights, and jointly reflected on the teaching and learning that had occurred in each Junior Science classroom and on our understandings of environmental literacy. These meetings were held at the end of the first cycle in August 1996, and at the end of the second cycle in January 1997. By the end of the first cycle, however, the team had lost one member, Limpho, and at our second reflection

workshop we were without another member, Lebu. We invited some teachers from schools not very far from the environmental centre, where we held our workshops, so that they could comment on and critique our findings.

By writing and presenting our findings at the following fora we further analysed and reflected on our conclusions: two international conferences (EEASA) held in South Africa, in July 1996 and July 1997, and the National Curriculum Development Centre workshop for science teachers in Lesotho, in July 1996. To facilitate a detailed study of the comments of participants at these fora, I collated the comments and submitted them to the team members to comment on (Fieldnotes 09-09-96; Fieldnotes, 10-09-96; Fieldnotes, 12-09-96).

In terms of the principles of collaborative research (e.g. Oja and Smulyan, 1989) I also attempted continually to reflect on the data collection methods we used during the research process, with a view to their possible re-development and refinement.

2.5.2. Reflection on Data Collection Methods

Class observation notes

I took detailed longhand notes of the activities in the classroom during my observation of the lessons. These notes were helpful in augmenting tape recordings of sessions, particularly when a technical problem resulted in the failure of the tape to record one of Map's lessons (Fieldnotes 06-03-96) and a students' discussion group in Limpho's lesson (Fieldnotes, 20-03-96).

Interviews

Individual interviews were conducted with the teachers involved in the research and group interviews were conducted with students in Map's case. Interviews would proceed as follows: I began by informing the interviewee(s) about the purpose of the interview. Thus, for example, I would explain to teachers that I required their views for the thesis that I was writing or in preparation for a paper that I would be writing to present at the EEASA

conference or for sharing the teacher's insights with other team members. To the students, I would explain that their teacher and I required their views so that we could know how their teacher could teach them better. Having judged the proficiency of students in the English language during my lesson observation sessions, I interviewed them in Sesotho, though some showed preference for English (Fieldnotes, May 1996, Map's Case). Teachers were interviewed in English; however we occasionally switched to Sesotho during the interviews. With hindsight I realised that in some cases teachers might have been more open about certain issues had they been interviewed by a third person. This was particularly evident in the case of Lebu, when I interviewed him on his experiences of the research project. However, I had decided to interview the research team on all issues after Limpho's argument that she would not like to be interviewed by a 'stranger' (Fieldnotes, 17-09-96). In addition I thought that by personally conducting all the necessary interviews I would be showing a commitment to the concept of working as a team. I only involved a third person for interviewing the director of the environmental centre, when I thought that the interview was too sensitive because it concerned my apparently strained relationship with the Centre (see section 5.0).

All arranged interviews were tape-recorded with permission. In the case of the audio-recording of lessons, permission was sought only from the teacher, not the students. At the end of one of my interviews with Map, she requested that in the future I give her questions in advance to think about, so that she could be more accurate in expressing her views (Fieldnotes, 11-09-97). This seems to imply that Map thought she had to say precise and 'correct' things and avoid being ambiguous during our interviews. However, she said this at my last interview with her.

Some interviews were conducted in undesirable conditions. For example, in the case of Map's study my interview with students was interrupted by curious students who peeped through the windows of the classroom where we held the interview (fieldnotes, 19-03-96).

My reflection on the transcriptions of my interview with Map (April, 1996), based on her lessons, revealed a number of limitations. I took note of the following points which guided me in subsequent discussions:

- get to the point, say what you want to say.

- I need to familiarise myself (even memorise) appropriate phrases for probing, before discussion. I ran out of appropriate probing phrases.
- I must avoid formulating statements for the teacher to complete. For example, "So in other words...." Similarly must avoid starting statements with "So you...", "So you think that...". Starting my questions with these words appeared to lead the teacher to agree with me, perhaps to avoid disagreement with me.
- Avoid using "I think" unnecessarily. I sounded as though I was deliberately reluctant to take a position or had no clear opinion of my own at all times. Whilst I thought that this was a useful strategy for creating 'space' for clarification of ideas and for the teacher's meaning to come through, my frequent use of 'I think', in retrospect, sounded as though I was deliberately avoiding expressing my own views. This, I thought, might have given a misleading impression of uncertainty on my part. It was from this perspective that I also jotted down the next point.
- Avoid being unnecessarily tentative. Examples of tentative statements included the following: "I don't know, do you..."; "May be I should ask you..." or "I don't know whether..."; "I am not sure whether what I am saying..."; "May be" was also used unnecessarily.

Use of Audio tape Recorder

The use of tape to audio record students' small-group discussions and lessons:

When the audio tape recorder was used to record students' small group discussions, it appeared to influence some students' behaviour. The discussions would occasionally be disrupted by some students who spoke close to the tape to pass a 'funny' remark or tease others. Also, during a whole class lesson or discussion (e.g. Map's lesson), some students who sat at the front of the class close to the tape recorder took the opportunity that arose to pass an inappropriate remark. Students who were too far away from the front, on the other hand, were inaudible on the tape. Perhaps this was due to the large size of classes (e.g. Map's case, lesson 2). Thus, a study of classroom interactions in a class of about 40 students or more may require the use of two tape recorders, one to be placed at the front and the other at the back of the classroom in order to capture all voices clearly.

Decision to limit the use of audio tape for interviews:

After Lebu's lesson (fieldnotes 26-03-96) we began a wide ranging discussion with him, talking in Sesotho. When I realised that we were discussing important issues, I asked Lebu to permit me to tape-record the discussion. The use of the tape seemed to formalise and restrict the discussion. Immediately (when I turned the tape recorder on) he switched his conversation strictly to English, and then started talking in a formal way. I tried to use Sesotho hoping that he would use Sesotho, but he did not switch to Sesotho. It occurred to me that using English formalised and restricted our conversation (fieldnotes, 26-03-96).

This led to my decision to use audio tape rarely, and to rely more on anecdotal data. The experience suggests that the use of tape recorders in the present study may have restricted the free expression of ideas. An alternative method for ensuring the free expression of ideas by the interviewee could be to take short-hand notes during the conversation, immediately followed by detailed expansion of the notes.

Transcription of audio-recordings:

In order to facilitate our analysis of the audio-recorded interviews and lessons we had to transcribe the lessons. This became exclusively my responsibility because of the amount of work the other team members had in their respective schools. It proved enormously time consuming, and I resorted to using our small research fund to employ two research assistants to help me with the transcription.

Developing Questionnaires

To facilitate greater reflection on lessons we developed student questionnaires. I first drafted the questionnaire and submitted it to the teacher concerned for comment. The teacher administered the questionnaire to the class. The use of these questionnaires was very helpful in facilitating reflection on the lesson and the students' responses appeared genuine.

2.5.3. Broad Cycles Completed

Contrary to my expectation that three teachers would engage in at least three cycles during the project, Map completed two, Lebu one and Limpho less than one. The cycles were completed during the research period, 1995-1997. During the first cycle the number of lessons on which reflection and analysis were based was determined by me (the facilitator) and the individual teacher (See Table 2.3 below). Our decision depended on the length of the topic taught, and the time available.

Stuart, Morojele and Lefoka (1997:173) have observed that "many action research projects end after one cycle" and that by the end of the cycle the teachers usually feel that they have gained a lot. Indeed the research team in the present study learned a lot from the study, as will be noted in the chapters ahead, despite the limited number of cycles.

Table 2.3: Number of Teaching Lessons Per Cycle

Research Team Member	Cycle One Lessons	Cycle Two Lessons
Map	Four +	Two
Lebu	four	None
Limpho	four	None

+ Excludes the excursion that students had to undertake as home-work.

I strove to encourage each of the team members to 'implement' at least three cycles, as initially planned. In this section I describe some of my initiatives and the problems I encountered in the cases of Lebu and Limpho.

After the lesson in which Lebu employed a small group discussion method to reflect on the excursion (see section 3.2.3.), I had a brief discussion with him on the lesson. I asked him how he planned to take the excursion further. He had previously said that long-term investigation of environmental issues with students was important within our initiative (fieldnotes,14-02-96). He had no ready plans, and also sounded reluctant to take the excursion further (see the fieldnotes below):

> I was concerned that he should follow up on the issues raised by students on littering, impact of man on the dams etc. I tried to suggest that he should follow up and he sounded reluctant; he rather said that he wanted to teach another topic "photosynthesis". I asked him if he could link 'photosynthesis' with the field trip; he said it seemed impossible. I told him that I would like to come to his class in any case. He tried to discourage me, saying that the lesson was not relevant to the present study/research, and I explained that I would like to come because I thought it was relevant. He finally agreed, and he told me to come on Thursday 29-03-96, at 2:00 (Fieldnotes, 26-03-96)

One possible reason for Lebu's apparent reluctance to follow up on the lesson is that he might have been concerned that he should cover the syllabus content.

In a further attempt to encourage Lebu to extend the excursion, we agreed that we could audio tape-record a lesson, at a later stage, in which students planned actions that they could take to solve the environmental problems which they had identified during the excursion (Fieldnotes 09-04-96). We agreed that I would call him during the course of that week, to confirm the day on which I could come to audio tape-record the lesson (Fieldnotes 09-04-96).

About a week later I telephoned Lebu (Fieldnotes 18-04-96). He was still not ready to extend the data collection. His response was that he had a lot of work that week. He had to set examination papers since students were due to write end-of-term examinations. On one of my visits to Lebu I met the Head teacher of his school, who confirmed that Lebu was overloaded, since there was a shortage of teachers in the school (Fieldnotes, 30-04-96). Lebu had explained his working conditions to me earlier:

> ... when I asked him if he was still teaching at both primary level (for which he was not trained) and the secondary level, as he had told me during the interview at the beginning of the project, he said he was still teaching at both levels, and the problem was that the school was not willing to employ more teachers (Fieldnotes 29-03-96).

There were, in addition, certain extra-curricular school activities that further inhibited Lebu from continuing with the research. This surfaced after much despair and frustration on my part with regard to Lebu's apparent lack of initiative and motivation, in my interview with him, towards the end of the project:

> Interview Extract (04-06-97)
> Tsepo: ...Ntate Lebu. you told me that you were busy this year and that is why you could not attend one of the environmental education workshops in January.

What sort of things demand a lot of your time?

Lebu: E...eh! I should think most of ..... the things which are done here sometimes they would uhm waste a lot of time which we could have spend in class, so much that you find that you are a bit behind what you are supposed to be doing with kids and therefore you need to be there almost most of the time, then we have the idea of sports which now the kids are just picking up recently.

Tsepo: Are you doing sports everyday?

Lebu: Ae. Not really, it was just on Friday afternoon...,but nowadays we have football teams and we have to be there all the time.

Tsepo: And you are a responsible person for sports?

Lebu: Yah.

Tsepo: Any other thing which take your time?

Lebu: I should think just the load itself which we get, teaching all classes Chemistry and some Biology.

In my interview with Lebu, towards the end of the project in 1997, he ironically explained that the research was not an added burden to his work. He said that the research was 'not burdensome', although, as mentioned, he had indicated on a number of occasions during the research that he had no time and was working under pressure. It can be argued that Lebu was merely trying to please me or was denying the issue that turned out to be a very important inhibiting factor during the research process.

Interview Extract (04-06-97)

Tsepu: Ehm. What were the most burdensome aspects of this initiative?

Lebu: Burdensome (NA)

Tsepo: Yes.

Lebu: (silence).

Tsepo: ...say inconveniencing you, and all that, or too much to do..?

Lebu: Eeh.. che!, I couldn't think there were ..you know, burdensome aspects.

Tsepo: I would ask you to think a little bit Ntate Lebu (Both laughed)

Lebu: No (inaudible)

Tsepo: Not at all?

Lebu: Um...cause what I was doing was just part of teaching (Tsepo:Yah), yah, it Didn't involve anything extra to, to me.

Tsepo: But going to the (Environmental) Centre to meet with other people, eh preparing information to share, was that not extra load on your work..?

Lebu: Ah, ah. I can't say that... because I should think that what we were doing was not out of the curriculum. It was what we would have taught anyway, maybe apart from that we were taking the kids out. Now the kids were evaluating what we were doing. That wasn't burdensome. I think it was an advantage to us.

Limpho's decision to discontinue with the research also occurred after I took much effort to encourage her to continue (Also see Chapter 5). She could not complete the first cycle and did not attend a workshop for the team where we shared our first research findings. Reflecting on my experience and notes, Limpho's lack of interest was manifested in many ways and for a long time, but she was reluctant to inform me that she was no longer willing to continue with the research. Thus, for example, when she mentioned that she could not continue the research with the Form C class as they were about to sit for mock-examinations, I suggested that she could work with another class (e.g. Form A), which led her to further explain that she was too busy with her university-entry examination (Fieldnotes,10-09-96). She frequently failed to keep our appointments or arrived late for unconvincing reasons. When I realised the nature of the situation, I requested an interview with her, which was to be our last meeting. She was willing to give one. However, as usual, she failed to keep our appointment, for a reason that I thought was feeble (Fieldnotes, 13-09-96). I patiently arranged another one, and just as I was about to leave she arrived, about one hour late (Fieldnotes, 17-09-96). In my fieldnotes I recorded feelings of frustration and disappointment when Limpho failed to keep our appointments, which I interpreted as her way of communicating that she had lost interest in the research project. I thought she could have communicated this explicitly to me, without wasting my time (Fieldnotes, 10-09-96; Fieldnotes, 13-09-96; Fieldnotes, 17-09-96).

Nevertheless, in my deep reflection on Limpho's situation I thought that it was reasonable for her to give priority to her studies, as this would be relatively more rewarding to her professionally in terms of certification and accreditation (Fieldnotes, 10-09-96). Perhaps this experience increased my intention to discuss with my supervisor for the present study at Rhodes University, the need and appropriateness for the University to provide the team members with some form of certification for participating in the present research project. It is, however, noteworthy that the idea of the certificate also emanated from the contradiction and guilt I experienced about the project motivating me, alone, with the possible reward of a certificate. From the perspective of the University these teachers I worked with, whom I had come to view as co-workers, were merely my sample. By rewarding me alone with a certificate the University treated my team members as though they did not exist, yet the present thesis, informed and shaped by their contributions, would be taken seriously by the University. By trying to encourage the teachers to continue with the research, I was merely

motivating them to help me achieve my hidden reward. My supervisor facilitated the provision of a letter in July 1997, signed by her and the Dean of the Faculty, to each member of the team in recognition of our work. This response was a great encouragement to me, and I assume to other team members as well. However, by this time Limpho had discontinued her participation in the research.

In an attempt to address some of our constraints, in particular workload and limited research time, I suggested to the team members (Fieldnotes, 24-06-96) that we invite representatives of two teachers' trade unions to a workshop where we planned to share our findings. My hope, which I shared with other members of the team, was that the trade unions would recognise the value of our work and explore with us how teachers who engaged in action research could be provided with some incentives (i.e. provision of remuneration for teacher-researchers and reduced workload). The invitation was sent late to one association, a few days before the workshop, and the chairman of the other association promised to attend but never did, without any explanation. We never made any further attempts to involve them in our work. From this perspective it can be argued that our research orientation on the whole was 'passive' and not critical. Drawing on Lather (1986:263) we operated from an "apolitical value system". Critically oriented action research projects "enable practitioners not only to search out the interpretative meaning that educational actions have for them but to organise action to overcome constraints" (McKernan, 1991:24), this involves "addressing the relationship between the classroom and the wider social contexts that control and direct personal preferences and professional practices" (Fien and Rawling, 1996:14).

2.5.4. Reflection on Analysis

Introduction

Data analysis was done in two phases. The preliminary analysis was done during the project in collaboration with other team members, and I later analysed the data further on my own at the end of the last action-research cycle. In the latter case in particular data analysis involved the following strategies: first a careful reading of data in order to identify key concepts; mapping of data to identify frequently occurring issues, common trends, themes and categories (Maxwell, 1992); a creative and 'reflexive' (see Janse van Rensburg, 1995;

McKernan, 1991; Stuart, 1987; Winter, 1989) interpretation of evidence and findings; member checking (Lather, 1986) for inter-subjective objectivity (Ely *et al.*, 1991), as an approach to 'validate' the research team's subjective assumptions and conclusions; 'validation' of some conclusions through the triangulation of different sources of data (Cohen and Manion, 1994; Kincheloe and McLaren, 1994; Marshall and Rossman 1989). The constructivist theory (Bodner, 1986; Gilbert, Osborn and Fensham, 1982) of knowledge acquisition also guided analysis of some of the data from Map's case study.

Preliminary Analysis

As part of our initial plan, research team members were to analyse data and write up reports on their findings to present at research team meetings. The two research team meetings and the two conferences we attended (see section 7.0) during the course of the research project forced us to analyse the collected data. This, however, did not always proceed smoothly, as illustrated by the case of Lebu, below.

Following Lebu's administration of a questionnaire to his class to evaluate the excursion method he struggled to find time to read through the completed questionnaires:

> ...he told me that the students' feedback on the questionnaires that he administered was available. I asked him whether he had gone through the responses, and he said no he did not have time to do so. We agreed that I should fetch the questionnaires the following week, Monday (Fieldnotes 18-04-96).

In order to help Lebu to analyse the questionnaires I typed and listed the students' responses for each question, and then submitted the data to Lebu for reading and to comment. At first he was too busy to read the responses. I found him busy marking and "He asked me to keep the document until the following week (13-06-96), and to bring it for our next meeting (at his house) when he was through with marking" (Fieldnotes, 06-06-96). We were only able to analyse the questionnaires with some rigor later when we prepared for our presentation at a conference the following month, July 1996.

Further Analysis

In my analysis of the data I understood validation to mean the employment of procedures that facilitated the construction of a 'coherent picture' (see Stuart, Lefoka, Morojele and Lefoka, 1997), resonant with reality as experienced by participants in research situations. This contrasts with the positivist perspective within which researchers may attempt to coincide their interpretation with an 'external reality' or attempt to generalise or replicate their understandings (See Winter, 1989). I also attempted to validate conclusions by exploring a number of possible interpretations of experiences or points of view rather than seeking to establish a single universal claim based on certainty about experiences. This approach has been referred to by Winter (1989) as a 'reflexive critique' and as an important dimension of validity. This largely occurred naturally to me as I interacted with the various accounts or viewpoints. The role of my supervisor and other 'critical friends' also facilitated this 'reflexive' analysis of our conclusions by making apparent possible interpretations which were initially obscure to me. The surfacing of such alternative interpretations opened up new channels of argument and discussion during our presentation of research findings and my writing up of the present research report.

The viewpoints of the research team members during interviews and of other people involved in the research have largely been presented in their own words. Where they used their mother tongue, English translations have been provided. In accordance with relevant theories (see section 1.3), I wanted to avoid subjugating Sesotho by exclusively providing English translations. My translations were verified by specialists in Sesotho and English.

My analysis of the complex scene of various accounts or viewpoints engaged me in a process that Winter (1989) has referred to as a 'dialectical critique', as I attempted to explain the 'how' and 'why' of situations and points of view. In order to understand situations or view points I, for example, broke them down into constituent elements and explored relationships between amongst these elements. At times the latter were apparently contradictory, conflicting, inconsistent and ambiguous. The 'dialectical' approach, however, reminds us not to always look for uniformity and consistency in our analysis of complex situations, since

> Individuals are the products of the social world, but this social world is structured in a series of contradictions, and is thus in a continuous process of change; its influence upon individuals is thus both conflicting and varying, and can thus never be either unambiguous or final. Consequently, individual consciousness is also structured in a

set of contradictions.... (Winter, 1989:51)

2.5.5. Writing up the Research Report

My review and analysis of data and the writing of the report reminded me of a time of harvest in my grandfather's maize fields. As I went through the three case studies and re-wrote several drafts, I developed an extended image of harvesting, *ho kotula poone masimong*. For several times I revisited the maize field to seek possible remaining maize, *ho khoahlapisa*. *Ho khoahlapisa* is an ongoing process, and never really ends until the time for *ho phunya ts'imo*. This is the time when livestock are allowed to raid the field and feed on maize-stocks and any remaining maize. *Ho phunya ts'imo* is a process that marks the end of harvest, the laying of a field to rest, and is associated with the beginning of the time to make use of the fruits of harvest. Thus, with the end of the write-up comes a time to utilise the harvested fruits of new understandings and insights in our professional practice (Dec. 1997- further developed thereafter).

CHAPTER 3

TEACHING STRATEGIES FOR THE DEVELOPMENT OF ENVIRONMENTAL LITERACY

The quest for relevance calls for more than choice of material. The attitude to the material is also important. Of course, over this, there can never be any legislation.

(Ngûgi wa Thiong'o, 1996:105)

3.1. INTRODUCTION

The attempt to explore teaching methods appropriate to the development of environmental literacy began at the first planning workshop for the research team in February 1996. The teaching methods introduced or identified at this workshop were subsequently tried out in the classroom context by the three teachers.

At this workshop I introduced the concept of the integrated teaching of science to the research team. My decision to do so was underpinned by my understanding that integrated teaching supported an important aspect of environmental literacy, the ability to understand environment and environmental issues in a holistic way (see Chapter 1). This view developed from my interaction with the relevant literature (e.g. EEASA, 1994; Haggis, 1991; Kincheloe and Steinberg, 1993) and my participation in a conference of the Environmental Education Association of Southern Africa (EEASA) in 1994. I invited Drs. Gerard Mathot, a science education lecturer from the local university, to introduce and facilitate discussion on the theme of *"Integrating Junior Science Disciplines. Why?"* During the session the following points were made:

- The world is integrated. Organisation of knowledge into disciplines may be leading to a fragmented understanding of the world around us.
- Children think in an integrated way. From childhood we perceive the world as integrated, and not in terms of disciplines: for example a baby relates to its mother's sounds, food, people and everything around it.

- In a study that Gerard Mathot undertook in Ghana with students, concerning things that students would like to know about, the questions that the students raised were not discipline-specific; that is, they were integrated, indicating that the students thought in an integrated way.
- People interact with the 'whole' environment from the day they are born; that is, in real life we do not compartmentalise the environment. Compartmentalisation is for the benefit of those concerned with examinations and specialised studies, and is not to the advantage of the learner.
- The following teaching approach was therefore suggested for the development of an integrated view of the environment: the use of 'themes', which involves a focus on broad issues such as 'transport' rather than narrower topics. A theme must be as near to the concerns of people as possible, and must have as many connections with other issues affecting the people as possible. Concept maps may be used to facilitate the linkage of various related issues about our environment. Through small group activities the workshop participants explored this teaching approach, drawing on content from the Junior Science syllabus.

In another session at the workshop the following approach was suggested for integrated teaching. Teachers might begin by identifying environmental issues and trying to relate these to the Junior Science content. By proceeding thus it would be possible to include economic and political problems/issues. There was, however, a concern that big words such as 'economic' and 'political' might confuse students and a suggestion was made that these concepts be developed without using the big words.

Other suggestions that were made by the participants in the workshop about appropriate teaching methods for developing students' environmental literacy included the following: student projects; visits/excursions and field work in the local environment, which should involve students in deciding on how to solve environmental problems; demonstrations; pupil-centred methods, including the use of familiar examples; discussions; the question and answer method; the discovery method; students' experiments; the use of posters and photographs; role-playing; students' involvement in the community by visiting villages or

inviting guest speakers to the school from the village, including knowledgeable people who may not have experienced formal education; and the use of a local radio station. At this workshop, Limpho distributed a paper which she wrote prior to the workshop, titled *"How Can the Teaching of Junior Science Solve Lesotho's Environmental Problems?"*. This paper was based on a topic included on the workshop programme sent to the invitees. In this paper Limpho raised a number of teaching strategies that she thought were relevant in the context of Lesotho schools, including several mentioned above. Some of her suggestions appeared to challenge the established education system:

> The school Administrators should establish or set aside one week which could be '(school name) Environmental Week'. Within this day should be established where all our scientific emphasis would be placed upon the issues of environment and how it affects the individual, the home, the community and the nation. There again individual responsibility should be stressed.
>
> ...each student should be encouraged to make a plan whereby individual and collective, all students, participation would help in eliminating environmental problems.

In the subsequent workshop held in August 1996, after trying out action research in the classroom, the research team took a critical look at the teaching methods that were suggested at the first workshop, in the light of the insights and experiences gained by members. The team mentioned 'group discussion' as an additional approach for developing environmental literacy. This approach had been tried out by all three team members in their respective schools during the first cycle. During the discussion the team further discussed the practicability of strategies such as the use of a local radio station, suggested at the first planning workshop. Below, Lebu reports the conclusions of the team to the workshop participants:

> And coming to the teaching methods and strategies...we thought um maybe what we left here was the group discussion... I have already said people are aware of some problems, they have seen them, even though we have to change the wording to think about them, so by just putting an idea on the board, saying how do you feel about these, and then forming groups and they discuss, that's another strategy... Then we looked at....how are, how practical are these eh suggested methods,...we picked out Radio Lesotho and say how practical is this? (inaudible) here we thought maybe um it could be used in such a way that, the...Radio Lesotho is used to inform other students in other schools about what is happening in this particular school that we are in. (MEC workshop report, August 1996)

In Chapter two I have discussed some of the activities we undertook to prepare for testing our ideas on teaching strategies in the classroom. In my attempt to facilitate this process I condensed the ideas from the first planning workshop (fieldnotes, 22-02-97) into a summary table (see Appendix 3), which I shared with the team members (Fieldnotes, 22-02-96; 10-04-96). I intended this information to be used by members for quick reference to ideas that emanated at the workshop.

Also mentioned earlier is that individual team members selected a class of students (a case study) with which to work. The three case studies will hereafter be referred to as Case study one (for Lebu), Case study two (for Map) and Case study three (for Limpho). The following symbols are used where extracts from transcribed lessons are quoted: 'T' for teacher and 'S'or 'SS' for student or students respectively. Lebu and Map directed their teaching to the local aquatic environment and the impact of humans on the biophysical environment. Their initiatives reflect an attempt to study interactions between the biological, the physical, and the social dimensions of environment. Map explored solving the problem of littering by integrating the issue with a science topic. Limpho's study was based on energy, with a focus on local issues and problems; her study makes apparent the interactions between human beings, energy and the biophysical environment.

3.2. CASE STUDY ONE

Lebu taught a Form C class, at a school situated about 40km from Maseru city and within the compound of a university (See Tables 2.1, 2.2). This school has international status (i.e., it is an 'International School'). Following the first planning workshop of the research team, Lebu and I considered how he could teach a Junior Science topic on ecology drawing on the ideas of the workshop. Subsequently, he made an excursion with his class to the local ponds, located about 500m from the school, to study "the impact of man on the environment". Afterwards, Lebu and I evaluated the excursion using a questionnaire, and he also arranged a small-group discussion in class, for students to reflect on their experiences during the trip. This initiative is discussed in detail below.

3.2.1. Excursion Method and Learning Outcomes

The excursion involved a whole class (25 students) taking a walk to local ponds and studying the environment in and around the ponds. I was not present when Lebu planned and implemented this activity as he was not able to communicate this plan to me in time for me to attend. At a reflection workshop/meeting for the research team, Lebu mentioned that the class had to freely observe and note down the effects of human beings on the environment:

> Workshop (August, 1996)
> Joale idea eaba hore, banna ke hore re ke re tsoeng, re le tjena, re le class, re tsamae, re ke re just observe and to note down, any bad effects of man within the campus moo re tla tsamaea teng. 'Me re ile ra etsa joalo le bona, we went out e le field trip and they were very excited, ba le free joalo, e mong le e mong a tsamae a nota libaka tseo re ntseng re fihla ho tsona, hore na what the bad effects of man on the environment within the campus ena ea rona....
>
> **English Translation**
> Now the idea was, guys we should go out, as we are, as a class, and travel, and just observe and note down, any bad effects of man within the campus where we would be walking. And we did just that together, we went out in a field trip and they were excited, they were free like that, each of them noting the places we arrived at, and stating what the bad effects of man on the environment within the campus of ours (were)...

Our analysis of the students' questionnaire responses (see Appendix 4) showed a range of views with respect to the environment they explored. These views related to an awareness of the surroundings that some students said they had never experienced before, students' recognition of pollution, and the gaining of new knowledge about certain aspects of the biological and the physical environment. These varied views of the students are summarised in Tables 3.2.1, 3.2.2, and 3.2.3, and discussed in detail below.

Table 3.2.1: What students said they liked about the excursion

What students liked	Students No.	Reason(s)
Observing the surroundings	1	-there was a lot to say about the surroundings [1] -I recognised that I would do better than people who just spoil the environment [1]
I saw new places	2	-I can get there again[1]
I learned more/many things/a lot; trip was educational	6	-
We studied about environment & pollution	2	-
It was fun to study about our environment	1	-
To see and know the environment around me	1	-
To know how to keep the environment clean	1	-
The ancient dinosaur footprints and rocks	1	- they were 'fascinating' and 'intriguing'[1]
I learned what to do to protect the environment	1	-
The visit was part of education	1	-
I saw new species	2	-'I love learning something that involves nature' [1]
I became aware that it is necessary to take care of environment	2	-
Looking at water & moving around making short notes	1	-
Birds	1	-
I could see what I was learning about	1	- 'It was a refreshment from being in a class' [1]
It was interesting	1	-
Nothing	1	- 'Something was missing, something I can't quite put my finger on'[1]

NB. Many students did not provide reasons for their views, hence the missing information in the third column.

Table 3.2.2: What students said they did not like about/during the excursion

What student did not like	Students No.	Reason
The smelly ponds/litter/ sewage.	8	-
The untidiness/litter/pollution.	4	-
Long walking distance.	4	-
It was too hot.	6	-
There was little water remaining in the ponds.	1	-
Seeing polluted water and air/environment.	2	-'I kept imagining how many people could catch diseases caused by pollution'[1]
The sewage ponds were not fenced.	1	- 'kids can swim & catch diseases'.
There was little time & we didn't see much.	1	-
The place was boring/ not interesting.	2	-'it didn't have much to study'[1]
Not studying in detail; little teacher's explanation.	3	-
Human beings' destruction of nature and organisms in the ponds.	1	-
The teacher did not allow us to walk alone.	1	-
A cat that died from drinking polluted water or the smell from ponds	1	-

NB

- Number of responses not classified due to vagueness and lack of clarity =1
- Many students did not provide reasons for their answers, hence the missing information in the third column

Table 3.2.3: New knowledge that students said they gained during the excursion

New Knowledge Gained	Students No.
Humans pollute the environment.	4
Humans can prevent pollution.	2
Sewage can be recycled.	5
Ecology means the study of environment.	1
It is vital to keep environment clean.	1
New organisms.	7
Presence of sewage dams on campus.	2
The pollution (dirty, careless).	3
The importance of studying ecology (help keep organisms alive].	1
New habitats.	2
New communities.	1
Conservation of plants.	1
The source of the river.	1
How to keep environment clean & healthy.	1
The University has no properly managed tip site.	1
Livestock move freely into the university compound & drop faeces everywhere.	1
Nothing new	1

NB

- Unclassified because the response is unclear = 1
- The number of students corresponding to knowledge gained indicators is higher than the actual number of respondents because some students gave more than one view

Table 3.2.4: Surprises Encountered During the Excursion

SURPRISED = 21 STUDENTS	
Reason	Students No.
The many dams on university campus.	3
To see a very big dam without water.	1
To hear that we drink water that was once sewage/recycled water.	3
To see that the university was so dirty & polluted/littered	7
Disorganised & dirty university trash site.	2
Poor university sanitation.	2
Survival of animals in polluted environment.	1
'that people don't even think of cleaning the mess, instead they add it'	1
Reproductive rate of water weeds.	1
Grass inside the pond water	1
NOT SURPRISED = 4 Students	
Reason	Students No.
'I already knew that humans are terrible to the environment because I always watch Eco-Act'	1
'I already knew the dam'	1
None	1
None	1
NOT SURE IF WERE SURPRISED = 1 Student	
Reason	Students No.
None	1

NB. Unclassified response due to lack of clarity, not make sense, incomplete=1

The students' questionnaire responses reflect the following perspectives with respect to their experience during the excursion: encounter with the environment, awareness of pollution, and the gaining of new knowledge about organisms, and some claimed not to have experienced

anything new.

Encounter with the Environment

Several students' statements suggested that their usual teaching is largely confined within the classroom and that the excursion provided them with a rare opportunity of interacting with and learning from the local environment. One explained that he was "delighted to see and know what is around the environment"; another thought that the excursion was a "refreshement from being in class all the time", while a third stated that they enjoyed and learned more during the excursion "than always being in class".

For some students (four of them), the excursion was an exposure to part of their local physical environment they had never seen before. For example, they became aware that there existed sewage dams within their school environment.

One student, however, indicated that he did not learn anything new from his encounter with the environment. Interested by this perspective, Lebu corroborated this student's view with other views he raised in the questionnaire, and drew the conclusion that this student was already familiar with the visited environment. In his reflection Lebu thought that this implied that he "should have planned [the excursion] together with [the students] and they should decide, or should decide together and say, let's move to a certain place, a certain area not this one..." (Workshop, Aug.1996). However, one could also go to a familiar place and look at it with 'new eyes' so as to uncover possible 'hidden' environmental issues. This could be seen as an appropriate orientation for an educational excursion that is aimed at developing students' critical thinking about environmental issues. O'Donoghue has, for example, illustrated how a game of pictures of an environment that students may have seen before provided them with the imagery and language to 'see' things differently in familiar surroundings (Janse van Rensburg, 1998 pers. comm.).

Awareness of Pollution

Some students (eleven) were surprised to see such pollution in their local environment (See

Table 3.4). Some were even stimulated to think about the dangers associated with the pollution. As one explained, "I kept imagining how many people could catch diseases caused by pollution". It also seems that some students (five) developed a greater awareness about the role of humans in polluting the environment and that humans may play an important role in preventing pollution. One stated: "I learned how vital it was to keep the environment clean after seeing even innocent animals being exposed to the pollution".

One student, however, said that she had learned from television that humans cause damage to the environment, and that she was therefore not surprised when she saw pollution in the environment they visited: "I already knew that humans are terrible to the environment because I always watch eco-act", she said. This seems to suggest that television could be a useful teaching aid for educating students about environment. A further implication is that knowledge gained by students from television about environment may greatly influence students' understanding of environmental knowledge taught at school and, unless there is an opportunity to engage in critical dialogue, this could be problematic for students when such knowledge is contradictory.

From these students' responses it can be argued that excursions have the potential to raise students' awareness of the environment and associated problems (as does television). The students became aware of pollution and associated problems in the environment, and that humans were responsible for the environment.

Knowledge Gained about Organisms in the Environment

There is also evidence that many students gained more or new knowledge about the biological environment, plants and animals, through the excursion (See Table 3.3). Some, for example, wrote: "I liked the ancient dinosaur footprints and rocks which were nearby..."; "I didn't know there were blue dragonflies"; "I never knew some species of ants and plants that I saw ever existed".

Reflection on the Excursion Method

In this section I discuss the views of Lebu and the students on the excursion. Lebu's views are those that he shared with the research team at the end of the first cycle and during my interview with him after the first cycle. The students' views on the excursion were determined through the use of a questionnaire. Students' views are important for the development of teaching strategies since they provide the teacher with another perspective from which to evaluate his/her actions.

The context in which Lebu and his class undertook the excursion was captured by Lebu in his presentation at a workshop. In his analysis of the context of the excursion, Lebu described the students' life as a routine that alienates them from their own surroundings.

> Workshop (Aug. 1996)
> One of the things which I believe I should say at this point is that, eh normally, or I should say some of the kids, eh the way they are learning or the way their life is made up, they go to the school, let's say they live in town, they go to school, come back and so on, that's the way they live. And even during the whole day, eh the situation is that (inaudible) they, they are never exposed to, to their surroundings... So the fact that, when you are going out with them they are surprised by so many things, which you take for granted, that every kid would know. So, I, I think I should point out that, this is an advantage for the kids to be out of the classroom and exposed in the environment.

In my interview with him at the end of the project, Lebu mentioned the excursion as one of the useful aspects of the study:

> Interview (04-06-97).
> Tsepo: Ntate Lebu, if you were to share your experience with other teachers about the small environmental education initiative that you, 'Me' Map myself and the environmental centre were involved in, eh, what would you say you found useful? (Both laughed)
> Lebu: It's a broad question.
> Tsepo: It's a broad question. Maybe you could focus on the most useful.
> Lebu: One important aspect of it was e...eh! the chance given to the kids to explore the environment that means going out of the classrooms...and interacting with the environment outside....

Many students' overall view of the excursion was a positive one. Twenty four of the twenty five respondents wished to have excursions regularly (See Table 3.2.5). However, these students also provided suggestions on how the excursion could be improved (See Table 3.2.6

below).

Table 3.2.5: Students' Views on whether or not they would like to have more excursions

STUDENTS **WHO WISH** TO HAVE MORE EXCURSIONS = 24	
Reason for having more excursions	No. of students
'It is easier to learn'.	1
'It is wonderful seeing our environment'	1
It is wonderful knowing how to keep our environment clean.	1
Provided we are transported by car.	1
I want to know about other areas.	2
They are 'educational'/we learn a lot or more.	9
'So that we can have more general knowledge'	1
They are 'interesting' or 'exciting', 'fun'.	7
I gain more knowledge.	1
I become 'conscious of the environment'.	1
'it gives me ideas about what should be done to improve it [the environment]'.	1
So that we visit 'important' places such as Thaba-bosiu, Morija, and Katse dam.	1
I enjoy long walks.	2
'I like site seeing'.	1
We exercise during the trip.	1
So that we can study different places and compare them.	1
Yes, but not to such a place, it's common.	1
STUDENTS **WHO DO NOT WISH** TO HAVE MORE EXCURSIONS = 1	
Reason for not having more excursions	No. of students
'I am tired of ecology'	1

NB. Responses that were not classified because the answer was incomplete, unclear etc = 1

Table 3.2.6: Students' Suggestions on Improving the Excursion

What the teacher **should do** [Students No.]	What the teacher **should not do** [Students No.]
Take photos and stick them in our class. [1]	Make us walk for a long time. [1].
Make excursion longer. [3]	Should not explain things in a hurry. [1]
Transport students by a vehicle. [1]	Not make us walk in the sun for a long time. [1]
Bring a box of matches to burn up the litter. [1]	Should not walk in front and leave the students behind. [1]
Give us about 2 weeks to prepare for an excursion. [1]	Should not walk too fast. [1]
Announce the excursion early so that we come with appropriate clothes. [1]	Should not walk with us. [2]
Be given chance to distribute trash cans at the school yard, and the school should join the Lesotho recycling society [1].	'Not assist us because we are big enough to take care of ourselves'. [1]
Closely supervise students, to ensure concentration. [3]	'Not take us to rubbish dumps, stinks bacteria' [1]
Should do what he did during the first excursion. [2]	Should not talk to one group only. [1]
Organise the trip well, the students were all over the place not listening to the teacher. [1]	Nothing [5]
Should let us walk alone & explore the environment. [3]	
Study/explore [the dams] in great detail. [2]	
Take us to an unfamiliar place with plenty of organisms.[1]	
Groups should be assigned a specific task. [1]	
Should let us do 'individual research' [on the dam]. [1]	
Arrange a bus trip and go far, to 'study something for many days'.[1]	
Collect [pond water] specimens. [1]	
Give us questions to answer during the trip. [1]	
Let us go alone. [1]	
Should take us to Katse dam.[1]	

NB

- Unclear response(s) = 1
- The responses are relatively few in the second column since many students overlooked the 'should not do' in the questionnaire.

The diverse views of students on how the teacher could improve the excursion provided a rich source of ideas for improving the teaching approach. However, it is also possible that such heterogeneous ideas could present the teacher with certain difficulties should she or he

try to meet all the students' needs. It seems logical that in such a situation the teacher's consideration of pupils views should be guided by a conceptual framework for the development of environmental literacy rather than be driven merely by students' interests. Such a perspective would enable the teacher better to decide between the contradictory views of students who mentioned, for example, that they enjoyed a long walk during the excursion, and others who said that they did not.

Concluding Remarks

One student was concerned that they did not take any action to solve the problem of littering they encountered during the excursion. Her view concerning how the teacher could improve the excursion was that "my teacher should bring a box of matches to burn up the litter"

Whilst this student's proposed solution could be questioned for its possible impact on the environment, the excursion appears to have developed or elicited a desire on the part of the student to take action to solve an environmental problem that she encountered during the excursion.

It can be argued, though not proven here, that the above student's intent to take action to solve an environmental problem was engendered by her encounter with an undesirable condition in the environment. From this perspective, the excursion had the potential to motivate some students to solve an environmental problem. This view is supported by the student who indicated that she wished to be involved in more excursions because this "gives (her) ideas about what should be done to improve the environment" (see Table 3.5, above). In his reflection on this concept of action (see Chapter 4), at a reflection workshop/meeting for the research team, Lebu stated:

> ... and some of the responses show eh [students'] likelihood to act, **which I believe we said from the beginning that environmental literacy**, does not just end by eh just knowing about the environment, being aware of the problems but **eh there should be some action...**:then likely to act is this one 'I will do better than the people who just dump everything around and spoil the environment'; 'Bring matches to burn up the litter' [inaudible]....(Workshop, 16-08-96) (My own emphasis added.)

Reflecting on the project towards the end of the research, Lebu thought that the development of "ideas of environmental literacy" is dependent on the nature of the science topic and the teaching methods employed.

Interview (04-06-97)

Tsepo: ...referring to the teaching methods that you are using, would you say that in your view they develop the students' environmental literacy?

Lebu: Sometimes I would say it just depends on what topic you are dealing with... eh, how well you can bring about the idea of the environment into the topic, because we may treat other topic [inaudible] but there are topics where you know that well in this case... the method which I will be putting forward will have to make it very clear to the kids that this is more related to environmental problem that we have and so on, so yah there are those methods or there are those topics where the methods used will...help the kids to get the ideas of environmental literacy.

Further evidence of environmental knowledge gained by students during the excursion became apparent during small group discussions in the classroom, following the excursion. This teaching approach is discussed in the next section.

3.2.2. Group Discussion and Learning Outcomes

Subsequent to the excursion Lebu reflected on the activity together with students in the classroom (Fieldnotes 26-03-96). The lesson proceeded as follows (Fieldnotes 26-03-96): the teacher made a short introduction about the previous week's excursion and then asked students to work in small groups to answer some questions. There were 25 students in all, and they worked in groups of three or four. After the discussion students reported their findings.

Lebu explained the aim of the small group discussions at one of our research team meetings as follows:

Workshop (August, 1996)

Joale after a field trip, re ile ra ba le group discussion ka hara classe...hore re behe lintho tsena ka tsela e hlakileng hore qetellong re tsebe hore eh, re bone hore there is overgrazing, if there is, re bone hore there is pollution, litter, if there is, ntho tseno. Joale ba tle ka tsona hore, lintho tseo re li fumaneng ke tsena. Joale re le boleletse hore joale afterwards re tla be re re joale, what can we do hore joale re solve taba ena ea environmental problems. Eh kaha re ne re nkile hore boikemisetso ba [Science] syllabus, ke eona environmental literacy. Me ka moo e hlalositsoeng ka teng its not only knowing about the problems of the environment, but also acting or trying to

solve the problems.

English Translation

Now after the field trip, we had a group discussion in the class...so that we put things in a clear way, so that in the end we should know that eh, we see that there is over grazing, if there is, and see that there is pollution, litter, if there is, such things. Now they come up with them so that, things we have found are these. Now we have told you that, now afterwards we would say now, what can we do to now solve the issue of environmental problems. Eh, as we assumed that the intention of the [Science] syllabus is environmental literacy. And as it has been defined it's not only knowing about the problems of the environment, but also acting or trying to solve the problems.

I randomly selected one of the discussion groups. I tape-recorded the discussion and transcribed the recorded information for analysis. The preliminary analysis was undertaken by Lebu and myself when preparing for the EEASA conference in mid-1996. The second detailed analysis presented below is partly informed by this early analysis.

The discussion was guided by questions provided by the teacher. The students were required to classify things they observed during the excursion into living and non-living things, to identify the effects of humans on the environment, and to suggest ways of solving the environmental problems they observed. A myriad of ideas ensued from the discussion. Table 3.2.7 provides a summary of the ideas that emerged from a group of four students.

Table 3.2.7: Views Emerging from Small Group Discussion.

Organisms identified during the excursion		Non-living things identified by the students during the excursion	Students' observed effects of humans on the environment.	Students' suggested solutions
Plants	Animals			
Water weeds Water reeds Fungi Green algae Brown algae 'small tiny plants on the surface of the water' trees moss grass orchard	spiders mosquitoes flies locusts frogs dragon fly	water litter overgrazing air pollution	Litter Overgrazing Pollution 'man has affected the habitats of the environment' polluted water	-'all litters should be recycled and those that can't be thrown in the dongas or make compost heap.' -'they should graze them [animals] in different places because overgrazing can [cause] soil erosion' - put something like a glass houses around the dams to prevent polluted smelly air* - burn the rubbish*

* Received a lot of debate, and refuted by some students.

Classification of living and non-living things

As mentioned, one of the tasks of the students was to classify objects they identified during the excursion into living and non-living things. Through the excursion method the students had first-hand experience of living and non-living things in their local environment. Contrarily, the dominant use of the lecture method within classrooms in the teaching of science in Lesotho (e.g. Talukdar 1995a, 1995b) deprives students of this experience.

In the following extract the students discuss and classify living things and non-living things which they observed during the excursion. The students may be seen to be sharing their knowledge about various organisms as well as being involved in decision-making on how to present their findings.

Extract 1 (26-03-96)

S1: So we make something like a table. So we put the organisms on one side and the non-living things which are these, litter, yah.... (DM)

S2: On living things we can put frogs, fungi, algae and those others....(KL) Okay, let me say everything out then, then you'll be writing. Write the living things or write the definition first and then write the table with the living things and the non-living things. (DM)

S1: The living things were the dragon fly. (KL)

S2: Small tiny plants on the surface of the water, water weeds, spiders, water reeds and spiders.(KL)

S1: The living things were the dragon flies.

S2: Dragon flies and water reeds.

S3: Water reeds?

S2: Water reeds and water weeds.

S3: Ke li-living things/Are they living things ?

Key:
DM: Decision-making.
KL: Knowledge of living organism(s).

At the first research team workshop the concept of environmental literacy was associated with 'understanding of the environment'. In classifying living things through discussion, students shared and reflected on their experiences of the organisms they observed during the excursion. It seems that this process of classification clarified their understanding of certain aspects of the environment they visited.

The next extract illustrates how students clarified their understanding as they distinguished between two species of algae which they observed during the excursion.

Extract 2 (26-03-96)

S2: Moss, write the green algae and the brown algae. (PR)
S1: The brown?(AC)
S2: Brown algae in brackets and write oily. (PR)
S1: Oily, was it oily?(AC)
S2: Remember when we were at Lifariking, there was something brown which was also oily...
S1: Was it brown?(AC)
S2: Yes it was brown and then the green algae (C)
S3: Which was the green algae?(AC)
S2: The one near the grass. (C) Then we are through with the living things. The non-living things, what are they?

Key:
PR: Prescriptive
AC: Asks for Clarification
C: Clarifies

Small group discussion here developed students' understanding of environment by enabling them to question and respond to each other, in the process distinguishing between two species of algae. There is, however, an apparent limitation in the above extract that might have inhibited other students from freely sharing and expressing their ideas. Student S2 is rather prescriptive or domineering when sharing her own experiences, as demonstrated in, for example, her ordering of student S1 to "write" her views before others could comment on them. In addition student S1 simply talked when she sought clarification. Thus, the creation of a conducive atmosphere for all participants in a group to freely share their experiences and views is important for the effective use of this approach to learning.

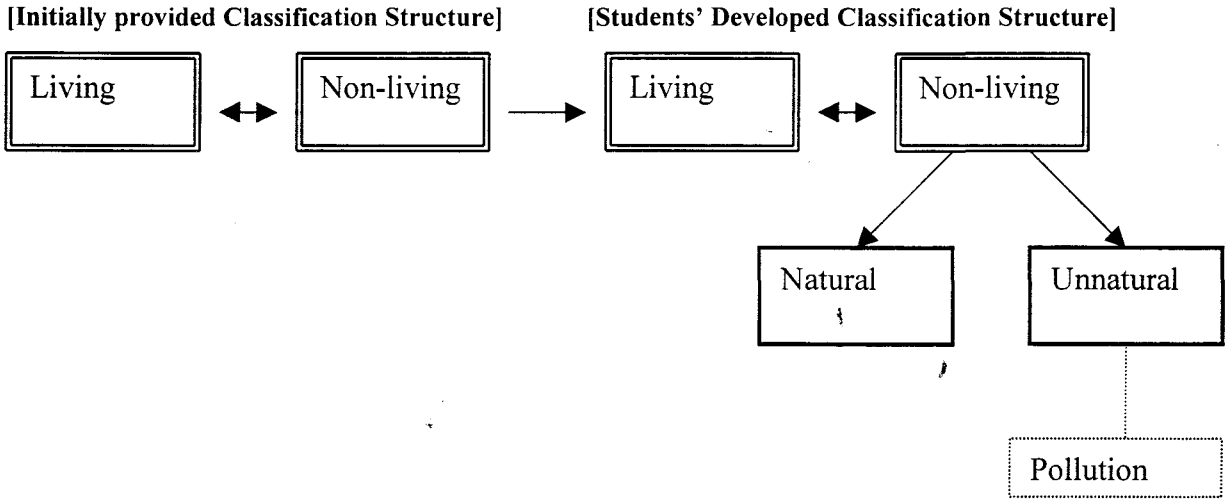
The students further discussed the concepts of litter and pollution, and sought to clarify and distinguish between them in the context of classification. Litter was classified by the students as non-living. Two new categories of classification were 'coined' by one student as they attempted to classify pollution: "natural and unnatural non-living things":

Extract 3 (26-03-96):

S2: The non-living things, what are they?
S1: The litter.
S3: Litter?
S2: Yes, litter is a non-living thing but then we can't classify pollution as non -living thing, we can't say that.
S3: **We should have written it under natural and unnatural non-living things.**
S2: When you have finished, we can write unnatural.
S3: Pollution.
S2: Under non-living, let's write natural and unnatural, what do you say Kawonga, make a table?
S1: Ache, let's just draw the map.
(My own emphasis added.)

The students' view of classification categories may be illustrated thus:

Figure 3.1. Students' Classification Structure



The above extract illustrates the potential of small group discussion to take learning beyond the knowledge base provided by the teacher. In this case students extended the structure of classification provided in their attempt to understand the nature of pollution.

During the same discussion the students identified environmental problems they encountered during the excursion and debated possible solutions for them. The problems identified by this group included overgrazing, litter and air pollution. The solutions that the students identified

for the problems they observed may also be noted in the following extract:

Extract 4 (26-03-96)

S2: Keneuoe write the effects of man.
S1: Effects of man on the environment.
S2: Man has affected the habitats of the environment.
S1: You can write the effects of man on the environment.
S3: Okay, by overgrazing.(KEP)
S2: Overgrazing, litter and air pollution or polluting. (KEP)
S3: But the litter is pollution. (CS).
S1: Just write pollution.(PI)
S2: So that's all? (laugh)
S1: Now let's go to the suggestions, they should not keep the animals on one place, they should graze them over different places. (KS)
S2: Eh (what)?
S1: They should not place them in one place, they should graze them in different places because overgrazing can be due to soil erosion. (KS)
S3: They should...
S1: ...The suggestion for litter.
S2: All litter should be recycled and all things that can't be recycled should be thrown in the dongas or make compost. (KS).

Key:
PI: Prescriptive Idea
CS: Challenging Statement
KEP: Knowledge of Environmental problem(s)
KS: Knowledge of Solution for Environmental Problem(s)

The discussion allowed this group to reflect on and share views on the environmental problems they had observed. Students went on to suggest possible solutions for these problems. It is noteworthy, however, that much of the extract shows that students jotted points down as they were raised by group members, rather than debated them first in order to record group conclusions. Such debate could possibly enable students to crystallise their understanding of the environmental problems and solutions by formulating arguments based on their observations during the excursion. Even when some students made what seem to be potentially debatable statements their views were not discussed or questioned: this may be noted when one student questioned another student's use of the labels 'litter' and 'pollution' (see CS) and when one prescribed an idea (PI).

The next extract reflects a moment, during the discussion, when some students' suggested solutions for environmental problem(s) stimulated others to question, suggest alternative

solutions, debate and reason.

Extract 5 (26-03-96)

S3: So I should write what?
S1: They should burn the rubbish.(IK)
S2: Burn it?(SQ)
S1: Burn the rubbish and take the one which they can recycle.(AS)
S3: If they burn it, the air will be polluted. (laugh). (SQR). So there has to be something about those dams which smells.
S2: Put something like a glass so that the air can not escape to, to.... (KS)
S1: May I ask, what about the compost, what if you pit the compost, it will still cause air pollution?(IR)
S3: Mamello! Mamello! It's not dirty! (ES).
S1: How do they do it? (RQ)
S3: It depends how they do it, you see like if you throw... .
S1: So what's the suggestion?
S2: They should put maybe a glass.(KS)
S3: Yes!
S1: Around the dam, it's too expensive. Even if they put a fence, there's no money for that. (SQR)

Key:
KEP: Knowledge of Environmental Problem(s)
KS: Knowledge of Solution(s) for Environmental Problem(s)
SQ: Solution Questioned
AS: Alternative Solution Suggested
SQR: Solution Questioned with Reason
IK: Inappropriate Knowledge
IR: Issue Raised
ES: Emphatic Statement
RQ: Raises Question

In the above extract the students identified some environmental problems and attempted to debate their solutions. Limitations apparent in the extract are that students did not systematically follow through on an issue to thrash it out and then move on to the next. For example a student S1 raised the subject of *compost* in the middle of the discussion (designated IR) on the solutions for pollution of the dams, and this diverted the discussants from the subject of focus for a while. This was problematic as it interfered with the group members' attempt to think through and exhaust the issues. A further problem may be noted with a student who made an emphatic statement (see student S3 above), apparently due to her impatience with others' questions. This may also deter other less assertive or shy members

from questioning. On the whole the extract reflects students involved more in brainstorming than discussion in their attempt to complete the given task.

The group discussions ended with the individual groups reporting and each writing a summary report on the chalk-board. When the shy students spoke softly the teacher took their note-books and reported on their behalf (Fieldnotes 26-03-96). The impact of this action on students' learning was never investigated further, as Lebu did not enter into the second cycle.

3.2.3. Conclusion

To conclude, an excursion which was guided by an open-ended intention to explore the impact of humans on the environment had the potential to develop ideas of environmental literacy as understood by the research team in the present study. This was evidenced in, for instance, the development of students' knowledge about their local environment as they discovered new species of plants and animals, became aware of pollution and associated problems, and realised the contribution of humans to environmental pollution. There was also evidence that the excursion motivated some students to think about solutions for the environmental problem(s) they encountered.

The students participating in the small group discussion talked and learned about the environment they explored. According to the ideas and views of the research team, as outlined in Chapter Four, such learning about the environment "what it involved" and "what things are involved" within it, constitutes a dimension of environmental literacy. As students classified the objects they had encountered into living and non-living things, they recalled and reflected on numerous plants and animals and the litter they had observed, distinguished between (species of) living organisms, and went beyond the classification structure, provided by the teacher.

Similarly, when discussing a question on environmental problems and possible solutions for them, students reflected on environmental problems they had encountered during the excursion and 'brainstormed' how they could be solved. They suggested solutions for

environmental problems and to a certain extent questioned their viability and presented alternative solutions.

Some limitations were also noted in the way the students participated in the discussion. There was some evidence of other students possibly domineering or prescribing their own views whilst others did not say much. The voice of the fourth student, for example, was not heard at all in the extracts presented. This suggests that whilst small group discussion may be a useful approach in learning about environment, its effectiveness depends upon members within a group participating effectively in discussion. How this might best be achieved within this context could be a subject for further investigation.

3.3. CASE STUDY TWO

Map taught a Form A class, at a school located in Maseru city (see Tables 2.1, 2.2). Drawing on ideas from the first planning workshop, Map and I decided to plan science lessons so that she could relate the concepts of filtration, unicellular organisms and magnetism, within the Junior Science syllabus, to the students' local environment.

In this section I discuss teaching approaches that Map employed to teach the concepts of filtration and unicellular organisms (see Examination Council of Lesotho, 1995), using pond water that students collected from their respective home environments, as well as approaches she used to teach magnetism with an environmental perspective. The teaching approaches she employed included assigning students the homework task of visiting the nearest pond(s), the whole class interactive method, laboratory activity and small-group discussions. Within the context of this teaching method I will illustrate how Map creatively integrated science concepts with water and land pollution and pollution prevention measures.

I conclude this section by arguing that the teaching strategies employed by the teacher developed the students' understanding of aspects of their local environment, which constituted an important dimension of environmental literacy as interpreted by the research team (See Chapter 4).

3.3.1. Whole Class Interactive Approach and Learning Outcomes

The term "whole class interactive approach" in this and the following sections is drawn from the phrase "whole-class interactive modes of instruction" used by Bodner, Metz and Tobin (1997), and describes a teaching approach which is predominantly teacher-centred. but within which the teacher involves students in the process of learning through questioning. Map began the lesson by asking students whether or not they had ponds or dams at home. She continued by asking students to name things that they had seen in the pond environment, to say what they used pond water for and what the characteristics of living things were. Below are some of the questions that Map posed to elicit the students' responses and class discussion:

- *Now we are appealing to our sense of sight. What do we usually see in that environment. Tell me what you have seen there. Yes?.*
- *In your own village what do you use ponds for?*
- *Now what are five characteristics of living things? What are the characteristics? Now for a thing to be living, what signs must it show?*

Some key concepts that she addressed in this lesson concerned the use of the sense of sight to observe living things and non-living things in and around the ponds; a review of the characteristics of living things (with reference to those found in the pond environment); and students' views on ways in which pond water is used in their home environment. The students' responses during this lesson are summarised in Table 3.3.1 below.

Table 3.3.1: Students' Learning Outcomes from Map's 'Pond Lesson'

Things that occur in the pond environment	Ways in which people in students' community use pond water	Characteristics of living things
-'stones and rocks'; -'fish in water' -'frogs' -'some small plants' -'dragon flies' -'*mahlaka*' -'*moluoane*' -'spiders' -'spiders' -'fine soil' -'heron' -'tadpoles' -'kuili'	-'for watering' -'building' -'washing' -'cooking' -'drinking'	-'they breathe' -'they grow their young ones' -'they produce their young ones' -'they excrete' -'they die' -'they eat' -'they are made up of cells' -'they are born alive' -'they are sensitive' -'they have skins' -'their skins are made of scales' -'they cry' -'they suckle their young' -'they show movement by the legs' -'they grow' -'they breathe by lungs'

The information in the three columns represents the students' immediate responses during discussion or in response to the teacher's questions. Incorrect or partially correct responses (e.g. they have skins; they cry) were probed further by the teacher for correction. In this lesson the teacher proceeded to give students an assignment to visit the nearest pond in their respective home environments and to:

a) draw a pond, including all things found in and around the pond, as well as

b) bring a sample of water from the same pond to school.

3.3.2. Laboratory Activity and Learning Outcomes

In a follow-up to the above lesson, the students worked in groups in the laboratory and experimented with the water samples that they had collected from the ponds. In the following sections I discuss class activity around filtration of the water samples and illustrate how the teacher integrated this concept with the concept of water pollution. I also show that the filtration activity involved the learning of new terminology and enabled students to

manipulate scientific apparatus to observe, examine and identify living and non-living objects. Other teaching approaches I discuss include the teacher's use of students' drawings and microscopes to study the pond environment.

Application of Filtration Method and Learning Outcomes

The teacher demonstrated how the students should set up apparatus in preparation for filtration of the pond water samples, and what the students should do to filter the water:

> Lesson (29-02-96):
> T: Take out those apparatus... the measuring cylinder, the funnel and the filter paper. First of all, fold it into two halves like that, and then into quarters. Fold it to a half and then a half of that half like that. There is a measuring cylinder. And then you put your funnel there. But before....Now when you have finished folding that, clean it under the tap. Don't rush. Just one member of the group. Be careful when you open that tap....

The students worked in small groups to filter their water samples. When the groups had completed filtering the teacher guided the class to examine the resulting filtrate and the residue (i.e. material trapped on the filter paper):

> Lesson (29-02-96)
> T: You think it is clean water. Do you all agree. Filtered water, clean water? Yes?
> S: Drops of water.
> T: Drops of water? Ok, usually we call this water that has been filtered or any liquid that has been filtered, we call it a filtrate. That which has been filtered we call it a filtrate. Filtrate!
> S: Filtrate! (chorus).

Next, the class identified the composition of the residue. Various groups closely examined things that were trapped on their filter paper after filtration. Some of the things that students identified, as reflected in the extract below, included "insects"; *"bolele"* (Spirogyra); *"Matsoaitsoai"*(ant); "humus".

> Lesson (29-02-96):
> T: ....what do you see on the filter paper? Some dirt like?
> S: Insects [inaudible].
> T: You have observed some insects. Very tiny organisms there.
> S: Bolele.
> T: Bolele. That is also there.
> S: Mantsoaitsaoi.
> T: Ants, what else?
> S: [inaudible].

T: Insects..... When we talk about insects we talk about those organisms with six legs. We agreed on that. Don't name any organisms as an insect. Just those with six or 3 pairs of legs as insects. Ok, somebody. What else is there?
S: Humus.
T: Humus, good! What are humus?
S: A thing like grass.

As apparent in the next extract, the teacher then creatively identified together with the students, the meanings of the following scientific concepts in the context of the filtration activity: 'living' and 'nonliving', 'insect', and 'pollution'.

Lesson (29-02-96):
T: ... All right, those things that you see on the filter paper are they living or non-living?
S: [inaudible]
T: ...Some are non-living. Which are they? Yes?
S: Insects.
T: Which insects? Which one? Which insects? All right, yes?
S: Spider.
T: Spider? How many legs does a spider have?
S: Eight.
T: It has eight legs, so we cannot say a spider is an insect. However, it is one of the organisms we find in water. Do you find it alive or dead? Now we are talking about water pollution....

The concept of pollution was of primary concern to Map and myself when we decided to link filtration, in the Junior Science syllabus, with water pollution. The teacher introduced this concept to the class as follows:

Lesson (29-02-96):
T: ...Now our topic there is water pollution. Why pollution? That is water pollution. We mean dirty water. Dirty water. The water has been polluted. And what kind of things pollute water?...
S: Animals.
T: Animals. Dead animals that you find in the pond, thrown in the pond. Tadpoles? Why tadpoles? Yes?
S: Broken glass.
T: Broken glasses.
S: Bones.
T: Bones.
S: Tins.
T: Tins? Who throw them?
S: Human beings.
T: Oh human beings throw tins into water. Human beings get water polluted. Yes.
S: [not clear].

T: Can you speak up please.
S: Keresi...
T: Oh these traditional ones. Traditional vegetable...You find them plenty in water. So these are the things that pollute water....

Viewing the class activity as a whole, it is apparent that Map logically derived the concept of pollution from the context of the filtration of pond water. Thus she integrated pollution with filtration and made apparent its connectedness with the students' home environment. The concept of water pollution is not mentioned within the context of filtration in the Junior Science syllabus (Examination Council of Lesotho, 1995) and the textbook (Ministry of Education, 1988) prescribes that a liquid used for filtration be prepared by mixing mud with water.

Map also directed the class to consider diseases associated with polluted pond water, and challenged them to think of pollution prevention measures. To facilitate this she creatively referred students to the drawings which she had instructed them to make when visiting the ponds.

Lesson (29-02-96):
T: ...Sometimes you may go into the dam, into the well, during drought when there is no water and get water for cooking, and get some of the things, those tiny, tiny organisms into our bodies. We start suffering from which diseases? Yes?...
S: Cholera.
T: Yes! These are the kind of things that make us sick, Cholera. So the pond water is polluted water. It has bad things. Including organisms that cause cholera. Any other disease?
S: Pimples, small pimples.
T: Pimples not pimples actually but...
S: Sores.
T: Any other disease?
S: Common cold.
T: Common cold?
S: Typhoid.
T: Typhoid! Yes! So many people have died from typhoid that is eh from this water, pond water; contaminated or polluted water. So how can we stop this? How can we stop this pollution? How can we stop it? You see it makes people become sick, people are killed? What can we do?
S: Madam.
T: By? All right we want to improve these conditions. Look at your dams. How can we improve the environment there?. Look at your own dams. Look at what you have drawn. How can we improve the situation there, so that we cannot

have the water polluted?

S: (make a "seftrat")

T: All right make security fence around the dam or at least fence the environment, or the dam. Yes.

S: (inaudible)

T: Make a sentence. Make a full sentence. All right, how can we stop this pollution, that is the question...?

S: I can stop it by planting trees and putting eh a wall or walls.

T: Making a wall around the dam? How will it prevent?

S: It will prevent to put the, it will prevent so that, so that the, the people will not throw tins or bottles.

T: All right that is another eh way. Any other way how we can stop water from getting polluted? You said that you go there for washing clothes, for washing yourself. Are you still going to go there? For washing clothes? For washing you body? You, yourselves are not going to go there, what about other people?

S: We can take that water and go home with it.

T: Oh so take that water and go home with it and boil it and...

S: Wash yourself.

T: What about this experiment. Aren't you going to apply this experiment in any way? Look at the filtrate?...You can perhaps filter the water and boil it, we can filter it and boil it and maybe in the right condition, the water can be useful. All right what about other people? How can you warn other people so that they can be able to take care of the water that they are using?... All right the dam is useful. How useful is the dam to the people?...

Other solutions that the students suggested were: "remove rubbish around the dam"; dig a hole into which people can throw rubbish; "we can make matsema"[5] ; "make a notice and tell that they can not pollute the place".

The teacher proceeded to engage the students to think about

- how they could apply filtration to purify pond water for use;
- how they could encourage other people to take care of water (in the dams); and
- how useful dams are to people.

Many of the teacher's questions seem to have emerged in the context of teaching, without prior planning. This may had be the reason why the questions were not given sufficient time for discussion.

5 *Matsema* is a plural of *letsema*, which is a strategy of problem-solving in Lesotho which involves people organising themselves into a team to deal with a particular social problem. This strategy is commonly employed, for example, in farming activities such as hoeing and harvesting.

The teacher's use of students' drawings in this way seemed to facilitate the students' reflection on things they observed in the ponds. The teacher selected some of the drawings, and pinned them up in the classroom, adding the heading "Pollution". She had informed the class that she would select the best pictures to pin up. As the class adjourned from the class to the laboratory to undertake the filtration activity, Map and I briefly shared some ideas on the first part of the lesson. We were doubtful as to whether the students pictures' represented dams that the students had actually visited, since many students did not bring the sample of water. Later in the Laboratory Map probed students on this matter:

Lesson (29-02-96):

T: ...you have the pictures of the pond showing everything around the pond you visited and it should have been accompanied by a bottle of water from the same pond. That's what should have happened. I see eh very few bottles [of water]. Now I begin to wonder whether eh you visited the pond. Did you visit the pond?

S: Yes madam! (chorus).

T: Do you all have ponds around your home? And what did you do? Did you draw something like the one I have here on the board?

S: [Many said yes- Observ. notes, 29-02-96]

T: Now eh, all right, lets look at those ponds. Now there is one thing very important. When you are asked to draw, don't draw what you think is there...

So it seems that, many students simply used their imagination to draw a pond, or copied the teacher's 'right' picture from the chalkboard, rather than visiting a pond and drawing what they observed.

Map immediately reflected on how the 10 samples of water might be used by a class of 48 students, as well as how she could motivate students to do their homework. When sharing her research findings at a research team workshop she explained how she dealt with this situation:

Workshop (16-08-96)

...now we had 48 students, but only 10 of amongst those had brought pond water; and then I started asking them, and some answered that they were afraid they could fall into the dam, others, there were no dam around their places, but others were em reliable enough to bring the pond water, and I made sure that I rewarded these who had brought pond water, by making them group leaders as we used the pond water afterwards. Now we had then, ten samples of pond water, and then we had em ten groups, ten groups of four to five students....

Following this lesson I suggested to Map that we interviewed some students to establish why they did not bring water samples. I formulated questions which we subsequently discussed (Fieldnotes, March 1996) (see Appendix 5). We decided that I should interview a group of four students. Three of them did not bring the water and their reasons were as follows:

- *afraid that I may fall into the dam (1).*
- *the dam was far away from where I lived (2).*
- *forgot the water at home (1).*

Two of them did not visit a dam/pond because the dam was too far away, but they drew and listed things found in the pond environment. The third student did observe a dam and drew it, but could not bring a sample of water to school because the dam was in a private compound, and she was afraid of "big dogs" in that compound.

These responses threw light on why these students, and possibly others, did not do their homework. On my part, the responses brought into question my assumption that the students were 'deviants' poised to defy the teacher or 'lazy' and in need of 'motivation'. Map's attempt to 'motivate' students who did not do their homework by making those who brought water samples group leaders suggests that she held a similar assumption.

It can be argued that activities such as the above homework shift the responsibility of learning to students and that this requires a relationship of trust between the teacher and the students. The teacher ought to be able to trust that the learners are eager to learn and are motivated to do so because they see the relevance of their studies to their own environments. From this perspective, there would be no need for the teacher to 'motivate' students to learn when they have not done their work, but rather to communicate with them to establish factors that might have inhibited them from doing their work, and to explore solutions together with them.

The water samples were kept for the next lesson, for the class to observe the microscopic organisms found in the pond water. However, these samples were never used since there were no cover slips. The school had only one functioning microscope, which the teacher used with the class to observe a ready-made slide of an amoeba (Observation-notes, 01-02-96).

Microscopic Work and Learning Outcomes

In this lesson the teacher introduced amoeba in the context of water pollution, as a biological organism which can make water unhealthy to drink. During the lesson a class of 48 students queued up to observe a prepared slide of an amoeba under a microscope. Students were not allowed to touch the microscope and all students had observed the slide in eight minutes (Fieldnotes, 01-02-96). The student sitting next to me seemed to have developed a misconception about an amoeba. My fieldnotes reveal this:

> I observed the slide under the microscope, it was not a good slide of an amoeba. (Some teachers, not science teachers, observed the slide out of curiosity; when we were in the staff room, one commented that the specimen looked like a 'horse'. I observed the specimen, and observed a 'horse' shaped structure. Later in the classroom a student sitting next to me commented to his friends that the specimen looked like a horse. (Fieldnotes, 01-02-96)

The lack of sufficient microscopes and the absence of cover slips in Map's school diverted our initial intention to involve students in a study of micro-organisms found in pond water, to a study of an organism that *could* be found in the pond water. Moreover, the students did not have the opportunity to manipulate the microscope. Yet the ability to use a microscope can be argued to be an important basic scientific skill. The following extract illustrates how the activity proceeded:

> Lesson (01-03-96):
> T: ...So I want you to come round one by one to look at this, but quickly indeed. Don't....One by one do that quickly because you are many, and we have a single period (40 minutes lesson). So let me check very quickly. (S One, two, three)....(23 sec). I think you will be able to see. Now don't move anything, don't move the microscope, don't adjust anything. Just use your eyes, look at that and move for other people to see. Ok...next person. (S:Hee!).

Confronted with this shortage or lack of laboratory equipment (microscopes and cover slips), I began to critique the curriculum (Fieldnotes, 01-02-96). In the fieldnotes I jotted down after the lesson I raised several questions. Based on the assumption that microscopes were unavailable because the school could not afford to buy them, I asked: Why should the curriculum in Lesotho be shaped and be driven by the curriculum from the North (i.e. studying organisms through a microscope), rather than by the needs of Lesotho? I considered this case as an example of a developing African country employing an imported modernist

curriculum that required the use of microscopes that were unaffordable. Such a curriculum, I thought, was not shaped by the socio-economic contexts of the country. Consequently, attempts made by Map to implement the curriculum generated further resource needs (i.e. microscopes). From this perspective, the curriculum may be expected to disempower rather than empower, dehumanise rather humanise, create deprivation rather than wealth, and create further dependence rather than independence. However, this condition may also be viewed as a laboratory management problem. There are reports of the problem of poor management of school laboratories in Lesotho. Talukdar reports that schools in Lesotho "have simply not developed a system of maintaining laboratory facilities at a reasonable level" (1996:11). There were several microscopes in Map's school which could not be used because they were out of order. Map alluded to this problem at a team meeting/workshop.

> Extract of Research Report (17-08-96)
> So I had to take, prepared sample of amoeba and show them that under the microscope**; but that didn't give them much practice, they had to do something themselves**. But because (inaudible) we had **just one functioning microscope**, under which I showed them em amoeba, using a ready made slide.... (My own emphasis added)

However, her comment that students "had to do something themselves", which was impossible with one microscope, may be seen as a failure on her part to have foreseen this problem and planned the lesson differently.

The teacher concluded the laboratory work by asking the students to formulate questions in small groups to interview their parents and other people at home on how pollution of the local dams could be prevented. She presented the assignment thus:

> Lesson (29-02-96):
> T: All right we said that we are going to make our own questions. Our own questions. The questions that we are going to take home with us, to interview our parents or people in the village. Our neighbours and the other people in the village as to how they think dams can be taken care of. So you put a...question. Any question you may like to ask them, about this pond or these dams that are being polluted. That are getting.....because they are polluted. People are pouring the dead animals and other bad things. So, now one of you, one of you should take a pen and write down the questions. That is one of you should be a secretary. Choose a secretary in your group. Don't start making noise. Do that very quietly.

In addition the teacher gave the students a homework assignment, to write short messages that could be displayed on a big board next to the dam/pond discouraging people from polluting the dam/pond (Fieldnotes, 29-02-96).

3.3.3. Interviewing People on Pollution

In this section, I focus on one of the small groups formulating questions to use for interview. There were four students in this group. I analyse the process of discussion, the type of questions formulated and emergent problems. I also discuss the students' reporting of interviews in class, after they had interviewed people at home.

This group formulated the following questions:

- *What can you use when the dam is not clean?*
- *How can you prevent water pollution?*
- *How can you stop the person who put the things in the water pollution?*
- *Who throw bad things in pond [or dam]?*
- *How can we prevent water pollution in our land? In the pond [or in the dam]?*
- *How can we make a person who throw the rubbish in our dam [or pond]?*

It is apparent that some of the questions did not make much sense or were grammatically incorrect, and this is attributable to the students' limited proficiency in English. This problem of language is also illustrated in the following extract, wherein one student (s2) starts the discussion by first clarifying the teacher's English formulated question, in her mother tongue. Then the group proceeded to formulate questions for interviews in English.

Group work extract (March, 1996).

s1: (Talks close to the tape-recorder). My name is 'Ma....Ngola date. Nthabiseng, you make noise. And you? (students talk).
s2: Ke hore in Sesotho re ka hloekisa ma, matamo a rona joang? Ka ho etsa joang? Ke potso akere?
s3: You collect the stone in the dam.
s2: U botse. U lo botsa 'me oa hao, le emong oa heno kapo..
s3: Security fence.
s2: Ua botsa. Ho thoe re botse hore na....
s4: What can you use when the...the dam is not clean?
s3: How can you prevent water pollution?
s4: Yes, she is correct.
s2: Why can you say "yes"?

s4: I say it's correct.....
(Teacher intervenes, talks to the group)

The students' struggle with the English language when formulating questions is also reflected in the following extract:

Group work Extract (cont.) (March,1996)

s1: Hm! How can we stop the person who put the thing in the water pollution? How can we stop the person?
s2: 'Na ne ke nahana hore akere ha re etsa lipotso madam.
s1: Wait we must use the ball pen because...
s3: We must use a pencil because when we got problems, when we got a wrong spelling mistakes we make it with a rubber, so what about a pen when we have got a mistake?
s1: Another question. How can we stop the person who make a water poll... (students speak at the same time).
s4: Who throw bad things in our pond or dam?
s1: How can we stop...spelling sa person.
s4: Person. Person. Per, son. How can we prevent, how can we stop a person who throw bad things. Who, double U.
s1: A rubber please...
s?: W, H, O.
s1: U tsebe cassette e ntse tsamaea.
s2: Who throw the rubbish. Throw, throw, throw.
s3: Rubbish in our, rubbish things in our. Throw rubbish germ or....in our.
s1: Another question. Who has another question?

(Teacher, intervenes)

T: All right I think you will finish up in your spare time. But before you go home, I want you 1,2,3,4,5,6,7,8 exercises.
S: Ok, madam. Yes madam.
T: Now you must finish those. I want to see those before you go home. And I want....
S: (Students speak loudly, whilst the teacher is still talking).

(Group discussion continues)

s?: How can we prevent water pollution in our land? in the pond or in the dam? How can we make a person who throw the rubbish in our dam or ponds?
s1: Why don't you write?
s2: I write.
s1: Why don't you write?
s3: Stop playing. Go back to your seat. Do you...
s1: Mookho stop playing. Mookho Masakala stop playing.
s2: Question about water pollution.
Tsepo: Thank you very much.

The question "How can we make a person who throw the rubbish in our dam or pond?" appears to have lost meaning as a result of the literal translation of Sesotho into English. Part of the question *"How can we make a person who throw..."* is a literal translation of a meaningful Sesotho phrase *"U ka mo etsang motho ea lahlelang...?"*; which could mean "what can you do when a persons throws....?", when properly translated.

It is also noteworthy in the above group discussion excerpt that the students were very conscious about getting the spelling of English words correct, in addition to their struggle to formulate sensible questions. It is remarkable that this group, which did not have a nominated group leader, was mostly focused on the provided task and several questions were constructed. Perhaps the use of a tape-recorder, which they appear to have been conscious about, ensured their commitment to the task.

Map thought that the group discussion was helpful in exposing the students' conceptualisation of pollution.

> Reflection Workshop (16-17 Aug. 1996).
>
> And I, I realised one thing, that this idea of pollution had not struck the minds of some of the kids that, they did not understand what it was; I was then aware, at one point I was, I took for granted that all students were clear of what pollution is; now this is one thing em that happens in the class, when you take for granted that students are quite clear and they got a direction of what they have to do. Now out of activity, out of doing something then I could see that the kids were not clear of what is pollution. **They took pollution as something rather than a situation...** They are in a group work or in a discussion; student one [in the lesson transcription] says "how can you stop the person who put the things in a water pollution".... (My own emphasis)

It is apparent that Map thought the students' question, "how can you stop the person who put the things in a water pollution", was more than just a language problem but reflected the students' misconception about the meaning of pollution. It could also have been that they simply confused 'pond' and 'pollution'.

In conclusion, the task that the teacher gave to the students was orientated towards the views of the research team about the meaning of environmental literacy. Although students did not actually 'take action' to solve any environmental problem when formulating questions for

interviewing people at home (see Section 4.1.2.), they were engaged in a process of thinking about 'action' for solving the problem of pollution of ponds. It can further be argued that in this context it was essential for the students to construct meaningful questions in order to elicit sensible information from other people on possible strategies of dealing with pollution. However, the group examined above struggled to formulate sensible and grammatically correct questions.

The teacher called the students to the front of the class, one at a time, to report on their interview findings and to read out their written poster messages (Fieldnotes 06-03-96). Students had to first read their interview question(s) before sharing the views of the respondent(s) (Fieldnotes 06-03-96).

Table 3.3.2: Students' Interview Questions and Responses on Pollution

Some students' formulated questions	Responses from parents/people in students' community
Student 1: "How can you protect your pond?" "Why haven't fenced your dam?" **"What** you keep your pond clean?"	"By making security fence around the pond, ponds". "The pond should not be filled with dirty water, it should be cleaned by changing water...[not clear]". "To put the...[not clear] around the dam and put the bricks and wire around the pond".
Student 2: "How can you prevent people to put rubbish in the pond?" "How do you prevent people to put the rubbish in your pond?" "How can you do to announce such a problems?" "Do you notice the people who do not, do rubbish there?"	"I prevent people to not making rubbish in a pond by making a security fence". "I can prevent people by making a fence". "I can announce such problem by making a board". "No, I do not notice the, the people about that".
Student 3 "Is there a reason to put a security around our pond? Why?" "Do we have to keep our pond clean?"	"There is a reason for putting security around our dams because by doing that we prevent deaths of children killed by pond water by drowning". "Yes, we have to keep our ponds clean. By keeping out ponds clean we prevent many diseases, diseases that can be prevented".
Student 4 "How can we stop children who swim in the pond ?" "How can we stop about...How can we do about people throwing dirty things in the ponds?" "How can we stop people that are washing near the dams?".	"We can prevent the children from the dam by closing a dam". "About the people that are throwing the dirty things, we can make meetings and taught them how it is important to keep our dams". "We can prevent that, we can prevent the people that are washing near the dams by punishing them with heavy punishment and order them to prevent washing". "We can prevent the people that are washing in the dam by punishing them with heavy punishment and order them how is good"
Student 5 "What will happen to our pond if we throw rubbish in it? What will happen to our village by the bad smell of rubbish we throw into the ponds? What will happen to the human beings when smelling starts, when smelling starts?"	"Eh bacteria will be many and our village will smell bad. Take people who do that to the office and get punishment if they do that again. It can, it is not good because we will get sick for many things".
Student 6 "How you protect your pond?" "How can you keep your pond clean?"	"By making a security fence around the pond" "The pond should not filled with dirty water? It should be cleaned every week by changing water and must put the notice or the people do not to throw dirty things in" .
Student 7 (na)*	"We can make 'matsema' to prevent rubbish things. We can fence the pond with security fence. We can do the gather to keep the pond clean"

* The question was inaudible from the audio tape recorder. NB Extract wording, unedited.

As may be noted in Table 3.3.2, above, many of the questions and responses were grammatically incorrect and therefore unclear. The teacher attempted to deal with the problem of language by reformulating the student's grammatically incorrect and meaningless questions:

Extract (06-03-96)

S1: "Why **haven't fenced** your dam?"
T: Why **haven't you fenced** your dam? That is the next one.
S1: **What** you keep your pond clean?
T: **Why** don't you keep your pond clean? That is the third question. Now, how many questions do you have?
S1: Three questions.
T: Three questions. Now what are the answers to the questions?

When one student read the interview questions she/he had difficulty with the word 'pond'. His/her question was badly phrased and did not know how to pronounce 'pond', which suggests that this he/she might not have known what the word meant:

Extract (06-03-96).

S: **What can you use when you cover in your 'poem'**?
T: What is it? Is that a pond or what? If, if it is difficult to talk about the pond, talk about the dams. Dam is easy.
S: "What can use...What can use when you keep...".
T: I hope you are listening.
S: **"What can use when you keep water clean in 'poem' in dam**?".
T: I said if pond is difficult, use dam. All right let me write it. It is dam or pond. Dam, pond, pond. Say pond class.
S: Pond (chorus).

(Emphasis added).

Further evidence of the English language problem in this class is captured in my class observation notes of this lesson. I recorded observing that many students hardly read their questions well when they were written in good English. This, I thought, suggested that they might have received assistance from educated members of their family (Fieldnotes 06-03-96). Later, in my interview with Map, when reflecting on the lessons that she had implemented, Map also mentioned the English language as a problem for students:

Reflection on Lessons (16-04-96):

Map: ... they fail to express their ideas (E-eya Ntate).
Tsepo: So is that the reason you feel it is important, that they speak English?
Map: E-eya Ntate, correct.
Tsepo: Correct...Okay, Okay.
Map: I think Ntate-there are several times when they (pupils) make their statements

> you could feel that these kids were thinking in their language and then... they fail to come up with the idea they have; when they say something it becomes different from what actually they wanted to say, e-eya Ntate; because they had to think in their language and translate that into English...

Many of the students formulated grammatically incorrect or very poorly phrased questions for interview (Fieldnotes, 06-03-96). This reflects the problem of the use of the English language in the teaching of science in Lesotho. Limited proficiency in English limits effective communication, and may hinder students from critically discussing environmental issues, sharing opinions or learning basic environmental concepts, thus preventing them from developing meaningful understandings of their environments.

It can be argued that the interviews that the students had to conduct with people in their community should rather have been formulated in Sesotho to enable effective and meaningful communication. The use of English by Map and her class in this way, in communities dominated by a local language, Sesotho, may create an undesirable situation whereby scientific knowledge is "caged within the linguistic fence of its colonial inheritance" (Ngũgi wa Thing'o, 1996:22).

The success of the interview and report-back activity was further qualified by Map's attempt to involve all the students in reporting. All 48 students reported their findings in class. In my class observation notes of this lesson, I noted the following points, which I subsequently shared with the teacher:

> teacher calls students who have done their homework to the front [to read their homework for the class], one at a time. After some time some students show little interest in the students who are reading. Students sitting next to me are sleepy. After some time students who are not reporting begin to talk. (Fieldnotes, 06-03-96)

Teachers with large classes might reasonably choose to involve fewer students in class activities in order to avoid 'wasting time' and/or monotony to the disadvantage of many students. In my school-visits for a university teacher training programme in Lesotho in 1997/8, I observed that many schools within the capital city, Maseru, and surrounding areas had overcrowded classes, and that as a result few students participated in class. It may be difficult for teachers in such crowded classroom conditions to apply teaching approaches that

actively involve students in the processes of learning, such as excursions, student-centred laboratory experiments, group discussions and reporting of group conclusions. Approaches of this sort are likely to encounter problems such as limited resources and lack of time. Crowded classroom conditions may therefore be seen as inappropriate for teaching approaches with the potential to meaningfully develop students' understanding of their environment.

3.3.4. Constructing Posters to Address Pollution

Drawing on the ideas of the team, developed at the planning workshop, about the meaning of environmental literacy, Map and I decided to engage students in an activity to make them think about possible solutions for water pollution. She gave students a homework task to develop posters which could be placed near a pond/dam to caution people not to pollute water.

In the next lesson all 48 students read their poster messages, one at a time, to the whole class. The Table 3.3.3 below lists some of the students' poster messages, as they read them.

Table 3.3.3: Students' Poster Messages

Messages Written by Students on Cards to Caution People Against Polluting the Pond.
"Don't throw dirty things on the pond or dams" "Warning! Don't throw the rubbish in"... Oh sorry, "in the pond" "You should not throw dirty things in this pond" "Do not throw rubbishes into the pond. It is an offence!" "Here is where you can put anything and burn it" "Please stop throwing the rubbish in our pond or dams" "Please stop throwing the rubbish in out ponds or dams" "We can throw rubbish in this rubbish bin. Don't throw rubbish in our dam" "Don't throw rubbish in the pond because this is where our life comes from. We can't live without water" "Pour a rubbishes a rubbishes in this rubbish bin please" "Don't rubbish inside the pond. Because when some people went there to wash their clothes they, they didn't wash them because of that rubbish" "Don't throw rubbish in our pond. Let's keep our pond or dam clean. If we work together we can" "Please don't throw the rubbish in this pond, because it is not a rubbish bin" "Please don't throw the paper or tins in the pond" "Notice! Notice! Please don't throw the paper or tins in the dam or pond" "Don't throw the dirty. Don't throw the dirty things in the dam" "Please don't pollute this water because it causes many unnecessary diseases" "Please don't throw. Please don't pollute this water because it causes many unnecessary diseases" "Don't throw dirty things in the pond or in dam"

The teacher subsequently advised the students to place the posters next to the ponds, in their community. She also provided students with guidelines for making posters:

> T: All right we have heard the, the posters, the notices that are going to put next to the dams. Now your posters or your notices should be clear. Should be clear and brief. Don't make many words. Just write something very important clearly and briefly. Don't make a story because people will just pass it by. They can't stand there to read the whole story on the posters. Just write something very important briefly and clearly. And it should be short and be very clear. That was great work you have done. (Lesson, 06-03-96)

One motivated student did as the teacher suggested and placed a board, with his own message written on it, next to a polluted dam that he visited. This became apparent during the interview that I had with him, together with three other students (May, 1996). The student mentioned that he warned people in his village to stop throwing litter in and around the dam:

> Joale 'na ke ile ka batla boardnyana ke ile ka e beha mono...lejoeng ke ile ka beha e 'ngoe, e 'ngoe e teng lapeng, ke ile ka e sia teng, hore batho ba se ke 'ne ba etsa joalo (bohlasoa) mono. Le (letamo) le lule le hloekile...ka ngola pele ka terata e itse ha ke qeta eaba ke mathisa pene mono

Putting his words in English:

> Now I looked for a board, I put it there...on a stone, I put another one, there is another one at home, I put it there, so that people should not do that (pollute) there. So that it (the dam) stays clean...I first wrote with a wire when I had finished I then traced the writing with a pen.

Reflection on the Poster Activity

It can be argued that if the poster messages were to reach many people the messages should have been written in Sesotho. The use of English in this way may fail to serve the interests of local communities. It is noteworthy, however, that when students read out their messages from their paper-posters, they appeared to be excited (Fieldnotes, 06-03-96). Reflecting on this observation, Map thought that the excitement or joy emanated from the students' exercise of "power to do certain things" (i.e. making posters) and from sharing of their dreams (i.e. messages or viewpoints).

> Reflection on Lessons (16/17-04-96).
> Tsepo: Would you say, maybe suggest...why there was that excitement among the students?
> Map: There was this, I think this is where they maybe they think they could show what they are always dreaming about **having power to do certain** things which people think they can't do as children, which they think themselves. (Emphasis added).

To elaborate on Map's viewpoint, it seems that the provision of students with an opportunity to share their ideas was a recognition of their power and that this was the source of their evident enjoyment. They exercised their power when making posters and expressing their own views/messages on them, whereas they are usually at the receiving end of the views of others.

It seems logical to argue that students may develop aspects of environmental literacy such as 'understanding of environment' and the planning of appropriate 'action to solve environmental problems' (see Chapter 5) in learning environments where they are provided with the opportunity to express their own views. The teaching approach employed by Map suggests that the provision of students with such opportunity not only engaged them in thinking about solutions (e.g. poster messages) for an environmental problem, but also proved

an empowering activity which engendered excitement among them.

3.3.5. Relating Science to Littering

In preparation for a second cycle of the process of action research, Map and I planned to relate a topic, 'Magnetism', to littering on school grounds (Fieldnotes, 16-09-96). The subtopics associated with this topic, according to the syllabus, include: magnetic attraction and repulsion, magnetic field, making magnets by stroking, and the uses of magnets in refrigerator doors etc. (Examination Council of Lesotho, 1995).

We video-recorded the lesson (Fieldnotes,19-09-96). An observation had been made at our previous workshop, in January 1997, that the video-recording of lessons could reduce the load of research work since there would be no need for the research team to transcribe and read the ensuing transcripts. Through the University of Lesotho we procured a camera man and the necessary equipment. During this lesson the students were,

- required to collect litter from the school grounds, to sort it and classify it
- introduced to the concept of recycling metallic (magnetic) objects and non-metals (non-magnetic) objects, as a strategy of conservation

In the following section I describe how the lesson proceeded by drawing on Map's narrative as she shared her experience of the lesson at a workshop. I further discuss the process of reflection on the lesson that Map engaged in at the workshop. Drawing on the perspective of the students on the lesson, I show that students constructed and retained knowledge of inappropriate environmental practice through practical engagement, but could not recall or mention appropriate environmental practice that they had been taught only theoretically in class.

Reflection from a Workshop

In this section I report on Map's narrative of her experience of the lesson at a workshop. Science teachers from several schools in Maseru had been invited to this workshop. I point

out how a question that was raised by one participant concerning Map's lesson, exposed the education system as a constraint to Map's approach and I argue that Map was reluctant to acknowledge this constraint, perhaps due to her wish to share only a 'success story'.

Map related her experience of the lesson as follows:

> Reflection Workshop (31-01-97)
> "The first thing I did with the students was to see whether they have an idea of what magnets are and magnets are..., I found that student do know about magnets and they could call them in various names like 'choke', and many other things. So I was glad that they have an idea. So now first of all.. students were made to collect every kind of litter from the environment, so I asked them to go out and for ten minutes to...collect any litter they could come across and they did. They collected papers, bottle tops, some metal sheet, and then after some time I called them in and I started issuing magnets to them.
>
> But before issuing the magnets, I made sure they could work in groups and I have enough magnets,... so after dividing them into those groups, I asked them to try all the litter with the magnets that I issued, to see which litter can be attracted to the magnet and which one do not. Now they had to make a list of those objects or those litter or that litter which could be attracted to the magnet and that which couldn't be attracted to the magnet. Now when they are finished, then I went on to....introducing adjective magnetic. So when we talked about magnetic objects and non-magnetic objects we had the action, we know what we are talking about. So I tried to explain to them that the objects that they have are magnetic objects... and those that can be attracted by the magnets are magnetic and explained that the word magnetic is an adjective to describe those objects to tell us more about those objects. So they made their list, they made a list of those objects that could be attracted by a magnet and those that could not be attracted by a magnet and they labelled them magnetic objects and non-magnetic objects.
>
> And then we went on to...a little revision on characteristics of metals and non metals, because those which were magnetic tended to be metals and those which were not magnetic were papers, grass and many others... so ultimately it became easy for us, they could mention that...the litter that was magnetic should be used for making some containers again, making metal sheets, making wire out of it and these was recycling the metals. And then pieces of paper, also could be used for making maybe...toilet paper or some tissue paper out of recycling.
>
> So we went back to the properties of magnets and characteristics of magnets and...asked the students to draw their own conclusion about the behaviour of magnets, so here I gave them an opportunity of being able to use the two magnets, so the students came together, so that in a group there were four people working together using two magnets and they fiddled with the two magnets and they realised the behaviour of magnets that some ends attract and some ends, they actually repelled others.

> Now after the activity the students were encouraged to take all the litter and throw into the rubbish bin, we made sure that all the litter was collected from the laboratory into the dust bin, and (I saw) some students outside the lab collecting papers and plastics until they got to their classroom and threw it into the rubbish bins.

Map's narrative shows that she employed student-centred and interactive teaching approaches within the lesson (i.e. group discussion, experimentation with magnets and exposition), as well as integrating students' pre-knowledge about magnets with science and littering (see Bodner, 1986). After sharing the above-mentioned story at the workshop, Map received some feedback from the participating science teachers. One participant thought that Map's lesson aptly embodied the concept of students learning through action and the attempt to teach the science topic (magnetism) from a perspective that developed the students' environmental literacy (as interpreted by the research team):

> I just want to say it's a very wonderful thing because I think it involves action... as you talk there, this [environment] is there in almost all the subjects and how do we make teacher aware of things they are not aware of... what Map did motivated the students to be more active, more environmentally literate. (31-01-97)

By contrast, another participant challenged Map to reflect on the limitations of her lesson:

> I have a question for Map. What sort of things do you pursue so that action where the students go and pick the paper, is not something demonstrated for that particular lesson because they were collecting papers outside and they played around using the magnets using those things, that is something (but) that is not on-going. Because I think the other thing that you should remember is that whatever we do in our lesson, it must not end up being just a once-off event. (31-01-97)

This participant raised an important issue associated with the examination-driven education system, which could explain the rationale behind Map's use of one lesson based on littering, without any practical work on recycling, so that she could proceed to teach new content and complete the syllabus in time. In her response to this participant, however, Map did not acknowledge the constraint created by the broader context of the education system on her initiative. It can be argued that she could not engage with her socio-historical context, to reflect critically on how it shaped her actions and explore with others how they could shape the context (see Cochrane, 1996; Nielsen, 1992:1992). Perhaps it was difficult for her to confront the limitation of her work, for she insisted on emphasising only the positive aspects:

> Okay thank you 'M'e, last year we [research team] actually chose the form A2 class

> and so it was something like a club and those kids were very aware of their environment. And each time I saw one of them maybe dropping a paper, I would say remember you are a student of environment. They stop others from throwing things, they also collect papers and tell others that they were improving their environment.

In the next section I provide an account of my analysis of the interview responses of a group of students in Map's class, in an attempt to reflect further on the lesson.

Reflection on Students' Views

In the interest of triangulation (See Chapter 2) I interviewed a group of students from Map's class in order to gain further insights into the strengths and weaknesses of Map's lesson on magnetism and littering. Shortly after the lesson, I interviewed a group of four students (see Appendix 6). I submitted questions for the interview to Map to comment on (Fieldnotes, 17-10-96). Four students were selected randomly by the teacher, two boys and two girls. I first analysed the transcriptions of the interview and then submitted them to Map for review and comment (Fieldnotes, 29-05-97). Drawing on the students' responses to the question, "What do you think your class can do so that we cannot see any more paper, plastics and tins all over?" I argue that the students could not recall or mention *recycling* as a strategy for litter management because the teacher did not take any action with her students to construct their understanding of this concept. None of the four students mentioned recycling as a possible way of managing litter, and two of them suggested that litter should be burned (See Table 3.3.4 below).

Table 3.3.4: Students' Interview Responses on Littering

Question	Response	Reason
What do you think your class can do so that we cannot see any more paper, plastics and tins all over?	- Collect the papers (2) and **burn it** (1).	- We have done this before with Maseru City Council before (1).
	- Maseru City Council should give us plastic bags to collect rubbish (1).	- -
	- Our class representative should speak to other student about litter at the Assembly. (2)	- Other students should listen (1)
	- Must use dustbins. When they are full, the rubbish **must be burned** (1).	- -

Key:
-- reasons not provided because, the student was not asked or probed to provide one.

The burning of litter involves the oxidation of the burned material and release of carbon dioxide and other pollutants into the atmosphere. The school, including Map's class, had been involved in the collection and burning of litter under the guidance of the City Council, as one of the students indicated (See Table 3.3.4). Thus, the City Council involved students practically in the burning of litter as a solution for littering. Map had simply explained to her class that recycling was a solution for littering without practically engaging her students in this method. It can therefore be argued that lack of experience with recycling could be the reason why these students failed to include the concept of recycling among their suggested solutions for littering. O'Donoghue (1993), has argued for a displacement of weak orientations of top-down messages to 'target groups' in environmental education to the notion of participants/learners communicating to 'make meaning' within the context of encounter with the environment and reflection. Such approaches may enable learners to "co-construct the conceptual, technical and social structures and capacities to solve environmental issues" (ibid: 31).

Further, it may be argued that the action that was taken by the students together with the City Council derived from knowledge that has been referred to, by Hashew (1986), as procedural

knowledge, i.e. knowledge which is applied automatically at an unconscious level. Procedural knowledge is automatically invoked once certain stimulus-response associations are present. Such knowledge is often adequate for certain purposes and when interacting with a limited domain of the world. Through such interactions certain behaviour towards environment becomes procedurally encoded. For example, littering may be associated with untidiness, and a response to this condition may be to collect and burn the litter, as did the City Council.

3.3.6. Conclusion

Guided by the ideas of the research team, shared at the planning workshop, Map tried a variety of student-centred teaching strategies. She creatively engaged students in drawing on various sources of information to develop a comprehensive understanding of the pond environments the students visited, the associated environmental problem(s) and possible solutions, and littering on school grounds.

It became apparent after interviewing some students who did not do their homework (i.e. who failed to bring a sample of pond water from home) that their failure to do their homework, and possibly that of many others who were not interviewed, was not simply that they were not 'motivated' and therefore needed to be 'motivated' to do their work, as Map initially assumed, but that they had genuine reasons for not doing the homework. It seems that communication between teacher and students, occurring within a relationship of trust, may help solve such problems.

Map further engaged students in collecting and studying the composition and nature of litter from their school grounds. By creatively linking littering with a Junior Science topic, Magnetism, Map attempted to develop students' understanding of litter so that they might learn how to manage litter appropriately (e.g. recycle it) and avoid littering. The teaching approach she employed, however, had limitations. For example, she devoted only one lesson to learning about litter and recycling; this can perhaps be attributed to the established order of teaching within the syllabus-driven education system. Further, the students whom I interviewed could not mention or recall recycling as a strategy for managing litter, which may

be attributed to the lack of practical experience of recycling within Map's lesson, as opposed to the practical and authorised (i.e. City Council) experience of burning litter. Perhaps practical work on recycling would have constructed the students' understanding and ensuring their retention of the concept of recycling more successfully than a mere mention of it in class. Moreover, Map could have dealt with problems associated with the practice of burning litter in class to enhance the rationale for recycling as an appropriate strategy for managing waste matter.

Contextual tensions also became apparent as Map tried out her planned teaching activities. As she involved all 48 students in learning activities (e.g. students' reading of interview reports) lessons became long and monotonous; the students' limited proficiency in English inhibiting their expression of ideas and views; and the attempt to observe samples of water under a microscope was defeated by the lack of cover slips and insufficient functioning microscopes in her school. The latter could be seen as a tension that derived from the established education system within which the implementation of the curricula content from the North generates resource needs locally: the need for (skilled) human resources for efficient laboratory management, and the material need for equipment.

Map's lessons, however, demonstrated evidence of reaching towards some aspects of environmental literacy as defined by the research team. Her teaching was oriented towards developing students' 'understanding of the environment' and 'awareness of the environment' they lived in, as well as motivating them to think about and take 'action' to solve 'environmental problems' (See Section 4.1.2.). For example, students observed their environment; collected objects/samples from their environment; experimented, examined and analysed the collected objects; and thought about and explored possible solutions for environmental problems through discussion, interviews and the development of posters. Her environmentally-oriented questions guided students to think, respond and act in ways that were focused on understanding their local environment, environmental problems and their possible solutions.

3.4. CASE STUDY THREE

Limpho taught a Form C class, at a school located in Maseru city (See Tables 2.1, 2.2). Following the first planning workshop, she taught the science topics 'Application of electricity' and 'Renewable and non-renewable resources' (Examination Council of Lesotho, 1995) by attempting to relate them to local environmental problems and issues (Fieldnotes, 28-02-96). Limpho and I planned her lessons together. She chose the topics, and the two did some initial preparation independently before meeting to share ideas.

Limpho tried out several teaching strategies for her chosen topics. These included the whole class interactive approach, small-group discussion, and the involvement of guest speakers.

3.4.1. Whole Class Interactive Approach on the Cost of Electricity

In a Science lesson on 'Application of electricity', Limpho gave the students some mathematical calculation problems on 'The cost of electricity' to work out as home-work. This sub-topic was part of the Science syllabus. In her attempt to relate this topic to the students' local environment she asked the class to discuss whether or not electricity was expensive in Lesotho, the advantages and disadvantages of using electricity, and how the use of electricity affected the environment. Limpho employed two teaching strategies within this lesson, the whole class interactive approach and small group discussion. She began with the whole class interactive approach which involved the teacher posing questions and students raising their hand to respond, the teacher agreeing or disagreeing with a student's answer or probing the student for clarification, and students in disagreement with a given response raising their hand to give their answer or point of view. Below is an extract from this lesson:

Lesson Extract (20-03-96)

T: A man has 60 watts bulb and two 20 watts bulbs suppose electricity costs 20 cents Per unit. How much will it cost to keep the lamps alight for 12 hours?...

S1: 140.

T: One hundred and forty.

S2: R1.40.

T: That's her answer.

S3: R2.40.

T: Ts'olo?...Two forty? I see. Any other answer?

S4: R1.44.
T: R1.44. So which answer do you want me to take?
S4: R1.40.
T: One forty? 144.
S5: R2.40.
T: 240.
S6: R2.00...
(Later)
T: ...You have looked at or you have calculated the costs of lighting and the cost of heating. Now we have a problem. Do you think electricity is cheap (in Lesotho) by looking at all these costs?

In this lesson (Fieldnotes, 20-03-96) the teacher and the students based their calculations on arbitrary electricity charges provided by the teacher, as illustrated by the teacher's use of the phrase *"suppose electricity costs [so much]..."*. Based on these arbitrary figures the teacher then discussed with the students whether electricity in Lesotho was expensive or not. This could be seen as the attempt by the teacher to make students think in abstraction, and failure to engage them with their own contexts.

When asking the students to comment on whether or not electricity was expensive the teacher required them to relate their calculations to their context. The limitation of this question, however, was that the decisions that the students had to take were not based on actual electricity charges. By drawing on some aspects of the concept of environmental literacy shared by the research team at the first planning meeting, Limpho could have developed the students' perspective of the environment in the following ways:

- the calculations on the cost of electricity could have been based on the real charge rate of electricity, and the students could have been guided beyond stating that electricity was expensive to consider why it was expensive? Who could and could not afford electricity, and why? Who determined the charges of electricity, and on what basis? This would be in line with the "awareness of the environment" dimension of environmental literacy (see Section 4.2.2).
- further, guided by the "action" aspect of environmental literacy, the students and the teacher could have considered whether the students who had electricity at home used it economically, as well as exploring ways in which it could be used economically at school.

The teacher then asked the students to discuss the advantages and disadvantages of using electricity in the environment, in small groups. Prior to the small-group discussions, the teacher used the whole class interactive approach to articulate the meaning of the concept "environment":

Extract (20-03-96):

T: ....Now looking at our environment. Do you know what environment is? You do? What does it mean?
SS: [Talk loudly at the same time.]
T: Environment means what?
S: Environment means something which is around us.
T: Something which surrounds, like your jersey, your jacket?
SS: [laugh.]
T: That is her definition. How do you, do you have any other? Yes?
S: Everything around us.
T: Give me those examples around us.
S1: Towns,
S2: Churches,
S3: Trees,
S4: Mountains,
S5: Schools,
S6: Soil,
S7: Air,
S8: Plants,
S9: Organs.
S10: [inaudible].
T: What else?
S10: Diseases
T: No I thought you said cheese? Diseases.
S11: Animals
T: Animals [echoes].
S: Hospitals
T: 'Hospatala'.
SS: [Laugh]
T: Now this is an activity..... Remember you said our environment is everything that is around us: plants, animals, people, soil, water, everything. Right? **I want you to sit in groups of five and discuss advantages and disadvantages of using electricity**. Do you understand. Advantages and disadvantages of using electricity. I haven't finished. You write down your points, OK? **If you say it is expensive OK? You explain why and how does that affect your environment**, OK?
S: Yes madam.
T: Anything you say, have good reasons. OK? So you write down your points then you pick one member who is going to make a presentation in front of the class. OK. How many minutes should I give you for that? [My own emphasis added in bold].

From the examples cited by the students, we can see that the perspective on the environment held by the class emphasises the biological and the physical dimensions. This emphasis is characteristic of the traditional view of the meaning of environment. From this perspective the political, economic and cultural forces that shape the biophysical environment may be ignored. At our first planning meeting/workshop I had proposed a 'holistic' view of environment, which included such aspects, and participants had debated its relevance for secondary school students (see Section 4.2.1). It can be argued that by being silent about these aspects of environment in her lesson, Limpho was not strongly committed to this view of environment. Following the clarification of the meaning of environment the class proceeded to discuss the teacher's questions in small groups.

3.4.2. Small Group Discussions on Electricity and Environment

My class observation notes became an important source of data for reflecting on this activity, as our initial plan to monitor and analyse one of the group discussions in detail was unsuccessful due to a technical fault in the tape-recorder during the class. Limpho gave particular attention to the organisation and reporting aspects of the discussion. She organised students into small groups of five members per group, and asked them to nominate a rapporteur. The students discussed matters with enthusiasm (Class-observation notes, 20-03-96). In groups that were close to me students were using their mother tongue, Sesotho. The teacher circulated around the class and talked to students in their discussion groups. When Limpho asked the class to stop, the students took time to do so, suggesting that they might have been enjoying the activity.

The various groups subsequently reported their conclusions to the whole class in the next lesson (see Appendix 7 for group reports). As in Map's case study, problems with the use of English also became apparent in this lesson, when students reported back. The case of a student who confused the words advantage with disadvantage was one striking example. That this student was in Form C, her final year of Junior Secondary education, illustrates the seriousness of this problem.

Lesson (23-03-96):

S: The disadvantages of using electricity to people: sometimes we can not walk at

night when it's dark, because we can not see clearly the cars...
T: What did you say? The first disadvantage is?
S: Sometimes we can not walk at night when it is dark.
T: You mean using electricity you can't walk at night?
S: You can walk at night when there are street lights.
T: Street lights. Is that an advantage or disadvantage?
S: It's a disadvantage.
T: I think it's an advantage.

Many of the advantages that the students associated with electricity concerned domestic uses such as cooking, ironing, lighting, heating, washing and radio. Disadvantages mentioned included electric shocks, short circuits, costs for use, and accidents (see Appendix 7). It seems that as students discussed the advantages and disadvantages of electricity they drew on their experiences and related electricity to the contexts they lived in.

As the students reported their group conclusions, the teacher seemed to be concerned that they did not place adequate emphasis on 'environment'. The following excerpts illustrate this:

Lesson (23-03-96):
S: The disadvantages is that it uses a lot of money.
T: **What good is it for our environment? Remember our aim is the environment**. If we just talk about cooking time, the, saving pots; they can't be burned, **how does that affect the environment? That is what we have to conclude in class OK? That's how it helps us inside the houses, but on the whole environment?...** (My own emphasis added).

By asking "what good is it for the environment?" and insisting that students "Remember our aim is the environment"; the teacher separated 'the environment' or 'the whole environment' from the socio-economic and domestic aspects of environment mentioned by the students. Thus, it can be argued, she reduced environment to the biophysical dimension, despite the fact that she had defined environment as *'everything'* in my interview with her at the beginning of the project and had participated in the research team discussion where the concept was defined broadly (see Section 4.2.1)

At the end of the students' reporting the teacher thought that the students' reports lacked an emphasis on environment. As a result she gave the class a more specific question to discuss further in small groups. In expressing her concern, again the teacher expressed a perspective on environment that stressed the biophysical dimension (i.e. plants).

Lesson (23-03-96):

T: All right it looks like most of your advantages and disadvantages were only on cooking. You like to cook I know. (Students laugh).... There are other things in our environment, which I want you to think about. Think about plants. How does electricity help plants? OK that is a question for discussion now. In just five, ten minutes. **Advantages of electricity to plants**. (My own emphasis added).

I tape-recorded one of the seven discussion groups for close monitoring and analysis. The group was made up of six students (Class-observation notes, 23-03-96). An extract from the discussion follows. In this extract g and b represent girl and boy respectively.

Group discussion (23-03-96):

g1: .... Advantages in plants. Joale motlakase u ka li thusa ho tsamaea? Ah? M-m.
b1: Plants li thusoa ke motlakase?
g1: He lang! Mobu oka, o na le moo o testoang akere? Ho utloa hore na o na le acid joalo. Oa testoa.
g2: Letsatsi ke source of light.
g1: Source of light.
g2: Ee source of light.
g1: Where does that sun get light from?
g2: From God.
g1: We can use electricity when we test for the acidity of the soil. Joale u re ke ngoleng? The farmers...
g2: Whether soil is acidified or is, is, or not?
b1: Se ka bapalang.
g1: Ache it is a difficult!
g2: You are asking a difficult question.
g1: Whether soil is acidified or not? When there is no electricity we can not test whether..
g2: When sowing a seed?
g1: Utloang enoa ea sa tsebeng hore na acicidy ke eng. Ke hore u mosotho-sotho ea apereng kobo tsatsi le chesa. Ua utloa? Ho thoe ho boleloang ha ho thoe acid, neutraliser, ha hona ntho eo u e tsebang. U tla tsebella kae? E re ke ngole.
b2: We can not test soil...
g2: ..if we don't have electricity.
g1: Butleng hare ngoleng. Disadvantage e bolelang? Advantage and disadvantage. Advantage ke molemo, disadvantage ha se molemo akere? Joale u mpolella hore ntho ee eo re e ngotseng ha se molemo? Ke molemo nthoeno! Liseed ha li na hola ntle le motlakase. E etsoa ke ho tsofala ha peo.
Teacher: Ten minutes is over.
[End]

Assuming that the teacher required all students to participate during the small group discussion, it is noteworthy that only four of the students actually participated, one of whom

(b2) doing so minimally. The students recorded spoke largely in Sesotho. This was not unique to this group, though: all the groups nearby me were conversing in Sesotho, although they wrote their responses in English (Class-observation notes, 23-03-96). In this group one student used Sesotho to clarify the meaning of the teacher's question, formulated in English; similar behaviour was noted in the small-group discussion in Map's case-study. This student translated the words 'advantage' and 'disadvantage' in the teacher's question into Sesotho to confirm the exact meaning of the words with his/her peers. English appeared to be a problem for other groups, too: in another group that was very close to me the students struggled to translate the phrase 'ho fehla' as in 'ho fehla motlakase' ('to generate electricity') into English; one of them had to move to another group to ask for help (Class-observation notes, 23-03-96).

Whilst the student who stated that "we can use electricity when we test the acidity of the soil" seems to have associated electricity with plants logically, the exact use of electricity in this way was not clarified. A student who sought clarity was scolded by this student as an 'ignorant traditionalist' ('Mosotho-sotho ea apereng kobo tsatsi le chesa') which could have been a result of the first student's,

- impatience with the student who sought clarity, thus showing her inability to participate in discussion;
- defensive attitude, emanating from a lack of clarity as to how exactly electricity might be used to test whether the soil is acidified or not, or because she was not clear about the relevance of her response to the teacher's question.

The views of other groups on the advantages of electricity to plants, at the end of small-group discussions (lasting for about 10 minutes) are presented in Table 3.4.2 below.

Table 3.4.1: Students' views on the advantages of electricity to plants - Small group reports

Advantages of Electricity to Plants
Group A At the Agric. College electricity is used to generate water from the dam, in order to water plant. It is used to cut big trees, using an electric saw. It is used for cutting grass. **Group B** There are electric machines which prune trees, this keeps trees well and healthy. **Group C** It is used for cutting grass. **Group D** It helps to prune trees with electric saw. **Group E** It helps by generating water for watering plants. It helps in cutting the plants. But we have to pay money. **Group F** It help in cutting the trees.

Following the group discussions and the reports by various groups, the teacher continued the lesson by developing a whole class interactive approach as she shared her own views on the discussed questions. Comparing Limpho's views on the question with the reports of the students, it is apparent that the students perceived the question quite differently from the teacher. This is illustrated in the next section.

3.4.3. Whole Class Interactive Approach on Electricity and Environment

At this stage of the lesson Limpho focused the class on Lesotho's environmental problems and how the use of electricity might contribute towards solving some of them. In the following excerpt she explains the advantages/importance of electricity to plants within a rural context.

Lesson (23-03-96):

T: As you can see there are a lot of things you can talk about electricity and the environment. You have shown the advantages to plants but I think that this is not quite enough. There are so many things that electricity can do to help plants or so many things that you can do as a harm to plants. I will give just one example. You seem to be thinking of plants in towns only. Lets look at villages in the mountains where people gather wood, cow dung, lisu. Where do they get them from? From the fields right? Some people...gather what do you call it? Corn, corn-stalks, lithlaka. Those lithlaka and lisu could have been helpful to the plants. If those people were using electricity how would that help? Cow-dung would rot and become what?

S: Fertiliser.

T: Manure. And in that way plants would get What? Nutrients. So if those people were to have electricity then it would benefit both people and the plants.

In her explanation above she inter-linked the following concepts: village people in the mountains and their use use of cow-dung (*Lisu*) and corn-stalks (*Lithlaka*), the fields, fertiliser (manure), nutrients, and the benefits of electricity to both people and plants.

The teacher's answer to the question on "advantages of electricity to plants" shows a different perspective from those of her students. This was perhaps a more meaningful association of plants with electricity from the perspective of the team's assumptions about the meaning of environmental literacy than, for example, the association of electricity with the acidity-testing of soil and plant growth. A further comparison of the responses of the students with the teacher's shows that the students' associations of plants with electricity were focused on their immediate environment. That is, their views showed a narrow linkage of electricity with their concrete experiences. This may have stemmed from differences between the students' and the teacher's interpretation of the question: Perhaps a more specific question such as the following could have focused students' discussion in accordance with the teacher's apparent expectations: "How may the absence of electricity in rural areas affect the biological and the physical environment?".

Limpho further guided the class to discuss how the use of electricity might help to solve the problem of air pollution resulting from the use of coal in Lesotho. Then the class explored alternative sources of energy that might be used in parts of Lesotho which electricity did not reach. During this discussion the following concepts were inter-linked: use of coal, *lithlaka*,

gas, paraffin and solar-energy as sources of energy; release of carbon monoxide; the lungs; air as part of the environment; plants' release of oxygen; absence of electricity in parts of the rural areas. This may be noted in the following extract:

Lesson (23-03-97).

T: ...some other advantage that we did not bring about of electricity to the environment. What happens in winter? People buy coals, twenty, thirty bags of coals in winter. Akere? What is the disadvantage of using coal?
S: The people absorb the smoke, carbon monoxide.
T: Disadvantage is Carbon monoxide. Yes Ponts'o?...
S: It can cause [inaudible]
T: What can carbon monoxide cause or do to lungs?
S: [inaudible].
T: Ok, some people put eh put this coal where the plants were supposed to grow. Ok, but in the case where we find carbon monoxide from coal. I want to find the effects of carbon monoxide.
S: Madam?
T: Seabata.
S: [Not clear]
T: So the carbon monoxide can be dangerous to people. It can kill people. That is from coal. Another thing with the burning coal, **remember we said our environment consists of four main things: even the air around us, smoke from burning that coal, where does it go to?**
S: To atmosphere.
T: What does it do? What does it do to the atmosphere?
S: [not clear]
T: Only plants release oxygen. Someone said that it causes air pollution. It pollutes the air. We are not going to breath clean air because of air pollution. Coal smoke. Using electricity minimises that eh danger of air pollution. See you can say a lot about electricity and the environment. I only got four. Try to think of more and more questions and to discuss in the next week when we get to the other topics....Electricity is not everywhere, it's only in towns, especially in Maseru or here in Masianokeng. I think people on the mountains or rural areas they also need electricity. How can we, how can they get electricity? Or if they can't get electricity, what are other ways of, what else can they use, lithlaka, and all that? They can use..?
S: Gas,
S: solar.
S: paraffin.
T: Paraffin is one of the causes of air pollution, causes lung diseases. Somebody raised the solar. But how does this solar system work? What are the advantages of using this solar system? Now we will discuss that next time, in the meantime, I want you to go and find out how the solar system works and how it can be useful to people and everything. I think its enough for today... .

The teacher's explanation integrated the biological and social domains with the topic of electricity. She linked electricity with soil fertility, plant life, animal life and the socio-cultural life of people living in the rural areas. In this way the teacher attempted to make apparent the linkages or interconnections that exist in the environment. She illustrated how rural communities may adversely impact on the environment, not so much because they are ignorant but because of the absence of alternative sources of energy such as electricity. To raise awareness of interconnections in the environment constitutes an attempt at developing an integrated or 'holistic' view of the environment as discussed in Chapter 1 and as agreed on by the research team at the first planning workshop. Further, the integration of concepts from different disciplines is in line with the recommendation of the Lesotho Junior Science syllabus that teachers "identify related topics in the different disciplines and correlate them in their teaching" (Examinations Council of Lesotho, 1995:69).

Limpho and I had also planned to relate the topic of electricity to the Lesotho Highlands Development Project (LHDP). Through the construction of five huge reservoirs the project is expected to earn Lesotho many advantages including hydro-electric power, but it has also raised much controversy about its adverse impact on the environment. LHDP was initiated in 1986 with the signing of a treaty between Lesotho and South Africa, but the science curriculum (Examination Council of Lesotho, 1995) is still 'silent' about this major technological project. In our lesson plan we had decided to link the science topic 'Electricity' with the project, by inviting a guest speaker from Lesotho Highlands Development Authority. The following extract shows how we thought of the involvement of such a guest speaker:

> Lesson-Planning Session (06-03-96)
> Tsepo:...we could invite somebody from LHDA or would we be going out of the way?
> Limpho: I think it is good, to talk about hydroelectric power.
> Tsepo: And other related things like plants.
> Limpho: Yes, how that building of the dam is affecting the environment. I think that's a good idea.
> Tsepo: ...I think it's under ecology where they talk about the importance of conserving....the indigenous plants and animals. So probably we also might say something about plants and animals that are indigenous. Limpho: Because somehow under that topic it talks about the habitat. I think the (LHDA) project somehow has disturbed the habitat and the organisms, both plants and animals.

This guest speaker was, however, never invited due to the amount of work Limpho had and her short participation in the project.

The activities that Limpho tried out in the classroom, and those that we planned but failed to carry out, reflect a different orientation from the one current in the Junior Science curriculum (Examination Council of Lesotho, 1995). The latter does not overtly address the question of linkages between 'electricity' and students' life contexts, but rather stresses the mathematical and physical science aspects of the topic.

It is noteworthy that initially, when preparing for the lessons, Limpho was concerned that the topic 'electricity' fell within the domain of physics and was not environmental (Fieldnotes, 28-02-96). I also had only a vague idea of how we could relate the topic to environmental issues. However, in our lesson preparation, individually (see Appendix 8) and during our discussion, we were able to relate 'electricity' to a number of local environmental issues, some of which Limpho did not ultimately bring into the classroom.

As we continued to think about new ways of teaching other science topics, we decided to invite a guest speaker from the Department of Energy, within the government Ministry of Natural Resources, to give a talk on a Junior Science topic, 'Solar Energy' (Fieldnotes, 27-03-96). Limpho subsequently asked me to give a talk on the Junior Science topic, 'Renewable and non-renewable Resources' (Fieldnotes, 17-04-96). These teaching strategies are discussed in the following section.

3.4.4. Guest Speakers' Talk on Natural Resources

Solar energy is briefly referred to as a renewable resource in the Junior Science textbook (Ministry of Education, 1988) under the heading "Using and Abusing Resources". Other concepts under this topic are non-renewable resources, pollution and conservation.

The guest speaker and her assistant from the Department of Energy brought with them equipment to demonstrate how solar energy worked. This included batteries, solar panels, and

television. In addition to the guests, the teacher and myself, there was a University lecturer who had visited the school and with the teacher's permission attended the class. Many of the students who asked questions spoke very softly and I thought that this was probably because of the presence of a large number of adults in their class (Fieldnotes, 27-03-96).

When the presenter called the students to the front to observe the demonstration, which was placed on a low bench, the students crowded around the guests and the demonstration. Many of the students, including myself, could not see everything. The guest speaker's talk was long and exceeded the set time of 80 minutes by 30 minutes. Below is an extract from my fieldnotes (27-03-96) on the lesson:

> Fieldnotes (27-03-96):
> The talk extended beyond break. I really felt it was too much for the students. As I looked around many students were tired, and appeared bored. I had hoped that the teacher would give the guest a cue. At some point I whispered to the teacher, and asked her to warn the speaker that she was left with 10 minutes: this was time left before the end of break. She said, she could go on as long as she wanted to since she had made arrangements. Shortly afterwards the teacher left the classroom. Five minutes later, she was still out; I decided to give the guest a cue that it was time up. By this time, she had exhausted the topic, and had introduced a new subject to students: that students ask her anything they would like to know. This was in spite of the fact that many students looked tired, having sat and listened for two hours, without a break. I had a feeling that the teacher thought the guest could not travel that long only to present for a short time, 30 min or so.

As a follow-up to this activity, Limpho and I decided to evaluate the lesson by drawing on the views of the students and the guest speaker. I developed the questionnaires which I gave her to read, comment on and edit (Fieldnotes, 27-03-96). When I went to pick them up two days later as we had agreed she had still not read them. However, we went through the questionnaires together and she made some comments. When I suggested to her that we should administer the questionnaires to the students as soon as possible, whilst the presentation was still fresh in their minds, she was reluctant and explained that she was busy studying Mathematics and Computer Science in preparation for university studies the following year, and that it was important that she completed the syllabus. She further said that the headmaster might complain about us making copies of the questionnaire using the school facilities; I assured her that the environmental centre was going to make the required copies for us. We finally agreed that I give her the questionnaires on Tuesday, the following week

(Fieldnotes, 29-03-96). Limpho administered the questionnaire to 23 of the 48 students in her class, to evaluate the guest speaker's lesson (see Appendix 9) and I administered one to the guest speaker. Of the 23 questionnaires that the teacher randomly administered, 10 were fully completed. The following discussion is based on these 10 questionnaires, as well as on the guest speaker's views on the lesson.

The Views of a Sample of Students on the Guest Speaker's Lesson

In this section I discuss the views of the students on the guest speaker's lesson in the light of our attempt to explore how this teaching strategy might best be employed for the development of students' environmental literacy.

Table 3.4.2 reflects the views of the 10 students on whether the guest speaker should visit their class regularly.

Table 3.4.2: Students' Views about the Guest Speaker.

VIEW	NO. STUDENTS	EXPLANATION
The guest speaker should visit our class regularly.	8	- she interested me. [1] - I understood her. [1] - I think I can learn more (about sblar energy) [7] - she smiled with us. I like a teacher who smiles [1]
The guest speaker should not come regularly.	0	0
Not sure whether the guest speaker should come regularly.	2	- there were things she did not know, but she taught well, we love her [1] - no reason [1]

NB. The frequency figures in parenthesis add to more than 10 because some students gave more than one reason.

The students' responses in Table 3.4.2 suggest that they liked the teaching approach. This was in spite of my observation that the lesson had been too long and therefore possibly boring for them. There is also evidence of students learning about solar energy from the guest speaker's presentation (see Table 3.4.3 for the views of three respondents).

Table 3.4.3: Students' Views about the Guest Speaker.

VIEW	EXPLANATION
The guest speaker said something that I liked/ interesting	- "all thing she says was the things that happen in this time... I liked whereby she says it is not expensive". [S1] -"she says that solar energy is not expensive as LEC electricity because is the electricity of nature, it is renewable". [S2] - "She said that in the place like highlands where there is no electricity. They used much wood for cooking and lighting and wood came from cutting of trees, which is the part of causing soil erosion. She said, they suppose to use solar energy to avoid that cutting of trees". [S3]

The language used by these students suggests that the guest speaker made them aware of the advantages of solar energy and of socio-economic issues associated with it. The view expressed by one student that the guest speaker shared current ideas/content was of importance within the context of our attempt to relate the teaching of science to current environmental issues. It seems that one advantage of a guest speaker over teachers who may be pre-occupied with their routine work of covering the syllabus is that guest speakers may have recent and relevant information to share associated with their work.

In accordance with the views of the research team, we considered the students' willingness to take action to solve environmental problems as an important sign of environmental literacy. Thus, one question that we asked the students was whether they were willing to share the information they learned about solar energy with others. Nine out of ten students thought it was their responsibility to share the information they had learned about solar energy with others. Table 3.4.4 provides reasons given by four of these students for this view.

Table 3.4.4: Students' Views of Information Provided by the Guest Speaker.

VIEW	REASON
It is my responsibility to share information about solar energy	"...people should know what is good for them to improve their lives without wasting much money that they don't have". [s1] "...I want every Mosotho person to live in easier way not to spend money to buy paraffin everyday it is important to buy solar energy". [s2] "...it is extremely good for our nations and for our environment". [s3]
It <u>is not</u> my responsibility to share information about solar with others	"... there are some people who think that using solar it is very expensive than the one at LEC and who think that at winter time the solar would not work so much as Summer time, so there is not need". [s4]

The reasons provided by these students may also be seen as their own opinions about the importance of solar energy. It is noteworthy that the student who thought it was not her/his responsibility to share information about solar energy said so because she/he was sceptical about the benefits of solar energy. This illustrates that this student had critically, rather than passively, listened to the guest speaker.

As mentioned above, we also canvassed the perspective of the guest speaker using a questionnaire (See Appendix 10), and this is discussed next.

The Views of the Guest Speaker on the Lesson

The guest speaker's perceptions of the students during the lesson are commensurate with the students' view that they would like to see the guest speaker visit their class regularly. The guest speaker wrote:

> They were very attentive and participative. They showed interest in the presentation and the presenters. But above all, I liked them since they knew something about solar, hence we talked the same language so to say.

Her view and the students' views about the lesson contrasted with my assumption reflected in my fieldnotes that the lesson had been too long and thus probably boring for students. She also thought that many of the students in the class participated enthusiastically in her lesson:

> Yes of course in a class, not all pupils will participate. But all in all the participation was OK. A lot of enthusiastic students and a different person for a change!

Realising the students' limited proficiency in English during the guest speaker's lesson, I asked her how she felt about using Sesotho in future presentations:

> Yes it depends on my audience. But generally speaking it's always nice and easy if Sesotho is used as a medium of instruction in cases like this.

In my own experience of the use of English in classrooms in Lesotho, the difficulty in using the language often intensifies when students have to think and express their own views drawing on their experiences, which are constructed in Sesotho. The lesson of the guest speaker was participatory and students were required to question and express their own views in English which, for many students, may not have been, to use the guest speaker's words, "nice and easy".

Limpho gave further application to this teaching approach by requesting me to teach her class about renewable and non-renewable sources of energy. Her request may also be seen as an attempt to equalise the power which I had exercised over her by observing her when teaching and taking the data away for analysis (i.e. recording her lessons and transcribing them) (see Winter, 1989:60-61). Winter (1989) has argued that if we observe colleagues without allowing them to observe us they may develop uncomfortable fears and worries, for the research process renders them vulnerable to the research initiator's observation and interpretation. He also argued that when colleagues observe each other, an opportunity is opened up for participants in the research to develop "fresh insight". This was not, however, how I thought about Limpho's request then. I recall feeling a bit reluctant to teach her class because I thought that we would be wasting the time available for her to try out more teaching methods.

The lesson I agreed to teach was on "Renewable and non-renewable resources". (Fieldnotes, 17-04-96). My primary aim with the lesson was to employ a whole class interactive approach

focused on conservation and the use of non-renewable resources, and the exploration of alternative resources.

The following extract shows some of the questions I posed to the class, to stimulate discussion. I made a conscious attempt to bring the issues we discussed as close to the students as possible by using *'we'* when formulating the questions:

Lesson Extract (17-04-96)

Tsepo: Are we using them (i.e. non-renewable resources) wisely or are we just using them carelessly? Now these are some of the questions that came to my mind. Are we concerned about the way we use petroleum for example? Eh are we concerned about our children who are not yet born? Because remember we are going to be mothers and fathers and we would like our children to have, to be comfortable and use cars just as we do. Unless we want them to use donkeys and horses, because there won't be any petrol.... I don't think that's what we want....Are people in Lesotho or Maseru using petrol, coal and other resources or fuels wisely? And I think the reason I thought about this is basically because resources take millions of years to be formed.....

I wrote these questions on the chalkboard and developed a whole class interactive lesson based on them. The discussion was lively and many students participated. My orientation was to develop students' understanding of issues by asking them "why" questions so that they could consider the reasons underlying their decisions and actions and by encouraging them to express their views and to hold on to a particular view for its strengths. I also avoided prescribing my own opinions to them. The following excerpt illustrates a moment when we were discussing the conservation of fuel in Maseru city.

Lesson Extract (17-04-96)

Tsepo: If you think too many people use private cars [in Maseru], and if it's a problem, why is it a problem?
S1: I think it's a problem because roads are not enough.
Tsepo: All right, that's what he thinks. Roads are not enough.
S2: [inaudible]
Tsepo: Can you speak aloud and turn around to the class.
S2: I think it is a problem because with my car, I use it as I want. I'm using more fuel than in a public car.

There was evidence of the students' ability to think critically about environmental issues during the discussion. In the following example, the student thought critically about the agenda underpinning the promotion of solar energy.

Lesson Extract (17-04-96)

Tsepo: OK. Anybody who wants to make a comment.
S: Eh sir it is true that oil is non-renewable?
Tsepo: Is it true that oil is non-renewable?
S: [Not clear].
Tsepo: Did you hear that question?
SS: [Chorus] No!
Tsepo: Can you repeat that question.
S: I said that it is true sir that oil is non-renewable or is it the wise way to make people interested in solar energy.
Tsepo: Can I ask you a question? Why do you think, eh, people could be made to be interested in solar energy?
S: [Inaudible]
Tsepo: Oh, you think it's a way of making people to just do away with..?
S: I think so far we have seen that the oil is being used in the whole world, if it is true that it can be finished it could, as ...[not clear] as well as coal. [My own emphasis added]

I was greatly surprised by the remark of this student; perhaps this was due to my assumption, based on observation during my visits to this class, that the students could not think critically. It appears that if students are provided with the opportunity they may indeed think critically about environmental issues. The above case suggests that this may be facilitated by asking open-ended questions.

The class discussion also focused on recycling as a strategy for conserving non-renewable resources. In my preparation to teach this concept I had visited a nearby recycling depot. This initiative was guided in part by a view we shared as a team that the ability to take 'action' to solve environmental problems was an important dimension of environmental literacy. Hoping that students would be interested in the financial returns of participating in the recycling of paper, which I thought was abundant and wasted in schools, I shared the address and the sales rates for the depot with the class. However, I was a bit disappointed when the students' response did not sound positive.

Lesson Extract (17-04-96)

Tsepo: Now I have got some information here, for people who are not only concerned with the recycling of metals but who are also concerned with plastics, paper, cardboard and glass and if you take your material there, you may organise yourself here at school or at home if you want some money, some pocket money [**Students laugh**]. Yes you can start making some pocket money, [rather than] only relying on your parents all the time. You can collect plastics [**Students laugh**] or paper.... you can even put a box here next to the class

and just put a notice that other students should throw eh whatever plastic or paper that they have used into the box. Now, do you know where the paper you have used here at school goes to? Who knows?

SS: We burn it.

Tsepo: Now you are burning money… . Because if you can collect it and somehow take it to this place, I have written here: "Welcome Waste", they usually refer to it as "Welcome Transport" you can get some money. Now for a kg of paper… if its this kind of paper, cardboard 15 cents. If its this kind of paper, the paper we use for writing you get 20 cents per kg….If you want to get into this project, maybe as a class, or as a group of people who are interested, you can simply, you don't have to go around in the street collecting paper, you put a box or rubbish bin somewhere and find out where this paper goes to and then somehow get it to the station….

S: For fifteen cents!?

Tsepo: Now, if you have a lot of paper, then you can get a lot of money…And if its 400 kgs, how much money could you have made? Mh? If a kg is 20 cents…

S: Eight Rand. Ahh, e nyane [**it's too little**]. Eighty Rand!?.

Tsepo: Anyway think about it, some people say it's money, some say it's peanuts. I think R80,00 is a lot…I think with that we have come to the end of the lesson. I hope maybe at later stages, we might have time to discuss those questions… **and those who will think about doing something about collecting paper, it's not only about money remember, but it's also about being concerned about those who are yet to be born. It's about conservation. About conserving non-renewable resources….** [My own emphasis added]

I thought that the concept of the sustainable use of resources was important to emphasise, but I avoided using the term and rather coined a phrase, *being concerned about those who are not yet born* when using our resources. This phrase also seemed to make sense to students and to elicit their thoughts about conservation practices.

Other questions that I raised in this lesson to encourage discussion and prompt students to think in depth about environmental issues are reflected in Table 3.4.5 below.

Table 3.4.5: Some Questions that I Raised in Class

- If you say we breath in oxygen and breath out carbon dioxide are we not finishing the oxygen in the atmosphere?
- 'Are we using them [resources] wisely or are we just using them carelessly?'
- 'Are we concerned about the way we use petroleum for example?'
- 'Are we concerned about our children who are not yet born.?'
- 'Do we have too many vehicles in Maseru?'
- 'If you have too many cars what might happen?'
- 'What is the rate of traffic ...say along Main South One [in Maseru?]'
- 'If you think too many people use private cars, and if it's a problem, why is it a problem?'
- 'Why do you think many people use private cars [rather than public transport]?'
- 'What are the problems associated with the use of too many private cars? And 'how can these problems be solved?'
- 'What can you do as a class to help solve problems associated with the use of too many cars?'

Later, in my reflection on my lesson, I realised how stressful it had been for me to manage the students' numerous responses to my questions in a big class of 48 students. I jotted down the following points about my feelings shortly after the end of the lesson:

> Personal notes (17-04-96)
> My general feelings during the lesson were that, the students were too many in the classroom, and that it was very very tiring and almost impossible to probe their answers. That is, it was impracticable to ask students, what are your reasons for your answer? how did you arrive at your answers etc, when there are so many of them. I found that managing the answers (ie through probing) of many students was stressful. Maybe in over crowded classroom it is unrealistic to expect the teacher to probe students. A teacher may even think: why waste time probing wrong answers, I should only tell students what is correct.

Concluding Remarks on Guest Speakers

In conclusion, the views of the students about the first guest speaker suggest that they gained knowledge relating to solar energy and some even indicated a willingness to share the information they learned with others, so that they might be encouraged to use solar energy and live a better life. Perhaps the following qualities, which some students indicated they liked about the guest speaker, also facilitated their learning: she smiled, and she talked about current ideas.

Similarly, during my lesson as guest speaker students participated in discussion, and raised questions about environmental issues. There was also evidence of student(s) thinking critically about solar energy when I posed an open-ended question, and in the solar power questionnaire feedback. In my interview with Limpho just after her decision to opt out of the research, she thought that the most useful thing about the research was that students had gained knowledge from the guest speaker:

> Interview Extract (17-09-96)
> Tsepo: And what have you found useful about it [the research]?
> Limpho: I would say not in my part, when we looked at students' part, I would say they obtained a general, how can I put it?.... with the books they have there is a limited information but from like getting guest speaker, you talking to them, they gain more knowledge than if I were to teach them alone. You touched some things that I couldn't touch from my side and the students liked it.

3.4.5. Conclusion

Limpho tried out the following teaching strategies: the whole class interactive approach, small group discussions and the invitation of guest speakers. She employed a whole class interactive approach when relating electricity to economic issues experienced by students. However, the charges of electricity used in calculating the cost of electricity were arbitrary rather than actual and current. This may be seen as a drawback within a teaching approach that attempted to relate science content to the students' local environmental issues and problems.

Small group discussions provided students with an opportunity to express their own views on issues concerning their local environment. As students discussed the advantages and disadvantages of electricity with regard to the environment, for example, they related the concept of electricity to their socio-cultural contexts. The students also discussed in small groups and expressed their views on the 'advantages of electricity to plants'. Their views on this question differed greatly from that of the teacher. The students' notion of the advantages of electricity was rather narrow, whilst the teacher developed a broad and complex association of electricity with plants, with abstract linkages. Perhaps the differences in perspective resulted from the type of question the teacher formulated.

It is also noteworthy that initially when preparing for the lessons, Limpho was concerned that the topic 'electricity' fell within the domain of physics and was not environmental. I also had only a vague idea of how we could relate the topic to environmental issues. However in our lesson preparation, individually and during our discussion, we were able to relate 'electricity' with a number of environmental issues, some of which Limpho did not ultimately bring into the classroom, due to her early discontinuation with the project.

Whilst students were expected to express their views in small-group discussion, one closely monitored group showed that not all students participated in discussion and that students could have been tutored on how to discuss effectively. It appeared that the use of English hindered students from participating effectively in discussion on the topic. The case of a student who confused the words 'advantage' and 'disadvantage' may be seen as an important indicator that English may indeed be seriously inhibiting students in their attempts to learn. Therefore, the use of English as a medium of discussion when the participants are not proficient in the language may be seen as inappropriate.

When discussing the advantages and disadvantages of electricity with her class, Limpho's orientation of environment emphasised ecology (also a Junior Science topic); yet, she had defined environment as *everything* at the beginning of the project, and had participated in the research team workshop where the concept was defined broadly to also include social and political dimensions (See Chapter 4). It can be argued that her view of environment was still strongly shaped by the conception within the discipline of Science that 'environment' is concerned only with ecology. She had, for example, indicated in my interview with her shortly after the research team workshop, that she had been confused by the definition of environment shared at the workshop, as she was used to a " short definition they give to students. Environment is every around us and they stop there..." (Interview, February, 1996). Her description of environment as *everything* and for her to reduce it to the biophysical dimension reflects an ambiguity in her viewpoint. Winter (1987:46:55) has argued that such ambiguity in thinking and understanding is typical of individuals, as we are products of a social world, which itself is structured as a series of contradictions. Between these contradictions or viewpoints, he argues, is a "creative space" for individuals to make their

own interpretation. From the perspective of the constructivist theory (see Bodner, 1986), this "creative space" may be seen as the interface of new knowledge and pre-knowledge. Thus, it appears that as Limpho explored the appropriateness of certain teaching strategies for developing students' understanding of environment (i.e. to develop their environmental literacy in accordance with the views of the research team), she also engaged with her own understanding of environment rather than reproducing a view suggested by the research team. This seems to suggest that theoretically shared views (e.g. research team ideas at workshop) of environment and environmental literacy may not simply be translated into practice (e.g. teaching in the classroom) and that perspectives of environment (and the associated meaning of environmental literacy) are constructed (in action and reflection) over time.

Limpho further invited two guest speakers to her class. The views of the students on the first guest speaker showed that they gained knowledge on solar energy, and some even indicated a willingness to share the information they had learned with others. In the case of my own lesson as a guest speaker, students participated in discussion, and raised questions that suggested that they developed some understanding of environmental issues; there was also evidence of a student thinking critically. However, the use of this approach in teaching (i.e. guest speakers) needs to be explored further, within the context of developing students' environmental literacy, especially in view of the fact that some guest speakers may lack pedagogic skills.

As mentioned in Chapter 2, a second goal of the project was to develop the meaning of environmental literacy by, in part, drawing on our experiences in the classroom. This dimension of the study is discussed in the next chapter.

CHAPTER 4

DEVELOPING THE MEANING OF ENVIRONMENTAL LITERACY

Words strain,
Crack and sometimes break, under the burden,
Under the tension, slip, slide, perish,
Decay with imprecision, will not stay in place,
Will not stay still. (T.S. Eliot in Ngûgi wa Thiong'o, 1996:74)

Our attempts to grasp the significance of our experience are an endless struggle with the possibilities and limitations of the meaning of words. (Winter:1989,40)

4.1. INTRODUCTION

In Chapter 3 I discussed the various teaching strategies tried out by members of the research team in the classroom, guided by our understanding of environmental literacy. In this chapter I discuss the views of the research team on the concept of environmental literacy at various stages during the project. These views emerged in the course of my interviews with the teachers, in focus-group discussion, and when we shared insights following our actions in the classroom. The views of team members on the concept of environment were also sought, but only to clarify their views on environmental literacy. Where views were expressed in Sesotho, English translations are provided in parenthesis.

First I discuss the team's early views on the meaning of environmental literacy, prior to teaching in the classroom. In the next section I discuss the team's reflections on their starting assumptions about environmental literacy, drawing on insights which they gained when teaching. I further discuss the perspectives of individual members of the team on the meaning of environmental literacy and attempt to analyse how they changed over time. In concluding this chapter, I highlight key insights and understandings associated with our attempt to develop the meaning of environmental literacy.

4.2. EARLY VIEWS OF THE RESEARCH TEAM ON THE MEANING OF ENVIRONMENT AND ENVIRONMENTAL LITERACY

One of our primary objectives at the first planning workshop, in February 1996, was to develop a working definition of the meaning of environmental literacy, which could then be developed further with the feedback of insights and new understandings gained during each cycle of action research. First, the meaning of "environment" was discussed at this workshop, and then the meaning of environmental literacy (EL) developed against this background.

In my facilitation of the discussion I employed certain aspects of focus group discussion strategy (Anderson, 1990; Debus, 1995)[6]. Thus, I formulated the following two questions to initiate and guide the discussion amongst the six participants (three science teachers, one university staff member, one environmental centre staff member, and a staff member from a Video Unit): "From the perspective of Lesotho's environmental problems and issues, discuss the following: What do you understand by the concept 'environment'?" and "what do you understand by the concept 'environmental literacy'?" The discussion was in two parts: the first involved participants discussing the meaning of the concepts as they understood them. I then asked the participants to relate their own understandings of the concepts to the views of, as I put it, "those who have already made an input into the definition of environment and environmental literacy (i.e. the international community)". The latter were contained in the literature that I provided them with on environment by some environmental educators within the context of our neighbouring country, South Africa (EEPI, 1994), and on environmental literacy from the World Conference on Education for All, held in Thailand (see Haggis, 1991:53). The discussion was tape-recorded for analysis.

Next follows the views of the workshop participants on the meaning of environment.

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6 I avoided participating fully in the discussion out of concern that I might influence the discussion towards my own understandings and that group members might regard my views as the correct ones. In retrospect I realised that my limited participation was a drawback in that the discussion was not well facilitated, in accordance with focus group discussion strategy, with the result that some participants were mostly silent and some views were not probed adequately.

4.2.1. Environment

The discussion on the meaning of environment started with the participants commenting on and questioning the views of five science teachers (three of whom subsequently became research team members) on the meaning of environment. These teachers had stated their views in the interview I had with them in August 1995, in preparation for the workshop. Their views are summarised below:

- the surroundings, e.g. "the space in the air", the floor, trees, rivers, people, animals, plants etc.;
- a concern with the preservation of natural resources: the maximum use of resources without depleting them;
- the land and the things found on it e.g. plants, animals, water, soil;
- everything;
- anything that is around us that affects us, e.g. people, animals, plants.

The specific views of the three teachers who became members of the research team are shown in the Table 4.1. below. These responses (as well as the above mentioned) were based on the question, *"What do you understand by the concept environment?"*. The responses provided a rich resource base of varied ideas for members of the research team to analyse their own personal viewpoints; it can be argued that through discussion and debate the members examined their initial understandings and then moved on formulate ideas which were "interpersonally negotiated" (see Winter, 1989:56).

Table 4.1: Initial Views of the Research Team Members on the Meaning of Environment

Teacher	Immediate view
Limpho	the world around us and the things that surround us. Everything: human beings, plants, animals, whatever; water, soil, everything.
Lebu	The surroundings: for example, if you live around the coast, your environment will be the sea, the beach, the plants and animals living there and so on. In the Mountain Kingdom we talk about the mountains, the trees, rivers and so on.
Map	surroundings; everything around you; anything that is around you that may affect you, like maybe people, animals, plants.

Whilst Map and Lebu used the concept "surroundings" to define environment and Limpho used the word "everything", the examples they gave refer to the bio-physical dimension of environment and are silent about other dimensions, such as the economic, cultural and political.

Limpho's views on environment were also reflected in a paper that she decided to write, after receiving a workshop programme, on the topic "How can the teaching of Junior Science solve Lesotho's environmental problems?" (see Appendix 11). In this paper she stressed the following as environmental concerns in Lesotho: "water problems" in terms of pollution; "rubbish problems" and the importance of a clean environment for promoting the "tourist industry"; the "ugly sight" of wrecked automobiles and abandoned vehicles; "energy problems" and the need to promote the utilisation of "alternative energy sources" such as "solar energy", "air pollution" resulting from a local "Dry Cleaner and vehicles"; and the "population explosion".

Using the views of the five teachers as a point of departure the workshop participants discussed their understanding of environment. The following concepts were associated with environment during the discussion: "the land"; "some things like the grass on the land"; "water and other things"; "natural environment and the man-made environment"; "things found on the earth, in the earth, and above the earth and around the earth"; "anything that is around us that affects us and that we affect"; "plants, animals and people, the air".

During the discussion I introduced the perspective that environment was an interconnectedness of the biological, the physical, the economic, the political and the socio-cultural contexts in which people live (EEPI, 1994). In the extract below Mathe, a university lecturer, argued that big words, such as "economic" and "political" should may be simplified for students.

Focus Group Discussion (20-02-96)

Lebu: So the question now is, can we bring this up in a science class, if you are talking about the environment, can we bring up, yes to the kids and say, when we are talking about things affecting us people, "socially", and the others [political, economic].

Mathe: You may not use a big word like physical to them, there are ways of talking about the issue in the classroom; 'development' for example, there are ways of

talking about 'development' without using a big word...[Members: Mhm]..so I still think there is room, at different levels.

Lebu: Yah, you mean JC level...yah. You mean at JC level we can talk about ' stability in the country'...?!

In spite of Mathe's argument that complex issues could be simplified for students, Lebu was uncomfortable with the idea of teaching about politics at Junior Secondary (JC) level. It seems that Lebu's actual concern was with the underlying intention and the appropriateness of teaching "politics" in the context of science teaching at Junior Secondary (JC) level, rather than with the use of big words such as "politics", which Mathe thought she was concerned about.

The above extract further illustrates that the concept of environment, which was introduced to help teachers to clarify their understanding of the meaning of environmental literacy, was interpreted as content to be taught to pupils. Against this background the participants proceeded to discuss and develop their understanding of the meaning of environmental literacy.

4.2.2. Environmental Literacy

A number of ideas emerged during discussion about the meaning of environmental literacy. These included the following:

- it involves "understanding the environment", what it "involves", and "what things are involved in the study" of environment;
- it involves "awareness of the environment";
- it concerns the ability to "manage the environment";
- it concerns the ability take "action" to solve 'environmental problems';
- the word "literacy" in environmental literacy means more than just the ability to read and write.

The above concepts, which were associated with environmental literacy, can be described as cumbersome and open to a number of interpretations (e.g. action). However, this seems to have given the team members a frame of reference for interpreting and translating the

concepts into teaching activities/approaches in ways that were appropriate to their teaching contexts. Further, the view that the word "literacy" in environmental literacy means more than just the ability to read and write is arguably in line with current understandings of literacy as "functional literacy" (Verhoeven, 1994), meaning the ability to use one's knowledge of reading and writing to live a meaningful and productive life.

The following excerpt highlights how the discussants arrived at several of the ideas mentioned above during discussion. Here participants may be seen attempting to clarify ideas and reaching some consensus on clear points of view.

Focus Group (20-02-98)

Lebu: But **awareness of the environment** should be the environmental literacy...

Kath: Mhm, **the word is more of an awareness than literacy, literacy is reading and writing....**

Mathe: Is it awareness only? Literacy means more than just awareness. **You can be aware of something and not do anything about it**.

Participants:

Yah; mm.

Lebu: **Awareness of the environment, what about the problems?**

Limpho: **You are aware of the problems and then you take action,...finally you solve them.**

Kath: Mm, [inaudible].

Limpho: How can we put it...being aware of the environment then [inaudible]..

Lebu: I will write something [laughter by members].

Kath: and **becoming involved in the management, that would be big words for small children**, but as a definition its taking the action, and it would also include your management means, [inaudible] it means getting involved and doing something about it, isn't it along those lines?

Mathe: ....I was a bit concerned when you just said awareness, you can be aware and not do anything.

Participants: Mhm. [My own emphasis added]

As in the case of discussion on the concept of environment, the statement by Kath also indicates a moment during the discussion when the concept of environmental literacy, which was meant to be described and defined by teachers so that it could guide the way they taught for environmental literacy, was interpreted as content to be taught to pupils, as they would hear it in the classroom.

Shortly after this planning workshop, I interviewed the three teachers participating in the research on how they felt about the activity on defining environment and environmental

literacy. In my interview with Lebu (February, 1996), he explained that the process had involved "some disagreements". He also recalled how the participants, as they shared ideas on the meaning of environment and environmental literacy, made one another aware of "certain portions" or other things that brought clarity to the meaning of the concepts. However, he explained that members already had their own ideas of the meaning of environment and environmental literacy by saying that "but people seemed to have an idea of what they [the two concepts] are supposed to mean". His use of "supposed to mean" seems to suggest that he too assumed that there were pre-determined meanings for the concepts. He thought the process of defining the concepts was on the whole "every interesting".

In her reflection on the activity of defining environmental literacy (February, 1996), Map dwelt on the meaning of environmental literacy and said that she could not recall exactly how environmental literacy was defined at the workshop. However, her tentative definition was that environmental literacy meant "Knowing very well of the things present in the environment". Yet she seemed to be concerned about recalling the exact words used by other participants to define the concept.

> Interview (February, 1996)
> Tsepo: How did you feel about the activity on defining environmental literacy?
> Map: (Silence).
> Tsepo: Do you still remember it or...?
> Map: Oh, ntate, was it the one about knowing the, knowing the environment? **Knowing very well of the things present in the environment** or, I don't remember very well...It looks like, I tend to forget it, but **I really want to know, remember very well what this environmental literacy means**. [My emphasis added.]

She further thought that the process of defining environment was 'interesting', and that it brought "real meaning or a clear description of whatever we were trying to describe".

Limpho (February, 1996) seemed to avoid commenting on the activity of clarifying the meaning of environmental literacy at the workshop. Her explanation that she could not recall the activity because she was "a bit sleepy" could mean that she assumed there were correct things said by other participants which she had to recall but could not, and was therefore reluctant to say them.

Interview (February, 1996)
Tsepo: How did you feel about the activity on defining the concept environmental literacy?
Limpho: I was a bit sleepy when we were looking at that one [laughs], so I think I missed a lot... I was! [Laughs]. Maybe I will explain it more sometime.

Her view that the activity of re-interpreting the meaning of environment "confused" her, differed from that of Map and Lebu who thought that the activity was "interesting".

Interview (February, 1996)
Tsepo: How did you feel about the activity on defining the environment?
Limpho: Yes, that one I was a bit confused because I'm used to that short definition they give to the students. Environment is everything around us and they stop there....

Limpho's 'confusion' appears to originate from her traditional practice of learning/memorising and teaching pre-defined concepts prescribed in the textbooks and the syllabus.

In conclusion it can be argued that the interview responses from the three teachers suggest that the first planning workshop initiated among them a process of thinking about the meaning of environmental literacy and the associated meaning of environment. However, Limpho's reluctance to say what environmental literacy meant, as well as Map's concern to recall how others defined the meaning of environmental literacy, could have stemmed from their assumption that word meanings are fixed, unproblematic and determined elsewhere. Lebu's viewpoint about the activity, however, could be described as amenable to the challenge of interpreting the meaning of the two concepts (i.e. environment and environmental literacy); a perspective which may be associated with his background of university studies, which the other teachers did not have (See Table 2.1).

4.3. LATER REFLECTIONS OF THE RESEARCH TEAM ON THE MEANING OF ENVIRONMENTAL LITERACY

At our next workshop, held after the first cycle in August 1996, the research team's views about environmental literacy remained largely similar to those articulated in February 1996, at the planning workshop. By this time one member of the research team, Limpho, had

withdrawn from the research. Drawing on ideas associated with focus group discussion (Anderson, 1990; Debus, 1995), I formulated the following questions to guide us to reflect critically on our early assumptions about the meaning of environmental literacy in the light of the experiences and insights we had gained in the first cycle:

1. How has your classroom experience informed your understanding of environmental literacy?
2. How has your experience at the Environmental Education Association of Southern Africa conference (in Stellenbosch) informed your understanding of environmental literacy?
3. When you reflect on your research findings, would you say that you developed environmental literacy in your students? Explain.
4. These are the ideas about the meaning of environmental literacy as articulated in the first workshop. Comment?
5. These are the ideas about the teaching methods/strategies that may be used to achieve environmental literacy. Comment?

At the beginning of the discussion Map and Lebu thought that there was nothing to *add* or *remove* from the ideas suggested about the meaning of EL in the first workshop. As Map put it: "I think awareness, concern, those words as far as I am concerned have, bring the meaning of the whole thing clearly". And Lebu stated: "Na ke bona eka e ntle definition ena e ngotsoeng mona, e includa nthoe ngata bona boo...ha ke bone hore na ebe re ka hlaha ka nthoe ncha" (I think this definition which is written here is good, it includes such a lot of things, I cannot see any new thing we can come up with). Moreover, Lebu, in particular, repeatedly questioned the rationale of redefining the meaning of environmental literacy. My own argument was that the words we used in February to define environmental literacy were cumbersome and could be clarified further. The following extract illustrates this.

Focus Group Discussion (August, 1996)

Lebu: **Ha ke bone eka hona le ntho e ngoe e setseng (I don't think there is anything else left out [in this definition]) .**

Tsepo: Now but with this observation [inaudible], what do you say? Observation, for you to be aware you have to observe; is it, does it, is it any kind of observation? [inaudible]

Lebu: Ke hona, u batla re...(That's why, you want us to...)

Map: [inaudible] it depends on a particular need, if maybe the kids or whoever [inaudible], to be aware [inaudible].

Tsepo: ...are we right then to say observation must be somehow guided?

Map: Ea ntate [Yes ntate].

Lebu: **Ee, na joale, ena le ntho eo e ekenyang moo, kapa e chenchang (Yes, but now, does that add anything here, or change anything)?**

Tsepo: ...hobane mona re re feela awareness of the problems, joale mona ebe re re (...because here we simply say awareness of the problems, now here we then say) to be aware, so we are saying there must be some observation skills,

which is somehow guided, so I think it takes [inaudible] observation to be somehow guided.

Lebu: **Now ntate Mokuku, ke hanana le uena mono; ke bona e ka u batla ho qanolla ntho e sentse e ipoletse ka bo eona (Now ntate Mokuku, I do not agree with you there, It looks to me that you want to analyse something that is self-explanatory)**, [My own emphasis added.]

In response to Lebu's argument, which I perceived as a reluctance on his part to engage in the task of defining environmental literacy, I became impatient and made firm statements to push my viewpoint. This firmness in my statements was particularly clear on the tape. I have highlighted these statements in the following extract with the letters **FS**.

Focus Group Discussion (August, 1996)

Tsepo: So, am I right? Let me just, summarise em ntate Lebu, and 'me Map, based on what we said, and based on the outcomes which 'me Map had, and concerning "action taken" we said students have to communicate effectively, [Map: Ee]. A kere ntate Lebu (Right Mr.Lebu? **FS)**. Because now we are expanding on the "action taken", so my understanding is that for action to be taken we must communicate effectively.

Lebu: Mm kea utloa, fela joale kere...(Mm I understand that, but now I say...)

Tsepo: We are expanding on this 'action taken' **FS**

Lebu: Ha ntle re etsa joang...joale (What exactly are we doing now...now?)

Lebu relentlessly questioned the logic of the whole exercise. After much argument with Lebu on the rationale of the exercise I reformulated the question, trying to get him to reflect on and relate his experiences during the first cycle to the team's earlier views on the meaning of environmental literacy.

Focus Group Discussion (August, 1996)

Tsepo: How would you suggest we go about this, [inaudible] say there is something you want to [Phe: add or subtract], add a little bit, or subtract, or define based on your experience...

Lebu: ***Ha ke so nahane hore hona le ntho eo nka e tlosang, kapo kare kea e adda.*** Ke hore joalo ka ha ke cho ke mona re bua ka awareness, a ke re you are aware? Kapo concerned, u concerned... Ke hore mona ha re bua ka environmental literacy ke bua ka motho eo mohlomong a khonang hore a maneje environment, haeba a bona hore this is over-grazing a tsebe hore re ne re tlameha hore re ***behe*** mono ho se ke hoa fulisoa, rea maneja. Re se ke ra ea le lintho ha ngata mono, re ntse re maneja, re etsa joalo. 'Action taken' u ka, u ka bua le bana sekolong, bana ba utlusisa hore na le ka ea la eo hleka, la cleana, that's the action taken....

English Translation:

I have never thought that there is anything that I can remove, or that which I can add. Like I say, we are here talking about awareness, you are aware right? Or concerned, you are concerned....Now here when we talk about environmental literacy I am talking about a person who would, maybe be able to manage the environment, when he/she notices that this is overgrazing he/she knows that we have to ***beha*** there, that there should not be grazing, we are managing. We should not take the stock there regularly, we are still managing, we are doing that. 'Action taken' you can, you can talk about kids at school, the kids understand that we can go and tidy up, and clean up, 'that's action taken'...(My own emphasis added.)

By mentioning the example of overgrazing and how this problem could be solved Lebu seems to be referring to one of the problems identified by his class during the excursion. He suggested the concept of *beha* (*behe* in a verb form) or rotational grazing as an example of "management", and the collection of litter as an example of "action", demonstrated by an environmentally literate individual. By responding to the question in this way, Lebu reflected and expanded on the meaning of environmental literacy. From this viewpoint his reluctance to engage in the activity seems to suggest that this process of reflection, which 'forced' him to relate his initial assumptions about the meaning of environmental literacy with his practice, was uncomfortable.

Further on during the discussion, Map raised a concern about the motive for expanding the definition of environmental literacy. She suggested that as a team we knew what the words we used to define environmental literacy in the first workshop meant, and she questioned the rationale for elaborating on them.

Focus Group Discussion (August, 1996)

Tsepo: Right. 'Me Map you want to say something?

Map: I don't know whether em, ntate whether this, what we are doing actually, is whether we are preparing this maybe for somebody or for some people (Tsepo: Mm) who do not know about it, and have to break it (Tsepo: Break it down) so that we can be able to explain it.

In response to her questions I stated:

I think by breaking it down, or expanding it we are clarifying for ourselves, and as I say personally there is some more information which by awareness, awareness is usually interpreted in many ways, and when you say from your experience it involves some observation skills, observation skills were important when you, say classify

things, and in the process of observation kids were carrying out water quality tests, then this said something about environmental literacy; that some skills of observation are somehow important, in the sense that in the case of 'me Map when the kids were filtering the water and um, but I think it had to be guided, (Map: Mm) because initially kids would see things I think without really bothering...about pollution. Because, I, I, yah some guided observation is necessary. So in sort of expanding, it doesn't really mean, we do away with that or add whatever, I mean, or this is not right, but to sort of clarify what awareness means....

Later on in the discussion, in his insistence that our previous definition of environmental literacy was adequate, Lebu argued that if we had not started by defining environmental literacy, we could have perhaps come up with a different definition of environmental literacy. He thought that our first definition guided our actions and experiences, preventing us from discovering anything different about the meaning of the concept. Retrospectively, given that the concepts that the research team associated with environmental literacy were cumbersome, the teachers seem to have interpreted and translated them in different ways in their teaching. Although Lebu maintained that his experiences had not added anything new or contrary to the earlier definition, when I insisted on prompting him further, a new idea emerged in our conversation as to his understanding of the notion of 'action' in the context of the present study. This could be seen as further evidence of his resistance to reflecting on his assumptions about the meaning of environmental literacy - resistance to some extent overcome by my further probing.

Focus Group Discussion (August, 1996)

Tsepo: So um, ntate Lebu in conclusion of this session is there any comment you would like to make? Or maybe I should take us a little bit back to the questions, guiding questions again. Based on the classroom experience, based on the EEASA conference and other experiences and research findings you don't feel you want to add anything more to the definition?

Lebu: No, ke ntse ke lumela hore mohlomong he, ha eba ntle le definition ena, e ba re ile ra ba le mohlomong lireport tsane tsa EEASA, e be mohlomong re bile le li experience e be joale re tlo defina environmental literacy, ke utluisisa e kaenvironmental literacy e bolela tjena but ha re sentse re definne re ea mane re fumane hore e hlile ho ntse ho le joalo [inaudible], re ea classroomung, classroomung a ke re hoa rona ke ho guida bana hore ba conforme to what we have already defined. (Map: Ee)....

(No, I still believe that, maybe then, if apart from this definition, and then we had maybe the EEASA reports [i.e. team's reports], and then maybe we had the experience, and then define environmental literacy: I understand

environmental literacy to mean this, but as long as we define it based on that [previous definition] we find that it is of course the same (inaudible), we go to the classroom, in the classroom let's say our role is to guide the students to conform to what we have already defined [Map: Yes]....)

Tsepo: So you say, you are saying that the definition, the fact that we started with the definition guided our actions?

Lebu: Ee e ne hlile e guida li action tsa rona. (Yes it was indeed guiding our actions)

Tsepo: But the actions do not say something contradictory to what, you cannot say they say something contradictory [inaudible] except that they expand?

Lebu: Ee joale u re, joale u breika lentsoe ka lentsoe, joale u re ena e bolela tjena, ena e bolela tjena. E leng mane mo ke reng ke bona, ke ha eba u se u na le motho, joale a re ngoaneso nthoena e bolelang? Ha hona motho ea ka reng ha a utlusisi hore na re bolelang ka hore 'I am aware' [inaudible]. (Yes now you say, now you break a word for word, now you say this means this, this means this. That is why I say I see, this may be when you are with a person, now she/he says my relative what does this mean? There is no person who can say that she/he does not understand what we mean when we say 'I am aware'.)

Tsepo: [inaudible] looking at the outcomes, students taking action, would you say that those are the two main examples you mentioned, can you say that taking decision and problem solving are additional to this or they expand or something?

Lebu: Ha se li addition, ke ntho tse teng ka mona.(They are not additional, they are already there here.)

Tsepo: Which ones...[inaudible].

Lebu: Ha eba re re we are '**taking decisions' here, a ke re ke eona action taken**. Le eona 'problem-solving' ha ke ha re re we are solving problems it means we are taking action. Ke hore 'na ke lumela hore ha se hore ha re re action in the environment joale, ke ho bolele hore re tlo tla cleana environment, action eka a ha re ntse re bua tjena.... (If we say we are '**taking decision' here, that is 'action taken'.** Even 'problem-solving' when I, when we say we are **solving problems, it means we are taking action**. That is, I believe that it doesn't mean when we say action in the environment, it means that we have to clean environment, **action could be as we are talking**....)

Tsepo: So for you action does not only mean going outside the classroom....

Lebu: Ee (yes) [inaudible] discussion groups, re inkile action (were taking action). [inaudible]. Na ua ntokolla ntate? (Are you releasing me ntate?) (Lebu wanted me to release him to take photos of the session). (My own emphasis added.)

Lebu's decision to leave (to take photos) before the discussion was fully concluded may be seen as a sign of lack of interest in the activity and a confirmation of his earlier concern that this activity was unnecessary. At the end of our discussion Lebu reported our findings to the workshop participants. This is how he summarised our discussion:

Lebu: Maybe if before the experiences and all the other things between that time [the first workshop] and now, uh we didn't just start by defining environmental literacy maybe we could have come up with different things all together. And we were saying this because all our experiences and actions eh were focused in a way that we

conform with, with what we have done....So we are saying everything that we have been doing, or was already being influenced by what we have defined as environmental literacy.... The only thing which maybe could be done, would be to try to expand and say what we mean by awareness of problems.... you have to have observed, you observe the environment you become aware of it; and does it have to be just observing the environment like that on your own [inaudible], without some form of guidance?...so somehow after guiding [inaudible] so that they look at it now in a different way, critically as we say, I have mentioned, now if they look at this then, in a different way eh rather than just looking at it and just passing, now they are aware that this is bad or this [inaudible] and so on... we could expand on what is meant by awareness, what do we mean by action taken, what sort of action, and in action eh we believe that it doesn't necessarily mean physically doing something...to prevent soil erosion we can say...when they are sitting down discussing the problems, we should think that there is action....

In conclusion, the attempt to redefine our beginning assumptions about the meaning of environmental literacy as a team was characterised by tensions and conflicting viewpoints. These centred on the rationale behind the activity of redefining environmental literacy and manifested in the reluctance of other team members to reflect on and revise the meaning of environmental literacy. I thought it was necessary to expand on the words that we had used earlier to define the meaning of environmental literacy, by drawing on our experiences in the classroom and other relevant experience (e.g. the EEASA conferences). However, Lebu and to a lesser extent Map thought that such elaboration was unnecessary, as the definition was clear enough to the team. Within this argument I could also sense their concern: "For whom do we have to elaborate this definition, when it is clear to us?" In my strong commitment to the need to learn and draw lessons from our actions in the classroom, I insisted that Lebu and Map reflect on the initial agreed meaning of environmental literacy in relation to their experiences during the first cycle, guided by the questions I formulated. At certain moments in the process of discussion, questions that I posed did elicit some information which expanded some of the concepts we used to define environmental literacy in the first workshop. The process of probing was not easy, as the purpose of the whole activity was continually questioned, in particular by Lebu. Thus, in my facilitation of this activity, I experienced some frustration at what I perceived to be a reluctance by Lebu to engage in the process. At some moment during the discussion I attempted to overcome this reluctance by making firm statements. In retrospect, I see that I have interpreted Lebu's reluctance to engage in discussion as an expression of "resistance" to engage in reflection, possibly because the exercise was challenging set views. Yet he also seemed to be open to the idea of team

members constructing knowledge by making others aware of certain things "certain portions" in clarifying the meaning of environmental literacy.

In the following sections I continue to discuss the understanding of the three teachers participating in the research concerning the meaning of environmental literacy, drawing on their interview responses and other evidence that emerged during the research process. I further reflect on my own developing personal understanding of environmental literacy during the research period.

Lebu's Case

After the first action research cycle, Lebu argued that his own understanding of the meaning of environmental literacy derived from the interactive sharing of ideas with other people at the two workshops for the research team. He was reluctant to refer to his own view of the meaning of environmental literacy since he thought that his understanding of the concept was informed by the ideas of others. He associated environmental literacy with the biological and the socio-economic dimensions of life.

Interview (04-06-97)

1Tsepo: Ok! Ntate Lebu...what can you say **in your view**, environmental literacy means?

2Lebu: (Silence) Mhm, its not very easy to say... 'your view'.

3Tsepo: 'in your view'.

4Lebu: Because you would say, uhm **we** are trying to put it and **then being corrected over and over again** and...then agree at one point; that I should believe is what **they** referred to as environmental literacy.

5Tsepo: And when you say 'they' would you say you were party to it?

6Lebu & Tsepo: (Laugh).

7Lebu: Uhm well, you may say that, for example I would say environmental literacy, you may say part of what many people would say is **the correct** maybe definition of environmental literacy, and then you realise that oh! I wasn't aware that this was also part of these.... So that's why we **agree with the people who have spent uhm a lot of time trying to clarify or define what environmental literacy means**, (V: Mhm), I think that's what I consider as the meaning of environmental literacy.

8Tsepo:Can you phrase that again ntate Lebu? Are you saying that you would rather not say here is your own view [of the meaning of environmental literacy]?.

9Lebu: Yes, yah! I would say that.

10Tsepo: But rather you would say what?

11Lebu: I'll say well, I agree with the view which is put forward on environmental

literacy.

12Tsepo:By whom?

13Lebu: Well I didn't say by whom [laughs], but from the workshop that's where we got ideas as to what environmental literacy means. So if I say my view, then I say the same words which I have picked up from somewhere else. And I wouldn't say it's really my view. I'm just agreeing [laughs].

At section 4 in the above extract, Lebu explained his understanding of the concept of environmental literacy as a product of a collective effort and an extended process of clarification (i.e. "correction").

Some contradictions may be noted in Lebu's statements, which may be seen as signs of a changing perspective (see Winter, 1989: 46-55). His statement that the attempted definitions were "corrected over and over again", as though by some objective individual(s) external to the process of definition, is not in line with his suggestion that his understanding was the product of a team effort. Similarly, contrary to his indication that his understanding of environmental literacy resulted from a collective effort, he referred to his understanding as a product of the ideas of others, when he stated that "I should believe that is what **they** referred to as environmental literacy". His use of *"they"* in this statement was inconsistent with his use of *"we"* in the earlier statement. He later clarified, in section 13, above, that by *"they"* he was referring to workshop participants, during research team meetings. It can be argued that the *contradiction* in Lebu's statements reflects his *changing* role or perspective, created by the research, from his traditional practice as a recipient of concepts defined by 'other' more knowledgeable individuals, to one of being a co-constructor of concepts with others as a team.

Lebu further explained, in section 7, that the advantage of "many people" defining environmental literacy is that they could mention things that one might not oneself have been aware of. He also alludes to the importance of people with experience contributing to the understanding of the meaning of environmental literacy. He seems to suggest that such experienced people ought not to be questioned: "so that's why we agree with the people who have spent uhm a lot of time trying to clarify or define what environmental literacy means". In the context of this study, "people who have spent a lot of time trying to clarify or define what environmental literacy means" must refer to those who participated at the workshops, i.e. the

research team members.

Further on it my interview with Lebu another meaning of environmental literacy became apparent. This may be described as a 'second order' of meaning of environmental literacy, in relation to the 'first order' of meaning discussed above. However, these two levels of meaning may be seen as integral rather than separate and unrelated.

Interview-continuation (04-06-97)

14Tsepo:OK, from the workshop what came out as an important thing for you about environmental literacy or important things?

15Lebu: E..eh. I would say normally we would or from the past, when we talk about the environment we just looked at our surroundings and that was all. But then from the workshops we even look at the way people live, uhm the economy of the country how the society lives, something like that, so much that it doesn't really only focus on trees, the rocks, the water, the air and so on around us, something like that. Involving everything that is human, animals, that interaction, their problems and so on. And because in most cases if you could say write down some of the environmental problems, some people before the workshop I think would focus on soil erosion; uhm pollution, but not looking at maybe some of the causes which are more social rather than the physical environment.

In his account Lebu associated the meaning of environmental literacy with the meaning of environment. It can be argued that he implicitly suggested that the meaning that one associates with the concept of environment will determine how one defines environmental literacy. He explained that "normally" or in "the past" he associated environment with the "surroundings" and nothing else. The examples he gave to clarify the meaning of the concept "surroundings", at the beginning of the project (see Section 4.1.), were exclusively derived from the physical and biological domains of the environment.

It appears that the project developed Lebu's understanding of environment and environmental literacy towards a holistic perspective, that included "the way people live", "economy of the country", "how the society lives". This perception of environmental literacy goes beyond his initial conception of environment as limited to the biophysical dimensions of environment. There is no evidence that Lebu developed this perspective within the context of his teaching in the classroom. But as he explained earlier, it is a perspective that he seems to have constructed at workshops in conversation with other team members.

Map's Case

In this section I attempt to construct Map's perspective on the meaning of environmental literacy by drawing on the views she expressed during my interviews with her. Her explanation of the concept of environment, below, occurred only in the context of her attempt to clarify the meaning of environmental literacy.

In my first interview with her (February, 1996), subsequent to the first planning workshop, Map associated environment with the "surroundings", with "living things" and "non-living things". This view was commensurate with her definition of environment at the beginning of the project and stressed the biophysical dimensions of environment (see Section 4.1.).

After the second cycle of action research, Map's view of environment reflected some new constructs that were not initially apparent. These included "resources" such as animals and plants, the "interrelationship between the two" (i.e. animals and plants'), and "environmental problems". This perspective was expressive of a relatively more complex view of the environment than her earlier one. Initially, Map interpreted the concept of environment without reference to the interrelationships between "living things" and "non-living things", or to or their usage as resources.

> Interview (11-09-97)
> Tsepo: What would be...in your view be the most important aspects of this environment,that one should know about, I realise that you are using a very embracing word, that it is about everything but um would you like to maybe highlight some key things which you think should be known about the environment...things that you consider as key things yourself?
> Map: I think **resources**...resources um...the...maybe **animals and plants, the interelationship between the two.**
> Tsepo: Anything which strikes you as important? Or other things?
> Map: Some would be **environmental problems**. (Emphasis added.)

Map thought that the EEASA conferences contributed to shaping her understanding of environment. She said this in my interview with her after she had attended two EEASA conferences, in 1996 and 1997. She thought that recycling was one useful thing she had learned from the conferences. The concept of recycling was, however, not entirely new to her as she had earlier taught it in relation to 'Magnetism' (see Chapter 3). It can also be argued

that the recycling of litter concerns "managing of environment" and action to solve an environmental problem, which were identified as dimensions of environmental literacy by the research team at the first planning workshop.

Interview (11-09-97)
Tsepo: Did you find the EEASA conferences useful?
Map: E-ea ntate, because from there...the presenters shared with us some of their experiences, about environmental education, for example maybe maintaining our environment, keeping it clean or making use of the litter that maybe is supposed to be collected and burned, instead of maybe burning, causing more problems in the environment, the litter is recycled, becomes useful.
Tsepo: Ok...did the EEASA conferences complement or contradict your understanding of environment?
Map: I think it complemented it.

Map's perception of environmental literacy may further be derived from the statements she made when reflecting on the project after her two action-research cycles, in my interview with her. She thought that one of the most useful things about the project was that it made her and the students *"aware"* of environment. The notion of 'awareness of the environment' had been mentioned by the research team as one aspect of environmental literacy in the two previous workshops. She explained the concept of 'awareness' among students to mean "knowing what things are found in their environment, to keep it clean and tidy, and to express this in their life, it should be seen expressed in their life, and they should not be pushed into it...and find it as if it is a torture" (Interview, 11-09-97). Here, Map associated awareness with voluntary action by an individual to solve an environmental problem. The workshop participants had earlier identified this as an aspect of environmental literacy at the first planning workshop.

In the same interview Map continued to explain the meaning of environmental literacy as follows:

Final Interview (11-09-97):
Tsepo: What can you say environmental literacy means in your view?
Map: I can say that environmental literacy means ... um **knowing very well about one's environment what is in one's environment ... the resources ... the ... everything that is around**... knowing very well about whatever is around and **how one can use it;** um how it can be worth while, or **how one can keep or can maintain the environment**.(My own emphasis added.)

It is remarkable that the notion of "resources" and the "use" thereof reflected features new to the team's initial perspective on environmental literacy. However, these features were not necessarily incommensurable with the team's earlier views, and may be seen as part of Map's growing understanding of environmental literacy. The use of the word "resources" reflected her newly emerged concern with the functional aspect of the environment. Her concern to know "how one can keep or maintain the environment" may be associated with the notion of the ability to live in a sustainable way. Sustainable living or development has been defined in the World Conservation Strategy as "...the management of the human bio-sphere that it may yield the greatest benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations " (IUCN, 1980).

In addition, Map thought that the two EEASA conferences that she attended during the research period contributed to shaping her understanding of environmental literacy. The example that she volunteered of knowledge that she associated with the conferences was her first experience of a herbarium and its function.

Final interview (11-09-97)

Tsepo: Did these conferences complement or contradict your understanding of environmental literacy?

Map: They complemented.

Tsepo: Maybe I should ask you again, a thing or two, a few which were striking which you think were a complementary to your own understanding, which you can immediately recall?

Map: Well I can remember one thing, that was the herbarium that we learned about, or that we visited. All along I knew that things were being collected and books were written about those herbs, these herbs, different herbs, different plants but I didn't think there was such a thing. It was very striking to see plants being collected from all over the country, preserved ... methods of preservation how they um ... cured their diseases. And all that.

My own personal experience of the EEASA conferences was that there was a stress on the perspective that environment and environmental literacy concerned a complex interconnectedness of the social, economic, political and biophysical aspects of the environment. The relevance of this perspective for secondary students had been questioned by Lebu at the first planning workshop in February 1996, and by Map subsequent to the workshop (fieldnotes, 22-02-96). Driven by my strong commitment to this view, on account of its ability to account for environmental problems (in Lesotho), I probed Map on it. She too

seemed to embrace this perspective on environment and environmental literacy.

Final interview (11-09-97)

Tsepo: 'Me' Map I just want to say about my experience that when I first went to EEASA, one thing that struck me was that ... people tended to explain environment as a broad 'thing' that included politics, that includes life, that includes sustainable living, which was defined as living today bearing in mind the needs of those who are yet to be born, economic issues, cultural and all these issues and was this what you felt yourself when you first went there; and did you feel that the idea that these...all these issues that are political, economic, social should be part of what is defined as environment?

Map: **The first time I went to the EEASA conference, maybe I wasn't really environmentally aware**, so I thought of something else, something that concerned plants, animals, well those biological things, I wasn't really focusing on such things as politics and other things. So I couldn't say that's how I saw the, or that's how I understood **environmental literacy**, the way it was described or the way it was discussed there.

Tsepo: But presently what is your (view)? ... What would you say... does it make sense?

Map: The second...in the second conference, yes I was aware of that...I was aware of that.

Tsepo: And do you think that all that makes sense to you?

Map: Yes! It does, it does ntate because there were a lot of things that I realised and did affect us one way or another...so I really was aware that ... politics are a part of um **environmental literacy.**

By stating that prior to her attendance at the EEASA conferences she "wasn't really environmentally aware", Map seems to perceive environmental literacy in all-or-nothing terms. That is, she intimated that she had been 'ignorant' prior to her attendance at the conferences but was subsequently enlightened by the 'correct' conference perspective. Further, in my fieldnotes at the end of this interview, I recorded my feeling of disappointment that Map did not mention the political and socio-economic systems as features of environmental literacy, as Lebu did, until I specifically mentioned this understanding of environment (Fieldnotes, 11-09-97). This feeling can be seen as an indicator of my strong commitment to this perspective on environment and environmental literacy, and also of my possible assumption that this perspective was the only 'correct' one.

In conclusion, Map's initial view of environment and environmental literacy, as formulated at the first planning workshop, developed into a more complex perspective. Her view appears to have largely been shaped by the workshops and conferences she attended. This picture

parallels that of Lebu during the research process. The concepts that Map associated with environment and environmental literacy included "resources", "politics", interrelationships amongst various aspects of environment (e.g. plants and animals), environmental problems (e.g. littering) and strategies for solving them (e.g. collection and recycling). For Map action that is not initiated by an individual to solve an environmental problem, for example in the case of students who are forced to collect litter as punishment, is not an indication of environmental literacy. The initiative to solve environmental problems ought to come from students.

Limpho's Case

Just before the end of the first action research cycle, when Limpho indicated that she wished to withdraw from the project, I interviewed her on some aspects of the project. I have drawn on her responses during this interview to construct a picture of her understanding of the meaning of environmental literacy.

In this interview Limpho stressed the importance of students taking action in the environment to make an observable difference, which she thought she did not achieve with her class.

> Limpho: There's nothing that you can point out and say these kids are doing these and these after you taught them these, yah maybe I never gave them a chance to do something, I don't know. (Interview, 17-09-96.)

Her view that such action must be voluntary rather than externally directed (e.g. as a form of punishment) is similar to that of Map.

> Limpho: I haven't seen them making their own knowledge or a cleaning campaign besides doing it as a punishment...." (Interview, 17-09-96).

The concept of taking 'action' to solve environmental problems had been suggested by the research team as an aspect of environmental literacy at the first planning workshop. Limpho's commitment to this concept is further noted in her suggestion that the value of the present research depended on whether or not action had been taken to solve environmental problems.

> Interview (17-09-96)
> Tsepo: How is this research important, in your view?...Or did you find it important?
> Limpho: It's important, if after doing the research something is done about our

environment here. Then it's important.

Tsepo: So you want some form of action to be taken?

Limpho: For example, we may teach about say pollution, water pollution or land pollution and there is no action taken about it, then the research is no good, you see. If after the research you say well, we learned this, we discovered this and that and that, what are we going to do about it? The whole thing is good provided there could be practice....

However, when I asked Limpho what she thought environmental literacy meant, she seemed to experience difficulty. She sounded reluctant to interpret the concept as she understood it. Yet she had just referred to the ability to take action to solve environmental problems as an important outcome of our research activity. Her response was rather technical, and she began by first defining the word "literacy" and then the whole phrase (i.e. environmental literacy). Her attempt was, however, an improvement over her earlier failure to define the concept, shortly after the first planning workshop, when she said that she could not remember how the concept was defined at the workshop (see section 4.1.2.).

Interview (17-09-96).

Tsepo: Well when referring to your research experience with your class, can you, what can you say, in your understanding, environmental literacy means?.... When you look back at what you did with your students um what can you say environmental literacy means in your view?

Limpho:To me, Ah, I still can't define that one (laughs), I can't. I still take as, you know, meaning of the word literacy, which I take, it as knowledge, general knowledge ok, so environmental literacy is knowing of the environment and understanding it, but I can't say further than that.

Limpho's statement that she could not go beyond defining environmental literacy as simply "knowing of the environment and understanding it" suggests that she might not have gained such experience as might have enabled her to say more on the subject, at the time of interview. This concise definition, and the words she used, suggests that by the end of the research she had not shifted much from the team's starting assumptions about the meaning of the concept. Her limited participation in the research (e.g. attendance at one workshop and failure to attend the two EEASA conferences) could have contributed to her apparent lack of further ideas, as compared to Lebu and Map.

Tsepo's Case

It seems that action research somehow orientated me to reflect broadly on the meaning of environmental literacy in contexts that I experienced during the research project, other than the context of science teaching. In this section I illustrate how the following contexts interacted with my research experience and thus shaped and crystallised my own understanding of environmental literacy: My participation in the national curriculum development process aimed at localising the secondary school curriculum; my teaching of curriculum studies in Junior Science at a university; my involvement in the formation of an association of environmental education; and my encounter with a local farmer who had developed a farming system adapted to Lesotho conditions.

Meaning Emerging at the Interface of my Research Experience and the National Science Curriculum Development Process

The present study coincided with an important initiative to localise the Senior Secondary curriculum, that had hitherto been developed and administered in Britain. As part of this process the Junior Secondary curricula also had to be revised. I was invited to participate in the Science Curriculum Review Committee, in my capacity as lecturer in Science Education at the University. The role of this committee was to support the Science Panel in its activities of formulation of objectives and development of science content. My perception of environmental literacy in relation to science was reflected in my contributions to the discussions at the Curriculum Review meetings I attended. Below I discuss some of the statements I made and their implications for my understanding of environmental literacy.

As we reviewed the science curriculum 'Mission Statement' I proposed that a section of the statement that read "localising science in Lesotho does not mean inventing a new form of scientific knowledge unique to the Basotho, and forgetting about what is going on in the rest of the world..." be modified to read as follows, "localising science in Lesotho may mean inventing new forms of scientific knowledge unique to the Basotho, but not forgetting what is going on in the rest of the world..." . After extended debate this statement was finally adopted within the mission statement (Fieldnotes, 15-01-97). This proposal was motivated by my

growing concern that local knowledge forms (i.e. indigenous knowledge or contextual knowledge) constituted an important resource for environmental literacy since, I believed, it advanced sustainable living. Studying the mission statement further (in small groups), at the same meeting, it occurred to me that there was no mention, in the Mission Statement, of '*environmental awareness*' among the many skills and attributes listed. I shared this concern with the participants and the concept *"environmental awareness"* was subsequently incorporated into the mission statement. While several specific objectives concerning the environment had already been formulated, it is noteworthy that my suggested amendments were never reflected in the final Mission Statement.

At some meetings I shared my insights from the project. For example, I suggested that an objective which emphasised the development of students' ability to solve their local environmental problems (Fieldnotes, 15-01-97; fieldnotes, 07-02-97) be included. The idea of solving environmental problems had not been mentioned in the specific objectives that had already been formulated (Fieldnotes, 15-01-97). In subsequent meetings (held on the 6 and 7 Feb., 1997) I also recommended a repertoire of teaching methods that we had employed in the present study for inclusion in the science curriculum, under Notes for the Teacher. Also, realising the advantages of action research, I recommended action research as an appropriate process for identifying and solving environmental problems in students' local environments (Fieldnotes, 07-02-97).

At the same meeting I also argued for an objective that affirmed the desirability of students' knowing of local plants and animals in their mother-tongue, namely Sesotho and Thembu, as well as by their scientific names. Thembu is spoken by a minority group of Thembu tribe mostly living in rural parts of Lesotho; it is not an official language and is excluded from the curricula. I deliberately mentioned the use of these languages in my attempt to promote their use as media of instruction in schools. This idea was in part driven by my realisation, during the research, that the use of English as a second language and a medium of instruction inhibited meaningful learning, and from my growing commitment to local forms of knowledge about environment, which I believed were embodied in the local language(s).

There is also evidence in my notes on the curriculum meetings that I embraced a view that environment (and environmental literacy) concerned an inter-relatedness of various systems of knowledge. This is reflected in my proposal for the formulation of an objective stating the political, economic, cultural and biophysical impact of the Lesotho Highlands Development Authority (Fieldnotes 07-02-97). This major technological project and its impact on the environment had not been mentioned in the list of objectives before.

Further, when discussing the objective that referred to the Basotho's knowledge-forms, we struggled to identify such knowledge. As a result a debate developed on the nature of scientific and 'indigenous knowledge'. I argued that science and the scientific method were not necessarily superior to local knowledge forms (Fieldnotes 07-02-97). In my fieldnotes on the discussion on the Basotho knowledge forms (Fieldnotes, 07-02-97) I recorded that "I strongly believed that the indigenous knowledge/Basotho's knowledge forms provided a strong basis for sustainable development - an aspect of environmental literacy". There is evidence in my fieldnotes on the Curriculum Review meetings that I had argued for the inclusion of indigenous knowledge forms within the science curriculum earlier in 1996 (Fieldnotes, 14-11-96). At one meeting, I strongly argued for the inclusion of an objective that stated "have developed awareness and appreciation of the role of science in relation to Basotho's knowledge forms" as an addendum to the goal "have developed awareness and appreciation of cultural values, norms and practices".

Zwahlen (1996) has referred to two reasons that make indigenous knowledge and practices an essential condition for sustainable development: the first is that they emerge from the cultural context of the people concerned, and the second, that they evolve in close contact with specific environmental conditions and are based on the traditional societies' intimate knowledge of their environment. However, he does not see the issue as a simplistic dichotomy in terms of which indigenous knowledge is equivalent to sustainable development and Western knowledge to unsustainable development, but rather as a matter of drawing diversely on existing knowledge systems. I continued to reflect on the meaning of indigenous knowledge systems in the context of the science curriculum that I came to perceive as predominantly Western. Consequently, when I was invited to submit an article on education by a local NGO I contributed an article titled *"Can we Translate our Wisdom into Education*

for Basotho? A Glance into Lesotho's Hidden Treasure" (Mokuku, 1996a).

Perhaps a dream that I had early in 1997 captures the transformation of my understanding about education, including science education, and teaching for environmental literacy. I have understood this dream to challenge the dominant paradigm in schools, which may be described as de-contextualised and oriented towards Western environments that are said to be 'developed'.

> My dream, early in 1997. Discovering the hidden world.
> Ke ha ke bona ke na le batho ba bangata, re le sebakeng sa boithuto, 'me re rutoa. Ha re ntse re rutoa ka nto fihleloa ke sefutho sa ho se khotsofalle seo re se rutoang, eaba ke se ke bile ke khetha ho ikhaohanya le sehlopha sena moho le sebaka.
>
> Eaba ke ineha naha, ka hlahlanka le lithota. Ke ne ke hlaha bophirima'me ke ea ke lebile bochabela. Ke hopola ke ne ke ts'ohile, ke le mong hara naha thote, lebelo la ka e eka la Ntso'ekhe. Ka iphumana ke se ke okametse lithaba, tse lilomo, 'me tlase e le likhohlo tse nyarosang. Ka iteta sebete ka theohela tlase, ke ne ke otloa ke letsoalo habohloko, empa ka peseletsa feela leha ke ne ke sa tsebe hantle moo ke lebileng teng. Ke ile, ke ile, eaba ke bona ke se ke hlahella motseng, ke o bonela o le hole tlase maane. Ha ke atamela, ka fumana motse ona e le oa batho ba ba MaAfrica. O ahiloe ka majoe, matlo a ruletsoe ka joang. Batho ba teng ba ne ba iketlile, ba sa potlaka, ho rena khotso. Ke hopola ke bona tsela e sephara e ka 'mila, feela ho ne ho sa bonahale moferere oa makoloi. Ka khahloa ke boiketlo ba batho ba motse oo.
>
> **English Translation.**
> I saw myself with many people, we were at a place of learning, and we were being taught. When we were taught I developed a feeling of dissatisfaction with what we were being taught, and then I decided to part with that group and that place.
>
> Then I gave myself to the land, I covered the plateau(s). I was coming from the west going to the east. I remember feeling scared, I was alone in a stretching land, my speed was like that of Nts'oekhe. I found myself overlooking the mountains, with huge cliffs, down there, there were deep scary gorges. I took courage and went down, I was painfully scared, but I just went on, even though I did not exactly know where I was heading. I went on and on and then I saw a village, it was at a distance down there. When I came closer I found that the village was inhabited by Africans. It was built of stones, and thatched with grass. The people there were satisfied, were not in a hurry, peace reigned. I remember seeing a wide path, more like a road, but there was no traffic of cars. I was impressed by the satisfaction of the people of that village.

I have thought of this dream as saying that environmental literacy involves the courage to break from the present established order to explore hidden and sustainable ways of living

within our local contexts in Lesotho.

Meaning Emerging at the Interface of my Research Experience and my Teaching at the University

At first I thought that my offer to teach curriculum studies in Junior Science at the university, during the research period, would provide me with the opportunity to try out action research and apply some of the insights I had gained from the research in my own teaching. This was largely not possible due to time constraints. However, some of my attempts to try and achieve this are worth noting.

In my interactions and discussions with colleagues at the university, and in reflection on my own teaching practice I continued to think about the meaning of environmental literacy in the context of my teaching of prospective teachers of Junior Science. One concept that interested me within this context was that of the 'integration' of Chemistry, Physics and Biology within Junior Science Curriculum Studies. This course was taught in a 'fragmented' manner by three lecturers, one to each of the three disciplines, and we neither planned our lessons nor our course outlines together. Yet in schools teachers were expected to teach the subject as one whole. I thought that this was an anomaly. Discussing this situation with one professor, I argued that I believed the integration of the disciplines to be important because it was in line with the notion of developing a holistic view of environment (Fieldnotes, 02-08-97). I subsequently shared my concern with two other colleagues who taught components of the course. One thought that teaching the course separately probably promoted the 'disintegrated' teaching of the subject in schools, and agreed to my proposal to plan the teaching of the course together (Fieldnotes 28-08-97). Our plan to discuss our approach to the course has hitherto not been realised. One colleague soon left the university and the other claimed it was too late for him to make new plans that year as he was busy with in-service activities. The latter was especially concerned about having to teach any content to do with Biology within such an initiative and has been reluctant to explore the idea.

Moreover, guided by insights I had gained from the research, I encouraged my student-teachers to, as I put it in the course outline, "relate topics to current or prevailing issues in

Lesotho" during micro-teaching, and to invite guest speakers during their lessons (Fieldnotes, 9-09-96). In one lesson I discussed the concept of 'integration' and traced it to the LISIP programme in Lesotho, arguing that its relevance within Junior Science was to assist in developing a holistic view of environment. I illustrated the latter by drawing on illustrations of diagrams from the EEPI document (1994). I further engaged the class in the activities of identifying Junior Science topics and discussing how the topics could be related to the economic, social and political aspects of environment in Lesotho (Fieldnotes, 19-09-96).

Meaning Emerging at the Interface of My Research Experience and My Involvement in the Formation of an Association of Environmental Education

My perspective on environment and environmental literacy is also reflected in my involvement in the formation of an environmental education association, housed within the Anglican Church of Lesotho. I had for many years experienced a growing anxiety at how the Christian religion, to which I was committed, claimed to provide solutions for human suffering and yet could not respond to the socio-economic and political problems in Lesotho. The resolutions of the synod of the Anglican Church of the Province of Southern Africa (CPSA) in 1995, brought to my attention by a Church official, became a challenge to me to make my religious practice relevant and responsive to environmental issues in Lesotho. These resolutions also came to my attention through a newsletter published by the Environmental Justice Networking Forum (Environmental Justice Networker, 1996), of which I was a member. My initiative was a response to the following resolutions:

> That this Synod [of CPSA]
> **Realising** that the future of human beings and all life on earth hangs in balance as a consequence of the present unjust economic structures, the injustice existing between the rich and the poor and the continuing exploitation of the natural environment;
> **And realising** that we as Christians have a God-given mandate to care for, look after and protect God's creation;
> 1. Endorses the 'Save our Future" Campaign...in order to create awareness of environmental issues and to integrate that awareness at parish level, diocesan and Provincial level
> 2. Requests all Anglicans to study, disseminate and commit themselves to the Campaign and petition. (Environmental Justice Networking Forum, 1996:19)

These resolutions, and others, became the basis for my proposal for and facilitation of the formation, in 1995, of an association called *Environment Desk (of the Diocese of Lesotho)* an association with a primary concern to promote environmental education. I facilitated the formation of this association with one environmentalist and later included two theologians and other interested people. We hoped to explore ways of infusing environmental issues into the teachings of the church, through educational activities that involved preachers, youth leaders, women's groups, etc. My commitment to this initiative was also guided by my growing conviction that school curricula alone could not tackle environmental problems, whilst the church, to which many Basotho were committed, continued to be silent about environmental issues and problems (e.g. Fieldnotes, 09-02-97).

It can be argued that the objectives of this association, which I first drafted for further development with others, reflect some features of my understandings of environment and environmental literacy. The following objectives were of particular concern and relevance to me, as a response to our degraded environment in Lesotho:

- to promote a view that environment and environmental problems concern a dynamic interaction between the cultural, economic, biophysical and political aspects of life
- to correct dominant ideas and forms of knowledge (e.g. theological, political, economic etc) that promote or silently defend exploitation of environment
- to explore and disseminate marginalised and 'oppressed' local forms of knowledge that promote sustainable living. (Environment Desk, 1998)

We hoped to achieve these objectives and others through workshops, group discussions and other creative strategies. The first objective alludes to my commitment to a holistic perspective on environment, which I thought should be shared by those who are environmentally literate. I also thought that knowledge could not only be seen as relevant or irrelevant, but that it could in fact cause damage or be used to exploit others; hence the second objective. For example, I thought that the apparent reduction of environmental problems by environmental educators in Lesotho, to biophysical problems such as littering and deforestation, which they attributed to the ignorance of the local people, masked and diverted people away from the actual problems of the unequal distribution of wealth and other

social inequalities. From this perspective knowledge was being adversely used to perpetuate inequalities. I raised this concern in an article titled, *It Is Rubbish to Say that Environment is Just About rubbish*, published by the Transformation Resource Centre (Mokuku, 1996b).

I have mentioned that during my research 'journey' I developed a perception that local forms of knowledge were an important knowledge base for environmental literacy. This perception gave rise to the third objective of the association, and reflects my changing perspective on what counted as 'acceptable' knowledge.

Meaning Emerging at the Interface of My Research Experience and My Interaction with a Local Farmer.

My interest in a local farmer, J.J.N. Machobane, who had developed a farming system adapted to local conditions in response to a school curriculum that he described as irrelevant for Lesotho in the 1940s, could be associated with my growing orientation to take local forms of knowledge seriously. I came to know about Machobane through a person who had worked on a farming project with him. I paid him several visits in 1996, and found his views on the curriculum and environment lateral and challenging. I subsequently invited him to our second research team workshop. He provided *"A local Perspective on Environment and the Curriculum"*. Below I highlight some aspects of Machobane's talk and discuss what environmental literacy means in the context of his perspective.

By listening to Machobane relate his life history at this workshop, I developed some understanding of Lesotho's environment in the past. Machobane explained how his realisation of the irrelevance of the school curriculum in 1943 resulted in his initiative to establish an education system that was more relevant to the needs of the Basotho in 1944. By 1957 he had established a college, which he hoped to develop into a University for Africa. This initiative turned into an arduous political struggle, culminating in his rivals destroying the college in early post- 'independence' political conflict in the 1970s. For him curriculum development initiative was unquestionably a political struggle. He challenged the workshop participants to engage in a struggle for curriculum development because, he argued, the introduction of the

educational curriculum in Lesotho (and the entire African continent) had been a strategy by the British colonial powers to maintain their supremacy and domination over the Basotho. This, he contended, was evidenced by the failure of the education system to develop Basotho's capacity to sustain their own lives. He argued, *"Mosotho is the most intelligent human being, feela ha a tsebe ho qapa"*; that is, in English, *"Mosotho is the most intelligent human being, but cannot invent/create"*.

Machobane related that he was born in the Republic of South Africa, and that his family migrated to Lesotho when the apartheid government passed a law that barred black people from practising *ho lema seahlolo* or 'sharecropping' (see Keegan, 1986), a practise which fairly benefited both black and white farmers. The passing of this law meant that Machobane's father and the entire household were to be mere servants of the white farmers. Life was different in Lesotho and farming opportunities were good. His family continued to practise farming and their maize production was very high (see Keegan, 1986). They used to produce about 300 bags of maize from their fields, he said, and some of it was sold. They used cattle for farming. His father ultimately had about 100 cattle, and they used to be taken to a cattle-post, *motebong*. Machobane recalled that there were many monkeys in the mountains of Lesotho in those days and that they used to call "ho ha!" when he was looking after the cattle. Yet they are now extinct. Machobane further explained that when he got to Lesotho he was overwhelmed by the size of the mountains. The Sesotho language was such a beautiful language for him and his love for the Basotho gradually developed.

When his father thought he had had enough experience of looking after cattle, he sent him to school. His performance at standard 6 was the best in the whole country. He continued with post-primary education at Morija College. He explained that his father was strongly opposed to the idea of 'employment', and that he thought an employed person was comparable to a chained dog, *U fana lenja*: the owner feeds it, but when there is disagreement, it starves, *e ja matlapeng*, since it has never learned to fend for itself.

Against this background Machobane presented his analysis of the school curricula. Below I present his argument about the curriculum in his own words, tape-recorded during his presentation. He first analysed the cause of Lesotho's socio-economic ills, and argued that the

curriculum in Lesotho was established by the colonialists as yet another grand strategy to perpetuate colonialism.

> We are a country, we are a government...naha e leng rona re feptjoa ke linaha tse ling ka liphallelo! Motho eeno ea re phallelang u eatla!...And he is just around; the first thing he is going to take from us ke basali, le joale ba sentse ba ts'ela...'me naha ha e qala e hloka basali is finished! And the second thing ke banna, ke bane ba sentse ba le makhooeng. 'Me banna bana ba sentseng hae mona, u tla bona monna ahloa lerallana a ea mane, o lapile. Joale ha a le mane paramente e ea kena...ha a theoha mane o bona mothonyana oa 'me ke eloa ka sebakanyana, o se a moshebile, o ntse a mosheba, hoane ba fihle ba be ba mobokanela mono, e kare lintla li tseka Lesapo. Ke tsona lintho tse etsahalang hona joale, re busoa ke tsona in Africa, the entire continent
>
> **English Translation:**
> We are a country, we are a government...a country, which is us, are fed by other nations through aid programmes. This person who is helping us is coming!...And he is just around; the first thing he is going to take from us, is women, already they are crossing the border...yet a country without women is finished! And the second thing is men, there they are, already in South Africa. And the men who are left here at home, you will see a man climbing a hill going up there, he is hungry! Now when he is there, a parliament sits [starts talking to himself]...when he comes down he sees a helpless woman there at a distance, he looks at her, he keeps looking at her, after sometime they arrive, and surround her there [i.e. rape her], as if they were dogs fighting over a bone. These are the things that are happening right now, they govern us in Africa, the entire continent.
>
> Nthoene ea bokhoba bona e qalile in the 14th century. Africa eena, North Africa ene ena le cities, big cities, batho bano bane ba ipusa. Eaba bana ba basue ba ntse ba atamela, eaba re qala ka honna re rekisa mona, ha bese ho fihla maArab ana, a tla ka tsoekere, ka likepe tsa bona...eaba ka nqena ha be ho qaleha hore ho rekisetsoa sechaba sa koana Amerika makhoba, batho ba batso...ra qala ra rekisoa mona, the entire continent! Hang fela e felisoe...hoatla ntho e bitsoang bokoloni, they are still doing it today, eaba ba etsa a structure e leng "curriculum" e le hore batle ba re buse re be liservants....Ha ba se ba re etselitse curriculum eaba hore re fasitse lithae, re reka liaparo ho bona, and we must never qapa letho! Basotho bane ba belisa lits'epe, ba belisa marumo, ba etsa ntho tsena kaofela, ba qapa....Eaba ho felisoa hore motho e mots'o a se keba a qapa, a tle a hiroe...e nore ha ba kopa (mosebetsi) ba re 'Vacancy!' a bese a etsa "I berg to apply for a vacancy..."; joale he ere ha a qetella mane ebe o re "your most obedient servant...". Ke bolela hore structure sohle sa rona ra se amohuoa.
>
> **English Translation.**
> This slavery started in the 14th century. This Africa, North Africa had cities, big cities, those people governed themselves. Then the white people came gradually, and then we started trading with them, then arrived the Arabs, they came with sugar, in their ship... then started a trade of black slaves to America...then we were sold, the entire continent! Once this was stopped...came what is called colonialism, they are still

doing it today, then they developed a structure which is 'curriculum' so that they govern us and make us their servants....when they had developed curriculum for us, then we fastened ties, we buy clothes from them, and we must never invent anything! Basotho used to smelt ore, smelted spears, doing all sorts of things, they invented...Then there was an abolishment of his creativity, so that he may be employed...so that when they beg (for a job) they may say/write, 'Vacancy!' And then write, 'I beg to apply for a vacancy'..., then when he ends he says, 'your most obedient servant...'. What I mean is that our entire structure has been taken away from us.

Ke ha ke tla nka bana bana, ho tloha fatse mane moo a leng teng, a ithute ho hama, le mae...ka ruta le mathuela ana, ka re motho o loea feela hobane a lapile...ke tlala e thehang lintho tsohle, 'me ke hobane curriculum ha e ea etsoa ke batho ka bo bona. Let us sit down to make curriculum...Ke ha ke tla theha college (Mants'a tlala College). Ka jeno lena motho ea keneng secondary school oa ngoanana o sebetsa liketcheneng mono, oa moshanyana oa utsoa hobane ha bo moo a ka sebetsang teng. Oa Matric ha a rate ho hama, ha rate ho etsa letho ka matsoho a hae, o lebeletse ho ja lebese lena le letle la 'Longlife' le entoeng ke bane ba ka nqane. Eaba Maburu a nka naha eena, ha a qeta ho nka naha ena a lema. Basotho bana eaba bantse ba ilo rutoa mane, ba ilo tseba ho bina lifela...ba litseba haholo lifela. Joala he maburu ana a lema ka nqane...a ntse a ts'oere lipolase. Ke ona a ileng a etsa develop economy (ka South Africa).."

English Translation.
This is why I decided to take the kids, from a young age, to learn how to milk, together with his/her mother...I taught even mathuela, and said a person practices witchcraft only because he is hungry...it is hunger which underlies all things, and this is only because the curriculum was not developed by the people themselves. Let us sit down to make curriculum...That is why I established a college [Mants'a tlala College]. Today, a person who has been through secondary school, a girl, is a maid, a boy, steals because he can not work anywhere. A Matric graduate dislikes milking, he does not want to do anything with his hands, he is expecting to eat this beautiful milk of 'Longlife[7]' which has been made by others on that end. Then the Afrikaners took this land, when they had taken the land they ploughed. These Basotho then continued to be taught in schools, to learn how to sing hymns...they know hymns so well. Then the Afrikaners continued to farm on that end...they are still in control of farms. They are the ones who developed the economy [in South Africa]....

Machobane associated education and the environment with the capacity of the Basotho to sustain their own lives and the failure of the present education system to achieve this. He mentioned the existence, in the past, of animals such as monkeys, of plenty of cattle and food

7 'Longlife milk' is a commercial product and one of the many foodstuffs exported to Lesotho. It is specially packed to have a long life-shelf, without any need for refrigeration. This and other import products are associated with modernism and the capitalist economy which emerged rapidly in Lesotho from 1870s onwards (see Keegan, 1986).

from the farms, of inventions such as smelting of iron ore and spears in Lesotho. This situation has been replaced by poverty, crime and the Basotho's dependence on other nations for jobs, clothes and food. This dependency was also echoed by one participant at the same workshop in the following words: "everything that is given to us comes from somewhere else and all that we need to do is just follow". Machobane attributed the present situation of environment in Lesotho to colonialism and the British education system. From this perspective, environmental literacy, concerns the development of the ability of the Basotho to creatively sustain their own lives. Drawing on Machobane's arguments, this would involve constructing a coherent picture of how present environmental conditions are linked with the past, and employing appropriate measures to address the root causes of the present environmental problems. For this to be achieved, Machobane calls for a transformed education system, shaped and developed by the Basotho themselves. By sharing his own initiative to transform the school curricula, he challenged the research team to do the same. This perspective of transforming the education systems, to address (over-) dependency and to develop people's ability to sustain their own lives, may be seen as an important dimension of environment literacy.

There was, however, no evidence of Machobane's ideas subsequently being translated into teaching plans or discussions in the following phases of the research. Following his presentation Lebu could not get started with the second cycle and Limpho had withdrawn from the research. Map did continue, but we did not make reference to any of Machobane's ideas; perhaps this was due to our focus on the science syllabus-based content, to the exclusion of his more openly political and historical views.

4.4. CONCLUDING REMARKS

Limpho's emerging view of the meaning of environmental literacy was relatively simple compared to that of Lebu and Map, which reflected the political and economic as well as the biophysical dimensions of environment, and the interrelationship amongst the various aspects/components of environment. Unlike Lebu and Map who participated in the project for at least one cycle, Limpho participated in the project for less than one cycle, attended only the first planning workshop and could not attend any of the EEASA conferences. These

conferences and workshops seemed to have contributed much to Lebu's and Map's understanding of environmental literacy. They were the fora where our work in the classroom was critiqued, where we shared ideas with other science teachers and environmental educators and gained new insights about the meaning of environment and environmental literacy.

My own understanding of environmental literacy also changed and developed during the research process. A focused initiative for the research team to develop a meaning of environmental literacy within the context of the teaching of science became a holistic process of reflection on the meaning of the concept. This reminded me of a learning experience that Doll (1989) has described as "transformative", concerned with a "a change in view, in perspective, in methodology. It permanently alters one's relationship to nature, to life, to the environment, to learning" (Doll, 1989:249). The ongoing process of reflection encompassed other contexts of my life experience that did not seem to have any apparent link with the teaching of science.

My understanding of environment and environmental literacy was reflected in my engagement in the process of national curriculum development aimed at localising the secondary school curriculum, and in the formation of an environmental education association emphasising local knowledge. Within the context of my teaching at the university; I explored the integrated and collaborative teaching of Curriculum Studies in Junior Science; and my encounter with Machobane alerted me to the importance of understanding the root causes of environmental problems, by drawing on the perspectives of the local people. My dream corroborates Machobane's view about the need to explore and develop alternative curricula that will restore the Basotho's *creativity*, so that they may be able to *invent*, produce their own food and not depend on other nations for *employment.* This was represented in my dream as a process that requires a courageous journey into the unknown, and the discovery of *'hidden world'*, where *peace (khotso)* and *satisfaction (boiketlo)* reign.

In the next chapter, I discuss the reflections of the team members on the process of action research, drawing on our experiences as we engaged with the method during the research.

CHAPTER 5

REFLECTION ON ACTION RESEARCH

5.1. INTRODUCTION

In this Chapter I discuss the reflections of the research team on the action research process by drawing on data from interviews, research team meetings (workshops) and my own observations. I focus on our interaction with the environmental centre, and show that the partnership between the team and the Centre was useful, but not without drawbacks; the nature of collaboration within the research team; the team's understandings of action research; and the EEASA conferences attended by members of the team during the project, and discuss their role in facilitating our attempts to reflect on and develop our practice. I conclude this section by describing how I attempted to consolidate and broaden the present project by exploring the issue, at our research team meeting, with school teachers with an interest in environmental education.

5.2. REFLECTION ON COLLABORATIVE APPROACH TO ACTION RESEARCH

Kopano ke Matla (Unity is strength)

Collaboration amongst the research team members was an essential dimension of the research process. Collaboration here means interaction promoting the sharing of ideas among members of the research team and those associated with the team, without the subjugation of the views of any of the parties involved, with the aim of achieving the shared goals of the team. In this section I discuss some factors that appear to have interfered with our effective collaboration during the project. These included tensions within the environmental centre where we held our workshops and issues associated with ownership of the project. I go on to describe how I attempted to ensure effective collaboration with the team.

5.2.1. Collaboration with the Environmental Centre

> *Participatory research proffers itself as an agency for inside participants to address existing power relationships that may be perceived as inequitable in some sense or another.* (Hart, Taylor and Robottom, 1994:213).

The Environmental Centre provided the research team with the valuable support of a venue for the workshops, with stationery, with resource persons during the workshops, and with funding for the attendance of a conference in Cape Town. This support was provided within the framework of the Centre's environmental education workshops for teachers in Lesotho. Thus, the director of the Centre and I perceived the research project as enhancing the role of the Centre to promote environmental education. However, a dramatic change of directors, associated with the transfer of the running of the Centre from the European donor agency to the local structure, and differences in perceptions of the status of the project in relation to the centre impeded our collaboration with the centre.

The origins of my association with the environmental centre may be traced to 1994, when I shared the concept of the project with the first director (an 'expert' from a donor country in Europe) at an EEASA conference in the Eastern Cape, in South Africa. Thereafter, the Centre supported the project as described in the ways described above. However, my interaction with the director was characterised by tensions which seemed to emanate from differences in our assumptions about our roles in the project. When I realised that the tensions were intensifying and obstructing our collaboration I arranged an interview with the director. To allow the director to give free expression to his ideas, I asked a third person to conduct the interview, with the director's permission. It became apparent from the interview that the tensions were rooted in the issue of ownership of the project: I held the assumption that the director considered his Centre to be an equal partner in the project, but this was not the case. The director of the Centre thought that the project belonged to me and that the centre was assisting me to realise it. This is how the director expressed his perception of the project in the interview: "basically it's his [Tsepo's] project and we wouldn't be a full - scale collaborator as such, but we assist him any way we can" (16-04-96). But he thought that the Centre and the project had a common goal:

Interview (16-04-96)

Ann: Is there anything you would like to say about your working relationship with Tsepo as a researcher, anything that you can say?

Director: I think we definitely fit together and we have things we can offer him and he has things he can offer us and as I have said already that our goals are the same and that is the most important thing, so definitely there's room for continuing co-operation.

Furthermore, the Environmental Centre itself was not a neutral associate in the project. It was plagued by some internal tensions associated with management and control. These intensified with the transition of power from the European donor country to the local body when the first director, a foreign expert who came to set up the centre, left Lesotho and a temporary director took over. On several occasions this local director informed me that she had been criticised by the management for supporting the present research project and for not serving the interests of the proprietors of the Centre, roles which the management apparently perceived to be mutually exclusive (Fieldnotes, 29-09-96).

The subsequent permanent local director who took over several months later had a new agenda, and like the management she thought that the Centre was providing unnecessary support for my own personal endeavour and gains (Fieldnotes, 29-09-96; Fieldnotes, 22-01-97). I patiently persevered with the collaboration, stressing the value of the project. The interaction was marked by moments of conflict and reconciliation (Fieldnotes, 22-01-97; Fieldnotes, 24-01-97), and some progress. I thought that the dream I had on the eve of my meeting with the senior manager to resolve a conflict I had with the director, over the use of the centre for a meeting of the research team, reflected a cordial collaboration despite the conflict: *I saw the senior manager of the centre and myself chopping a log of wood together, we were working together, and on the scene, also working along side us, was the director of the centre. She was driving the centre's car and looked rather busy too.* The meeting of the research team was subsequently held and the project progressed a step further.

5.2.2. Collaboration Amongst the Researchers

> *Participatory research has an interest in internalising the research agenda by enabling participants to direct the research towards issues of interest and concern to themselves.* (Hart, Taylor and Robottom, 1994: 213)

The project as my own personal endeavour

Limpho held a similar view to the directors of the Environmental Centre with regard to ownership of the project. She regarded the project as my own personal endeavour. At one of my visits to her school during the first cycle, when she introduced me to her acquaintances, she referred to the project as my project rather than a team effort. She used phrases such as "he is doing a research..." and "he is interested in environmental education...". (Fieldnotes, 29-03-96)

However, Lebu's view of the research, seemed to differ from Limpho's view at that stage of the project. Shortly after the first planning meeting Lebu's use of phrases such as "our research", "us as a group" during my interview with him suggests that he perceived the project as a collective undertaking more than my personal endeavour.

Limpho's perspective may be seen as oriented towards letting things happen without taking much responsibility and control. Perhaps Map's views with regard to ownership of the project may be noted during the team's evaluation of the first cycle. She, as well as Lebu, indicated in a questionnaire that we were "deeply involved" in the project. This involvement may be associated with 'ownership'. It seems unlikely that Limpho could have felt "deeply involved" in the project if she indeed perceived it as my own personal endeavour. This could explain, in part, her comparatively short-term involvement in the project.

Below I discuss our collaboration with respect to the planning of learning activities.

Collaborative Lesson Planning

Our intention was to plan lessons together as a team whenever we could. However, this proved to be impossible due to lack of time and the distances between schools. Lessons were planned at the teachers' respective schools, by the concerned teacher and myself. This worked out well with Limpho and Map, but we could not find suitable time for planning lessons with Lebu.

Lebu provided me with science topics for the first cycle lessons so that I could make preparations prior to our planning meeting (Fieldnotes, 14-02-96). However, we did not meet as planned since Lebu did not turn up for our meetings. The following fieldnotes elaborate:

> it was difficult for us to find suitable time in the week beginning on the 18-03-96, especially on his side. He went further to suggest that it was not necessary for us to meet and plan, arguing that we would be imposing our ideas on students. He said that he would like to have a planning session that involved the students. I agreed with him. (Fieldnotes 19-03-96. Tel. Convers.)

Lebu might have been unwilling to meet to plan his lesson together, or he might have deemed it more appropriate that he planned his lessons with his class. The latter is commensurate with the ideas of our first planning workshop, held at the beginning of the project, in 1995. We finally agreed that he would plan a lesson with his class, and that I would come to take notes about the lesson. However, Lebu decided to implement the lesson earlier than we planned, in my absence, so I was unable to take notes. He had planned an excursion with his class. He explained that he took the opportunity of the absence of a colleague from school and used her/his lesson to allow for more time (Fieldnotes, 23-03-96). Whilst he conveniently created more time for an excursion, to overcome the constraints of time presented by the established school programme, our team plan to take notes of the lesson was affected by his unplanned action. This could also be seen as an attempt by Lebu to avoid the discomfort of my 'supervision' over him when teaching (see Winter, 1989:60-61).

Evaluating our Collaboration as a Team

At the end of the first cycle the team evaluated the research process at a workshop held in August 1996. One aspect of the process of evaluation was the matter of evaluation of the collaboration amongst the team members. During the evaluation I asked members to give one another feedback about our role so far in the research. Members were very reluctant to comment about one another. I had also planned to use a questionnaire to facilitate this activity. When this questionnaire was used, members opened up and shared their opinions about the first cycle. The questionnaire was titled "Team Effectiveness Questionnaire" by Hope and Timmel (1988). The team members spent a few minutes selecting answers from the questionnaire, and this was followed by discussion. Guided by this questionnaire the team raised the following concerns:

- the team thought that they did not integrate contributions from various members well, and that they did not know enough about the relevant abilities they possessed and the contribution each could make in the project;
- members were concerned that they rarely met as a team, and as a result did not take decisions collectively;
- it was noted that the team was not creative. Lebu stated that he could not be creative because he had limited time, and that he always worked under pressure. He used the little time that he had to rest.

A commitment was made by the team to collaborate more in the second cycle. However, this did not happen because Lebu terminated his involvement with the project, on account of time constraints.

Attempting to Enhance our Collaboration

Subsequent to the workshop I collected timetables from Lebu and Map and worked out a single timetable, so that we might easily identify times for regular meetings (Fieldnotes, 05-09-96), as we had agreed. I also decided to write a letter to the team members titled "Update. Environmental Education Research Team" in which I informed members about forthcoming plans in the research process (i.e. that we planned to use a video, rather than a tape recorder,

for recording classroom activities) and other matters that I considered to be important. I also sent this letter to the Director of the Environmental Centre and Limpho, though Limpho had not attended the workshop.

Perhaps a further example of the attempt by the team members to effect collaboration may be noted in Map's sharing of a book on Environmental Law in Lesotho with me (Fieldnotes, 05-09-97), a book on case-studies of environmental education by Clacherty, Adatia and Clacherty (1996) and a list of topics she intended to teach during the second cycle (Fieldnotes, 01-09-96). I subsequently shared the latter with Lebu (Fieldnotes, 11-09-96), for him to read and to comment on as we had planned in the workshop. I also shared with the team members the paper that I sent for publication in *Work for Justice* (Mokuku, 1996b) (Fieldnotes, 23-09-96). Another example of our collaboration was when I informed Lebu and Map about the National Environment Fair (Fieldnotes, 21-10-96) which Lebu and I attended on 02-11-96. We thought that the Fair might inform our project somehow.

5.3. UNDERSTANDINGS OF THE PROCESS OF ACTION RESEARCH

In the following account I discuss the research team's developing views on action research during the project by drawing on data from their presentations at a workshop held at the end of the first cycle, and on information from the interview I had with each of them at the end of the project. I will further discuss the emerging pattern of the cycles of action research and the tensions associated with the method, based on my analysis of the three case studies. The following table provides a summary of the sessions on action research that individual members participated in during the research period:

Table 5.1: Exposure of the Research team to Action Research Theory

Reseach-Team	Action Research Sessions Attended	Primary Source of Information at Sessions	Other Available Source of Information
Limpho	One	Resources Person(s)^	Literature*
Map	Three	,,	Literature*
Lebu	Two	,,	Literature*
Tsepo	Three	,,	Literature

Key.

^ Resource persons who were invited to the research team meetings were the staff from the Institute of Education of the University of Lesotho.

* I made some literature available to members but did not confirm whether or not the members actually made use of it.

5.3.1. Case Study One

In this section I illustrate how Lebu's view that action research was 'nothing new' changed as a result of his engagement in the research. I discuss his association of action research with the following concepts after his participation in the project: the involvement of students in the planning of learning activities, the accommodation of their views in the process of teaching and the evaluation of his own teaching by drawing on students' views. I also discuss drawbacks that he identified in his attempt to employ action research.

When sharing his findings in a workshop at the end of the first cycle, Lebu described the action research method as *"ntho e ncha"* or "a new thing" that required the teacher to involve the students in the planning of lessons (as suggested at the first planning meeting). In the following extract, he explains that the involvement of students in the planning of lessons was a new experience for him and was difficult. He attempted to achieve this by "probing them" (*"ke ba proba"*) in order to make them realise that there were environmental problems both in the country at large and locally on the school campus, prior to undertaking an excursion with them (See Chapter 3).

> Workshop presentation (August, 1996)
> And by trying to implement this idea of action research or classroom action research, **joalo kaha re e nka e le ntho e ncha**, le ho bana, ho ne ho se bonolo ho nna hore ha re qala eh ha re qala feela re be se re, re lula le bona re discussa, eh ka tsela eo action research e neng e hlalosoa e tlamehile ho tsamaea ka eona [at the first workshop]. Ke hore we are supposed to involve the students from the beginning, hore banna le batla ho etsa tje? Re etseng tje? And so on, they should be involved.... ke ile ka qala ka hore 'na ke ntse ke ba proba feela ke ba bonts'a hore ho na le liproblems, environmental problems also ka hare ho naha ea rona. And also in the campus ena eo re leng ka hare ho eona.... (Emphasis added).
>
> **English Translation.**
> And by trying to implement this idea of action research or classroom action research, **as we regard it as a new thing,** even for students, it was not easy for me that when we started eh when we started say, sit down with them and discuss, eh in a manner that action research was described [at the first workshop]. That is, we are supposed to involve the students from the beginning, so that we say guys do you want to do this? Should we do this? And so on, they should be involved....I first started by probing

them showing them that there are problems, environmental problems also inside our country. And also in the campus in which we were.... (Emphasis added).

During the research Lebu and I developed a questionnaire for pupils to assist us in evaluating the excursion that he took with his class. He thought that the students' feedback enabled him to reflect on his teaching method.

Workshop Presentation (August, 1996)
...from this I could say I learned [that]... some of the important things...in doing action research..., **it really gives the teacher a reflection from the students' point of view as to what you are doing**. Eh, if there is something wrong with your teaching method...then you can get feed back from the students. Because most of the time we just teach, and there is no feedback from the pupils....(Emphasis added).

Lebu's statement that the process of reflection establishes whether there is "something wrong with your teaching method", reflects his pedagogic assumption that a teaching practice is either 'wrong' or 'right', and that reflection (drawing on students views) 'corrects' a teaching method that was initially 'wrong' - rather than viewing reflection as a process that 'develops' a teaching method to be relatively 'effective'.

Also, in his reflection during an interview at the end of the project, he thought that "a chance to be evaluated by the students themselves" was "very important" and one of the useful things about the project. He thought that this gave students the opportunity to express their own views on the way they were taught, which enabled the teacher the better to plan his teaching. The following extract illustrates this:

Interview (04-06-97)
Tsepo: Any other thing [that you found useful about the research project]?
Lebu: The other very important aspect was getting ... I think a chance to be somehow evaluated by the students themselves. I mean the kids were given the chance to say how they felt, uhm how they could improve these eh...eh how the teacher could maybe make some changes or improve that [the teaching method]. So I think that feed-back is very important.
Tsepo: Mhm.
Lebu: The students could help you plan better from such strategies.

Drawing on his experience, Lebu also observed that the involvement of students in the planning of a lesson and decision making, could be resisted by the students themselves, and that this required the teacher to be patient.

Workshop Presentation (August, 1996)
At one point I just showed students that we are going to learn this and this. Would you choose the one which you prefer we should start with... They, they were not ready, just to choose a topic and say, no we would like to start with this topic; they are expecting the teacher to, to do that. So normally I belief we should eh, lets use the words, nurse the situation.

His perspective on action research is further reflected in his description of his teaching plans for the second cycle.

Workshop Presentation (August, 1996)
When we reopen we will go into the second phase, of this action. E leng taba ea hore joale, re ba bonts'e hore (Which is a matter of, showing them that) you have found these, you have responded in this manner, so what can you do? Ok, and we believe at this level they will be ready hore, ba be (so that they get) **involved fully, in the planning ea liactivities (in the planning of activities) and they should feel responsible for them all**. And that also I should say, it is reflected by some of their responses; that they, they want to be involved, they are, we could say, they seem to be ready to try to do something.... (Emphasis added)

Whilst Lebu did not try out his planned ideas in the classroom, as he gave up on project before he entered the second cycle, it is clear that at this stage he considered the participatory planning of learning activities with students an important aspect of action research.

In spite of the insights he gained about the research process during the first cycle, Lebu thought that his understanding of action research was inadequate. However, contrary to his starting assumptions, the following extract suggests that by the end of the project Lebu perceived action research as more than just a familiar "problem solving method" (see Chapter 3):

Interview.(04-06-97)
Tsepo: Would you say that this initiative helped you understand what action research involves?
Lebu: Yeah! It did to **some extent**, because as someone who hasn't specialised, hasn't done any research before, **someone comes and tells you that this is action research this is how you carry it out. I don't think that was enough for us to say now we really understand what action research is all about.** We could understand the important aspects of action research but we can't say we are very confident about this idea of action in classroom.
Tsepo: Did you feel that there were...things you would like to know more about ... that you didn't get to understand?
Lebu: I should think if this was done more often because that was just a short period

> or just for a short topic and that period didn't involve that initiative, but **if there were more of these things, time after time, I would think somehow after a little while say, I think I would have got an idea now**. In fact if you have done it before you improve again....(Emphasis added)

Thus he suggests that one cycle was too brief for him to have engaged in or experienced action research meaningfully. During the interview at the end of the project, Lebu further argued that the notion of research is rather difficult for teachers (himself included), since they have had no research experience in their training.

> Interview (04-06-97)
> ...for people like me as just a teacher who has never done any type of the research. In fact I would say almost all the science teachers graduating from NUL with their first degree, they haven't done research, so the idea of research is something which is new to those people..., Maybe they have seen their friends or some other people around them showing them what they have done for a research project and so on then they would come up with some other idea about classroom action research. **They get mixed up somehow; is this really a research or what?** I think that's one of the questions I did ask (at the beginning of the project) whether this is ...should we call it a research or ... whether at one point was...I think it's **self-evaluation procedure**, something like that, because is what we do on the classroom and you try to formalise it, instead of just saying well I have seen I have made **a mistake** here, next time I would try these you write it down and say well maybe next time I will, I will do something else instead of doing it like this. And then you compare the results after you have changed your procedure and so on, **which I think is just self-evaluation**, so you come up and say this is action research. (Emphasis added)

Lebu's description of his experience of "self-evaluation procedure" parallels the process of action research. Perhaps his doubt about the meaning of action research emanated from the approach to action research, at the first planning workshop. The presentations and discussion overemphasised the concept of 'action research method' and largely excluded the participants' experience and understandings of other ways of improving practice.

However, drawing on Lebu's views and my own experience with current programmes for science teachers at the local University, where Lebu trained, I would say that science teachers are indeed inadequately equipped with skills to undertake research. There appears to be an assumption that school teachers role is to implement the curriculum in the classroom rather than to research. In the attempt to enhance teachers' capacity to implement the curricula, teacher education programmes in the University thus overemphasise 'student-centred

methods' to enable teachers to 'implement' (rather than reflect on and develop) the methods in the classroom and facilitate 'meaningful learning' (e.g. Ausubel, 1968; Bodner, 1996; Bodner *et al.*, 1997) of the established scientific content.

5.3.2. Case Study Two

In this section I demonstrate that Map viewed action research, in a way similar to Lebu, as a process/strategy that was useful in terms of reflection on her teaching, and that she assumed that action research was a process that leads to the 'correct' teaching method. I also discuss the pedagogic implications of the latter. In addition I show that she assumed that her engagement with action research implied that she had to repeat the same lesson content, after reflection, in the next cycle, and argue that this view probably evolved from the spiral model of action research that we used.

In an interview at the end of the project, Map thought that a helpful aspect of the project had been the opportunity afforded her to read the transcriptions of her audio-recorded lessons and to watch a video of her lesson. These enabled her to reflect on her teaching and attempt to improve it:

> Final Interview (11-09-97)
> Tsepo: You remember very early in the initiative there were also these **transcriptions that we had to read ... to think about how you were teaching**. Were those not also bringing extra load?
> Map: No ntate ... not so much, **they helped me a great deal** hobane (because) I could ... **I could be aware of my own mistakes** kea kholoa; ha ke ntse ke ruta bana mona, tsela eo ke pheta-phetang lintho, kapa eo ke ba botsang ka eona.... Ke hore ke ne ke hlokomela hore ... it takes may be too much time, wasting a lot of time sometimes repeating some of the things but at the same time repetition e ne e etsa hore ba utloisise. .... haholo ntho eo e ileng ea nthusa ke video...,ho pheta -pheta ntho hoa ka ho ne ho etsa hore mohlomong bana balose 'track' ea moo ke batlang ho ea teng. Ke hore ho hlalosa hoaka ho ne ho sa batle ho otlolohile hantle. **Joale ke ntse ke its'oaea ts'oaea ha ngata ... le ha ke se ntse ke ruta ke tseba ho its'oaea hore ke tsoanetse ho hlalosa ntho ka tsela e bonolo, e simple, eo bana ba tla utloa kapele hore na ke batla ba etse joang.**
>
> **English Translation**
> No Ntate...not so much, **they helped me a great deal because I could be**

> **aware of my own mistakes** I think; when I am teaching the kids here, the way I over repeat things, or the way I ask them (questions)...That is I realised that...it takes maybe too much time, wasting a lot of time sometimes repeating some of the things but at the same time repetition made them understand... What particularly helped me is the video..., my tendency to over repeat things, **made the kids to maybe lose track of where I want to go. That is my way of explaining was not so straight. Now I keep correcting myself repeatedly...even as I teach I know how to correct myself, so that I must explain something in an easy way, a simple way, that will make kids understand quickly what I want them to do.** (Emphasis added)

Her pedagogic assumptions are also apparent in the above extract: her view of herself as a 'path finder' for the students to follow and not "lose track of", and her intentions that students understand when her explanation is "straight" (succinct) and done it in a "simple way". Map's orientation may be described as informed by a modernist perspective (see, e.g., Doll, 1989) which attempts to simplify a complex process of teaching and learning, within which understanding is constructed - rather than transferred intact from the mind of the teacher to the mind of the learner through "straight" explanations - through complex interaction between the learners and between the learners and the teacher (Bodner, 1989; Bodner *et al.*, 1997).

Map's statement that her reading of the transcriptions helped her by making her "aware of [her] own mistakes" suggests that she assumed that there was a 'correct' way of teaching that she was working towards. This perspective contrasts with our initial intention, reflected in the second research goal, to develop 'effective' teaching strategies for environmental literacy, as determined by the group, rather than 'correct' teaching methods. Thus, it can be argued that Map's emerging perspective suggests that she (and possibly other team teachers) somehow did not adopt the same starting orientation as I did, to explore and develop effective ways of teaching, but held instead an intention to 'master' new (though established) ways of teaching.

By stating that as a result of action research she continued to "correct herself repeatedly" (Joale ke ntse ke its'oaea ts'oaea ha ngata) in her teaching, in order to "explain things in a simple way...so that students may understand quickly..." (ho hlalosa ntho ka tsela e bonolo, e simple, eo bana ba tla utloa kapele...), Map suggests that action research developed her ability to reflect on and improve her teaching. In similar vein, drawing on his experience of

the method, Lebu described action research as "self-evaluation". This reflection, however, did not occur in ways that matched the theory that Map learned about the method at the first planning workshop.

With hindsight, at the end of the project, Map thought that action research seemed to be simple when talking about it ("ha re ntse re bua eona it seemed simple"), but that "it wasn't so easy" to "follow". Thus, the interplay between her actions and a dynamic context influenced and shaped by numerous factors did not allow for the easy "following" of the method, as though the process were similar to the following of a medical prescription. It is noteworthy in the following extract that by asking Map whether or not she felt she was "following" the research method, I tacitly presumed a match between the theory about the method and its 'implementation' in the classroom as the ideal we had to work towards in order to achieve our research goals.

Final interview (11-09-97)

Tsepo: 'M'e Map was the method itself in practice as clear as it was when we first say ...described it at the workshop in Masianokeng, eh, would you say you ... really were following this method and was it useful, you felt you were following it and that it was a useful method.

Map: Eeya ntate it was useful because when coming to practice... ha re ntse re bua eona it seemed simple or yes it seemed simple, empa ha re se re tlo o sebelisa ache, ke ne ke fumana mathatanyana a mang. It wasn't so easy.

Map alludes to one difficult aspect of trying out the method in the classroom as the moment of reflection which required her to explore alternative ways of teaching. In this regard she mentioned time as an important constraint. Her explanation that time was a constraint because she had to "find another time for doing the same thing" ("re fumane nako engoe hape ho etsa the same thing") reflects her orientation towards the research process. She thought that she had to repeat the same content, instead of seeing the moment of reflection as learning from the first cycle so as to apply her acquired insights in the teaching of different subject matter.

Final interview (11-09-97)

Tsepo: What did you find as a bit difficult (about implementing the action research method) ... ke hore mathatanyana ao o nong o kopana le oona?

Map: Ke ne ke tlameha ho fumana mokhoa o mong hape - hape oa hore ke ba ... ke 'presente' whatever was taught that time ka tsela e 'ngoe e fapaneng ... le eane...So it was also time consuming hobane re ne re tlameha ho pheta - pheta lintho tseo re li entseng hape within a certain period re boetse hape re fumane

nako e 'ngoe hape ea ho etsa the same thing ... so it was difficult.

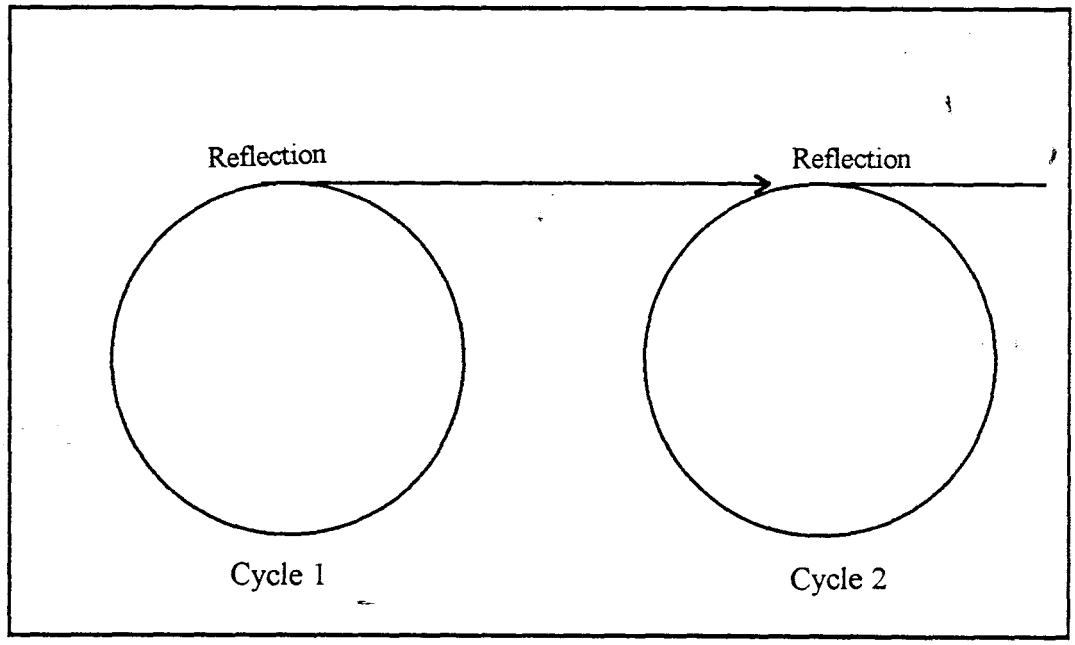
Tsepo: ...we used to have this planning session where we plan a lesson, then implement it, then monitor by using a tape recorder, maybe and class observation notes, and then finally reflect or analyse the result and then reflect, for example by reading the transcriptions. Now, of these four stages which one do you think were a bit tough and were not ... did not go as you had wished would go....

Map: ... sa bone ka 'nete because that's where I had to change things.

This perception could have stemmed from our image of action research as a neat 'spiral' model (see Figure 2.1).

As ~~m~~entioned in Chapter two, this is the model that guided us during the project, and I used it whenever we shared our findings at workshops and the two conferences. Perhaps a more useful image would have been that of action research as "a series of successive cycles each incorporating the possibility of providing evaluative feedback within and between the cycles of action", rather than as a spiral model (see McKernan, 1991:23). The spiral image tends to suggest a 'flow' of planned content from one cycle to the next.

Figure 5.1: McKernan's model of action research



5.3.3. Case Study Three

Contrary to Lebu and Map, Limpho made no suggestion that the method had been useful to her. She discontinued the research before she could engaged with the reflection stage of the first cycle. It is apparent in the following account that her participation in the research process had not been long enough for her to develop a coherent perception about action research or to claim to have benefited from it.

In an interview (Interview, 17-09-96), after she had informed me that she wished to withdraw from the project, her response to my question, "Would you say that this research helped you understand what action research is about?", was **"I never really did what I think was expected of me to do**. We discussed at the workshop, we said, I mean action-what-what, but to really put it into action!, I wish I had enough time to do so" (Interview extract, 17-09-96) (Emphasis added). Her remarks here suggest that she perceived the project as externally controlled and her role as simply that of an implementer rather than a participant. (Also see section 2.4.2.).

Whilst it was not our objective to develop our vocabulary on action research, Limpho's failure to attend the reflection workshops could explain why she could not recall the phrase 'action research' during the interview and refer to it as "action-what-what". She thought that time constraints made it difficult for her to try out action research and that this was compounded by the examination-based order of teaching:

> Interview (17-09-96)
> Tsepo: What was the most burdensome aspect in this research?
> Limpho: Burdensome, my own plan although I liked it but when it came to, you know, **squeezing it into my schedule**, it wasn't good.
> Tsepo: Which parts especially because I thought the guest speaker came as part of the lesson.
> Limpho: The thing is, we have a ... set-time, like the syllabus, we are expected to cover these and these and these. **Some of the things that were covered by the guest speaker are never asked in the examination.** So normally we concentrate on what we have to cover....(Emphasis added)

Klein (1997) reports of secondary school teachers experiencing similar time constraints in South Africa in the context of a participatory action project in environmental education. In view of this problem it may be argued that piecemeal initiatives in environmental education that are, to use Limpho's words, *"squeezed"* into the teachers' tight schedules, without any regard for the transformation of the whole school curriculum, are indeed burdensome. Thus it seems that requirements for developing environmental literacy 'run' counter to the established education order, or that the established order, with its emphasis on examinations, inhibits the development of environmental literacy.

There were, however, extra-curricular activities that apparently contributed to shortening Limpho's participation in the project:

> Interview (17-09-96)
> Tsepo: You told me that you will not continue with the research because you have to complete a psychology course with UNISA, is it with UNISA?
> Limpho: No, INTEC.
> Tsepo: INTEC, right...are there any other reasons why you decided not to continue with this research?
> Limpho: One being my studies, mm apart from that one, I just have too much work with these kids here, so I have to cover this year before leaving next year. I don't have enough time to sit down and prepare what I have to prepare for them....

In addition, towards the end of her first cycle, it surfaced in our conversation that she was studying in preparation for a university entry examination (Fieldnotes, 02-03-96). It is probable that these activities had greater professional value for her than the present study, as they concerned the promise of certification and further studies.

Another perspective on Limpho's failure to sustain her participation in the project even for one cycle, is that the attempt to implement action research in the present study was an attempt to implement an externally derived model disregarding Limpho's context. The initiative thus encountered contextual problems and failed to last.

Limpho's decision to discontinue the research meant that she neither shared her findings with the team nor reflected on her classroom activities during the implementation stage. She might have reflected on her practice during her teaching in the classroom (Stuart, 1987), but she did

not validate her conclusions concerning the teaching strategies or the meaning of environmental literacy by sharing them with other members of the research team (Lather, 1986).

5.3.4. My Own Views

As mentioned before, we had planned to 'implement' three broad cycles of action research. However, by the end of the project Map had completed two cycles, Lebu one cycle and Limpho less than one. This finding seems to be in line with Stuart's observation that "many action research studies end after one cycle" (1997:173). As a team member and a facilitator of the activities of the three teachers I was involved for two cycles. It appears that the teachers' workloads and time pressure were largely responsible for their engagement with fewer cycles than we intended.

Each broad cycle involves engagement with four moments: planning, action, observation and reflection. Within these broad cycles there was evidence of what Stuart described as "mini-cycles rolling along inside bigger cycles" or "nesting inside the overall shape" (1988:121;136). These mini-cycles occurred when a teacher attempted to 'implement' a planned learning activity, experienced or observed a problem, and immediately took action to resolve it without waiting to assess the nature of the problem by collecting data and analysing it. To be precise, the mini-cycles observed could be described as 'incomplete mini-cycles', as the teachers did not stop to collect data in order to monitor the impact of the actions they took.

Specific examples are provided in Table 5.2, below, to further clarify the nature of the mini-cycles that I observed in the three case studies.

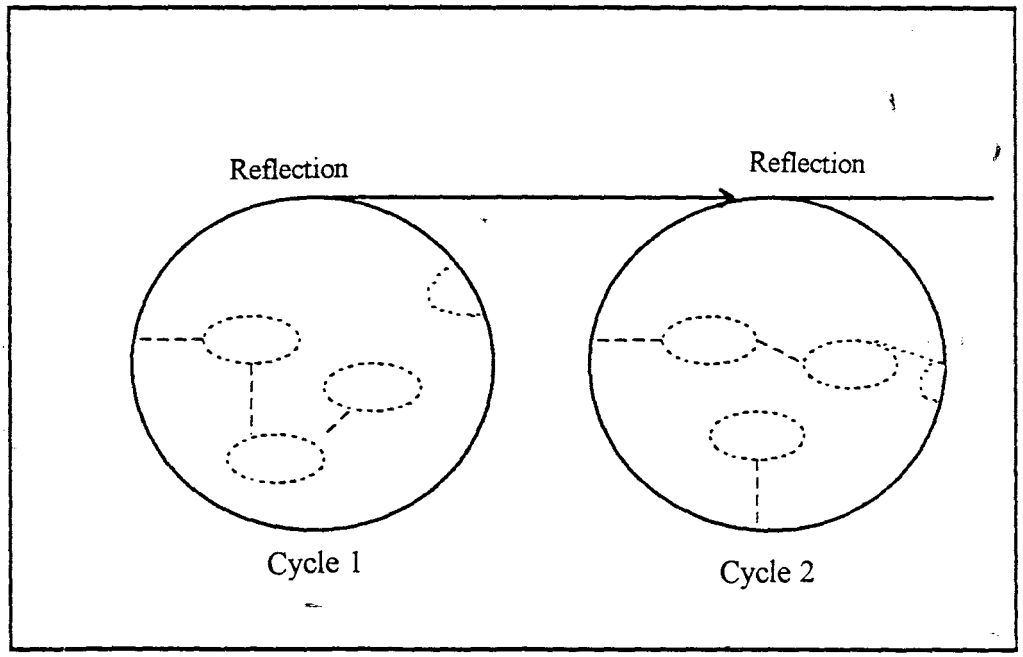
Table 5.2: Mini-cycles Within Broad Cycles

R-Team	Apparent problem	Action within lesson	Impact of action on teaching/ learning analysed	Remark
Lebu	Ss. read their group reports softly	T. decides to read out Ss. group reports	no	mini-cycle incomplete
Map	some Ss did not bring water sample from ponds as instructed.	T. makes Ss Who managed to bring water samples from home as home-work group leaders in order to motivate those who did not	no	mini-cycle incomplete
Limpho	two period (80min) not enough for the guest-speaker & Ss	T. extends guest-speakers lessons by more than 30 min	no	mini-cycle incomplete

Key
T = teacher
S = student
Ss = Students

The following diagram depicts how the mini-cycles relate to the broad cycles. The process of action research is here reflected as a complex process rather than a 'neat spiral'.

Figure 5.2: Mini-cycles within broad cycles



From this perspective, the cycles were in practice more complex that we anticipated. It seems that the completion of these mini-cycles could have deepened teachers' understanding of the research situations.

5.3.5. Concluding Remarks

Two members of the team thought that action research enabled them to reflect on the way they taught in order to teach better. These were teachers who had completed at least one cycle: Lebu with one cycle and Map with two cycles. The method enabled me to reflect on my own understanding and assumptions about the nature of the cycles. I learned that cycles can be complicated by the occurrence of mini-cycles. In addition the teacher who did not complete a cycle (i.e. Limpho), did not show evidence of reflecting on her teaching. Our intention, as reflected in our research proposal, was to complete about three cycles. We thought that this would sustain our action and deepen our understanding about our teaching. This was, however, not possible largely because of work loads and pressure of time during the research. In this regard I concur with Stuart (Pers. Comm., 09-08-97) that action research involves a great amount of arduous work, making it unrealistic to undertake many cycles of action research continuously. It is more reasonable to employ action research for a short time, followed by a period of rest during which the insights gained during the research may be put into practice. Reflecting on an action research project in Lesotho, Stuart (1988:140) refers notes that the participating teachers claimed to be using the insights they learned from the research even two years after the end of the project.

5.4. EEASA CONFERENCES AND ACTION RESEARCH

I first proposed the idea of sharing the research findings at a Southern African conference at the beginning of our research, at the first planning workshop. I thought this would 'motivate' the team to complete the first cycle. I also thought that a conference was an appropriate forum for sharing our experiences and conclusions with other environmental educators. I provided the research team members with membership forms for EEASA, the association that organised the conferences, and encouraged them to join. We subsequently attended two

consecutive conferences in July of 1996 and 1997 to present our findings for the first and second cycles respectively. In the following sections I discuss how the EEASA conferences motivated us and enabled us to reflect critically on our practice during the research project.

5.4.1. EEASA Conference as a Motivating Factor

Following the planning workshop, I kept reminding the research team members about the conference, and shared the information that I received about the next conference, due to be held in Cape Town, South Africa. I reminded the research team members to complete the first cycle before the date of the conference (e.g. Fieldnotes 09-04-96;10-04-96;10-04-96). Limpho was the only member who indicated that she might not be able to attend the conference due to family commitments.

After attending the first EEASA conference in 1996 Lebu thought that the conference did not address the concerns of teachers. He did however attend the next conference in 1997 (together with Map and myself), though he did not present a paper. He explained that he had a heavy workload and thus could not fully enter the second cycle of the research (Interview, 04-06-97). Thus, whilst the conference might have kept Lebu in the team, pressure of time remained an overriding factor that inhibited him from fully participating in the second cycle.

5.4.2. EEASA Conference and Reflective Practice

Our preparation for the conferences (in 1996 and 1997) motivated us to analyse research data in detail (Audiotape notes, 28-06-96; Audiotape notes, 26-06-97; Fieldnotes, 02-07-97). The conferences also enabled us to reflect on how to prepare and present research findings.

My experience of preparing for presentation at the EEASA 1996 conference challenged my perception of other members of the team. In my writing of the conference presentation, based on my experiences during the first cycle, I experienced great unease with the language I used to refer to other members of the team. My difficulty lay in finding the appropriate language for referring to the teachers as members of a team rather than as a 'sample' of 'my research',

in their presence. This became particularly clear to me as I rehearsed my paper to the team on the eve of our presentation. My language seemed to create a distance between me and the members of the team. I realised for example that I often referred to myself as the 'researcher' and referred to other members of the team as 'the sample' or as 'the teachers' (Fieldnotes, 11-07-96).

This reflection was particularly helpful in 1997 when Map and I presented at EEASA conference in the presence of several 'critical friends'[8]. We learned valuable lessons both from the experience of presenting and from the comments we received from some participants (Fieldnotes 03-07-97). These included the following:

1) We appreciated how incoherent and long (we almost doubled our given time) our presentation was. We realised that this stemmed from inadequate preparation and a failure to rehearse our presentation. We did not consider with sufficient rigour what to select and present from the ocean of data we had. This observation was also made by three of our 'critical friends' who attended our presentation. One critical friend, with long experience in research and who was present at our presentation at the EEASA conference in 1996, said that we did not present as well as we did the previous year. In further discussion with her the following guidelines for the preparation of a presentation emerged:

a) identify one issue on which to focus.

b) the information you wish to share should be something that interests you or that you feel strongly about.

c) one should organise and structure a presentation in the same way that one plans a lesson: that is, there should an introduction, aims/objectives, body, conclusion and closure (Fieldnotes, 03-07-97).

2) When Map, myself and a critical friend with experience in research further reflected on the presentation, it became apparent to me that I had not given Map a chance to decide which issue she personally felt strongly about. I rather led her to present what I thought was

8 The term used by Stuart, Morojele and Lefoka (1997) to refer to colleagues who comment on one another's practice in a the context of a relationship of trust: Fien (1996) has also used the word in a similar sense in the context of environmental education.

important. In my reflection, I thought I could have asked her the following question at the beginning of our preparation for the conference, 'what is it that you want to share with the group (of other environmental educators)?' (Fieldnotes, 03-07-97). This could have enabled us to discuss her views and thus learn more about her findings. It seems that this approach requires the confidence that other members of the team can make reasonable decisions drawing on their own experiences and that I lacked this trust in Map. This was probably rooted in my implicit assumption that I was the main 'researcher' who was better informed about the research and who had the exclusive prerogative to decide on what findings were important or unimportant.

3) Our presentation was also described by one experienced critical friend as rushed and our use of transparencies confusing because we talked when a transparency with a lot of information was still on. She did not know whether to read or listen, especially because she thought the content of the talk did not always correspond to the transparency.

4) Noteworthy in this context was the reluctance of Lebu to comment on the presentation, in spite of my earnest request that he give us feedback. I had noted his silence when we were informally discussing what we learned from the conference in the car on our way back from the conference (fieldnotes, 11-07-97). Perhaps this had something to do with the trust among colleagues involved in action research, referred to by Stuart, Morojele and Lefoka (1997:189). Lefoka interpreted the reluctance of teachers to allow their colleagues to observe their lessons as resulting from the absence of the relationship of trust among the teachers. She maintained that this inhibited the development of a 'reflective practice'. It can be argued that Lebu's reaction was an indication that by the end of the first cycle we had not yet established sufficient trust within the team for us to talk freely about one another. It is also noteworthy that our association with two of the three 'critical friends' who easily commented on our presentation had not been as long as our association with Lebu. It appears that the length of time of association may not necessarily be the main factor for establishing trust within a research-team.

5) When I realised after receiving feedback from critical friends, that our presentation had not

been good, I jotted down my own feelings as "terrible, bad, rather angry with myself for such a poor show" (03-07-97). It can be argued that this subjective feeling of disappointment derived from my perspective on feedback or my understanding of the purpose of presenting at a conference. Perhaps my subjective goal in presenting at the conference was similar to the one the president of EEASA described to me as "the conventional conference model of 'showing off' part of our results", which the association was striving to replace by making the EEASA conference "an unthreatening space to share and learn" (February, 1998). Drawing on Elbaz, Fien and Rawling have also alluded to strong feelings of frustration associated with reflection:

> Reflection may lead to very negative feelings about oneself, even in the most supportive of environments, if participants assume the blame for any perceived contradictions and failures in the practice. (1996:15)

Fien and Rawling (1996) further explain that Elbaz found that this may occur in spite of the participants' awareness of the influence of constraints that they have little control over. Likewise my feelings prevailed, despite my awareness that we had no time prior to the conference to prepare adequately for our presentation. Following Wildman and Niles, Fien and Rawling (1996:15) have suggested that these feelings require researching groups of colleagues to form strong support systems that may provide, to use Wildman and Niles words, "emotional and technical support that is necessary for professionals reflecting on their practice".

5.5. GOING BEYOND THE LIFE OF THE PROJECT

During the project I developed a concern that our environmental education be sustained and broadened. In an attempt to ensure this I proposed the formation of an association of environmental education at one of our research team workshop, held in January 1997. The workshop was attended by ten teachers. Map and I were the only members of the research team present. Limpho had withdrawn from the project and Lebu did not attend due to increased responsibilities at school. In the proposal I presented to the participants I mentioned the following aims for forming the association: to expand the capacity of teachers who wish to undertake research in environmental education by establishing interaction with other and

more experienced researchers; and to galvanise the participation of more teachers in research on environmental education. I saw broad-based and sustained participation in action research as a means through which transformative change of the curricula might be possible, and through which we could stimulate critical reflection on the larger society and the dominant ideologies (Shor and Freire, 1987) that promote environmental degradation.

A committee, of which Map and I were members, was elected at this workshop with a brief to explore the prospects for the formation of such an association. After consultations the committee convened a meeting for the people who participated at the January 1997 workshop. A decision was made at this meeting that the Lesotho Educational Research Association (LERA) could serve as a suitable forum for our intentions, since the association was already well established and had environmental education as one of the areas identified for research, with the potential to be funded.

Later, in my interview with Lebu, he expressed doubts about the relevance of the association to school teachers. Lebu referred to LERA as an association for mostly 'lecturers' rather than 'teachers':

Interview (04-06-97)

Lebu: ...most members of LERA are from University, lecturers and so on. And now we are talking of environmental education association with teachers from high schools and so on.

Tsepo: But are you aware that LERA's membership is open to all teachers?

Lebu: Yah, this is open to all teachers...but the fact we know is that mostly what we call lecturers, so don't you think that people who are just teacher, people who we really call teachers, who are in high schools and so on, uhm mixing with those people who say they are lecturers, because in most cases they would like to be referred to as lecturers not just teachers.

Tsepo: So you feel that there might not be a healthy [interaction].

Lebu: Yes...I have a feeling that people normally like to show their superiority, something like that, because some feel superior because they have a second degree and they want to show that they have these and you don't have that and people like me with the first degree in most cases, they easily somehow intimidated or easily... they feel inferior so... I don't know.

Tsepo: Perhaps those are some of the things which we could look at seriously...but I suppose that if we have a group of people with a common purpose of learning from one another and even appreciating that teachers who may be in a particular school may know more about that particular school or even the students, then I think we...we can come up with a situation where we realise

> we can constantly learn from one another...I think we can then begin to see that there is a lot we can share and learn from one another...But I think we can take advantage of what LERA proclaims, that it is open to all people and organise ourselves within it as teachers.

It can be argued that the divide that Lebu articulated as existing among educators is an impediment of unity and collaboration among professional educators with a common purpose. This social class division among the Basotho educators, often associated with qualifications and education, epitomises the established order of modernity in Lesotho. In this context values of individualism and excessive competition supersede unity and collaboration. However, Map did not express the same view as Lebu with regard to the participation of teachers in LERA:

> Interview (11-09-97)
> Tsepo: ....is there anything that you would like to say about our plan to join LERA in order to take environmental education further and involve more interested teachers?
> Map: Yes ntate, more especially when it allows even the students, I think it's very important, I think it's very useful.

Nevertheless, her silence on this issue may not necessarily imply that she did not have held similar thoughts to those expressed by Lebu. It could be that she avoided this view to me because of its potential sensitivity, as I belonged to the category of 'lecturers' rather than 'teachers'.

However, shortly after the meeting at which we took the decision to join LERA, several teachers who participated in the initiative joined LERA. One thing is clear, though: whilst LERA may provide workshops on research methods for members as the association normally does, the responsibility for finding the time and energy to get the work on environmental education we want done rests with us. Thus far, there is no evidence of action research activity in environmental education within LERA.

In the next Chapter, I discuss the salient findings of the study and their implications, by drawing on the previous five Chapters.

CHAPTER 6

EMERGING PERSPECTIVES ON THE DEVELOPMENT OF ENVIRONMENTAL LITERACY WITHIN SCIENCE EDUCATION

And just as nobody else can learn to
walk (or drive, or eat, or talk) for another,
likewise nobody else can do our developing for us
(Chinweizu, 1987:52)

6.1. INTRODUCTION

In this section I report on the key findings relating to this study. I focus on the research team's experimentation with teaching methods consonant with their own understandings of environmental literacy; on the team's emerging perspectives on environmental literacy; on action research as a curriculum development process; and on my own reflection on the theoretical framework which guided the study. In my presentation of the findings in these areas I attempt to synthesise lessons learned by the team members on the research journey and relate them to the context of Lesotho.

6.2. PERSPECTIVES ON TEACHING STRATEGIES

The team set out to explore teaching strategies appropriate for developing students' environmental literacy, in the context of their classes in Lesotho. As described in Chapter 3, a repertoire of teaching methods or strategies which were assumed to be appropriate was first identified then tried in the classroom. In this section I highlight some of the more important findings concerning classroom interactions and processes, of learning with reference to the following teaching methods used by participating teachers: the excursion; small group discussions; whole class interactive approaches; and the involvement of guest speakers. I conclude by discussing some factors which influenced the use of the methods in the classroom.

Excursion

This teaching method was tried out by one team member (Lebu), with the aim studying the local environment with students. The activity had the open-ended intention of exploring the impact of humans on the environment, and had the potential to develop certain aspects of environmental literacy as interpreted by the research team. Its success was manifested in, for example, the students' discovery of new species of plants and animals, developed awareness of environmental pollution and their realisation of man's adverse impact to the environment (see Tables 3.2.1, 3.2.2, 3.2.3, 3.2.4). There was also evidence that the excursion (see Table 3.2.6) motivated some students to want to solve the environmental problem(s) they encountered. For example, reflecting on the excursion, one student remarked: "I learned how vital it was to keep the environment clean after seeing even innocent animals being exposed to the pollution" (see Section 3.2.1), and another suggested that the excursion could have been improved by actually doing something about the litter they say: "my teachers should bring a box of matches to burn up the litter" (see Table 3.2.6).

The excursion method provided students with the opportunity to actively experience their local environment and develop thereby aspects of environmental literacy as defined by the research team (see Section 4.2.2). The small group discussions which were held in the classroom following the excursion (see table 3.2.7.) provided students with the opportunity to engage in the reflective process of clarifying their experiences and sharing possible solutions for environmental problems. This teaching method is discussed in the next section.

Group Discussion

Group discussions were tried out by all three participating teachers. Through this method students were able to express their views, share their knowledge and reflect on issues arising from their experiences. The use of this method after an excursion enabled students to discuss the environmental situations they had encountered and to talk about and clarify their experiences (see Table 3.2.7; Section 3.2.2). In Limpho's case it became apparent that discussion questions that sought to relate science topics to more social issues needed to have been well thought out beforehand, in order to enable students to engage appropriately with their own contexts (e.g. see Section 3.4.1; 3.4.3).

On the whole, the small group discussions seemed to be impeded by students' inability to express themselves in English and to participate in discussion (see Sections 3.3.3, 3.4.2.). English seemed to take time away from the actual teaching and learning of the subject content and to inhibit students from meaningful engagement in the processes of learning (about their environments). The efficacy of this approach might therefore be enhanced through the development of students' ability to participate in discussion meaningfully, and by dealing with the impediment presented by the use of English..

Stuart (1988:138) and her research team observed a similar problem (of students' inability to participate in discussion) in other schools in Lesotho. She describes how a team in her project attempted to remedy this by tape-recording small group discussions and replaying the recordings to students, and involving them in role-plays to illustrate points. This could be a useful starting point for further research into the appropriateness of this method for the development of students' environmental literacy. The implications of students' preference for Sesotho during discussion also needs to be investigated further within this context.

Presently, the language policy in Lesotho stipulates that "Sesotho is the medium of instruction from standard 1 to standard 4, English is the medium of instruction from standard 5 upwards, English and Sesotho are taught as subjects both at primary and secondary school levels, English is a failing subject" (Ministry on Education, 1995:21). Moreover, a National Seminar on Clarification of Policy on Secondary Education and Localisation of O' Level has recently recommended that "the use of English as medium of instruction should be enforced" (Ministry of Education, 1995:21).

The introduction and promotion of the use of English in Lesotho may be traced to the arrival of the missionaries in 1833 and British colonial rule during the period 1868-1966. From this perspective, it can be argued that the curriculum developers in Lesotho have associated the language with knowledge and power, which the missionaries and the colonial rulers exercised over the Basotho (see Rodriquez, 1995; Foucault, 1977). The findings of this study, however, suggest that the use of English as a language of instruction may in this context in fact disempower rather than empower students with knowledge. Drawing on the Norwegian experience where students use their mother tongue as a language of instruction, Brock-utne

has questioned the notion of the use of a European language (English) as a language of instruction within the cognate African context of Namibia - the choice which Namibia took after independence:

> it seems that Namibian parents are mistaken in the belief that the best way to learn English is to have the language as the language of instruction. It might be a wiser choice to strengthen the teaching of English as a foreign language through giving more time in school to the study of English as a subject, and to strengthen the Namibian languages as languages of instruction. It may be mentioned here that the proficiency of Norwegian secondary school students in English is high.... (Brock-utne, 1997:253)

Elsewhere in the paper Brock-utne explains that

> work in Nigerian schools with the use of Yoruba as the medium of instruction has been going on. Evaluation studies constantly show that pupils educated through the medium of Yoruba are more proficient in school subjects, including English, than pupils educated through the medium of English (ILEA, 1990). (1997:254)

Lesotho's choice to use English as a language of instruction is a colonial legacy which parallels Namibia's decision after independence, and is based on uncritical acceptance of a taken-for-granted 'development' strategy, that assumes English embodies knowledge and power, which paradoxically hides meaningful education.

Whole class interactive and student-centred activities

The teachers' use of student-centred and interactive approaches (e.g. small group discussions, laboratory experiments) involved students actively in constructing understandings of their local environments. These activities included the filtering pond water which the students had brought to school from their home environments (see Section 3.3.2), the collection and classification of litter from school grounds into magnetic and non-magnetic objects (see Section 3.3.5), and discussions on the advantages of electricity, illustrating the interconnections between electricity and local socio-economic concerns (sections 3.4.1; 3.4.3).

There was evidence of students showing excitement when given the opportunity to actively participate in class. Reflecting on students' behaviour when reading out their own messages on pollution prevention from the posters, Map attributed their excitement to their realisation

that they had the *"power to do certain things"*. Drawing on Wertsch, O'Loughlin has expressed the view that "multivoiced and dialogical" lessons empower students:

> To the extent that only one authoritative voice is heard in the classroom, and to the extent that no opportunities are provided to interrogate that voice, students receive messages not only about the power of objective, authoritative knowledge, but also about the lack of power they themselves hold to interpret events and critical understanding. (1992:812)

There is, however, evidence that multivoiced communication needs to be complemented by action to develop students' environmental literacy. For instance after a student-centred interactive lesson reported in this study, students could not recall the concept of recycling, which the teacher had taught theoretically in the lesson, but did remember the burning of litter which they had actually done did with the local City Council. O'Donoghue (1993) sees meaningful environmental education as that in which learners engage in action (e.g. do recycling) and reflective dialogue (e.g. in small group discussions), grounded in their encounters with environmental situations (e.g. experience of littering).

Some contextual factors influenced the use student centred-activities. For example, when Map attempted to involve all 48 students in learning activities (e.g. students' reading of interview reports), the lessons became long and monotonous (see Section 3.3.3). The attempt to involve students in observing the pond water samples they had brought from home under the microscope was thwarted by the lack of cover slips and insufficient functioning microscopes (see Section 3.3.2). The shortage of laboratory equipment in this context could be seen as a tension deriving from an education system within which the teaching of concepts developed outside the Lesotho context generates resource needs locally: the need for efficient laboratory management (e.g. the repair of microscopes) and for laboratory equipment.

Guest Speakers

The involvement of guest speakers in Limpho's class showed that the method had a number of advantages for developing students' environmental literacy, as defined by the research team. The guest speakers who visited Limpho's class brought with them equipment which the school did not have; many of the students who evaluated the guest speaker's lesson indicated that they would like the teaching approach to be used regularly and that they had learned new

and current information about solar energy from the guest speaker (see Tables 3.4.2; 3.4.3; 3.4.4). As one student explained: "all things she says was the things that happen in this time...."; whilst Limpho's view about my talk, as a guest speaker, was that: "with the books they have there is a limited information...You touched some things that I couldn't touch from my side and the students liked it". Moreover, as a guest speaker I learned that open-ended questions could prompt students to think critically about environmental issues (see Section 3.4.4).

Some contextual constraints, however, also affected the use of this method: as a guest speaker I found it stressful to probe and communicate with 48 students in Limpho's class. I thought that the large size of the class could encourage the predominant use of 'non-interactive' lecture methods (see Bodner *et al* 1997). The other guest speaker's talk lasted for two hours without a break (exceeding the lesson time); this could have been due to the guest speaker's lack of pedagogic background and the teacher's assumption that the guest deserved more than a normal lesson of 40 minutes. Whilst the students who evaluated the guest speaker and the teacher did not mention this as a problem, it seems appropriate that invited guest speakers should talk within the scheduled lessons to avoid disrupting the school programme and inviting unnecessary criticism of the method.

Further, Limpho viewed the guest speaker's visit to her school as problematic in that, as she put it, "some of the things that were covered by the guest speaker are never asked in the examination". The present objectives-led curriculum development model in Lesotho wherein content is prescribed (see Section 1.5.1) keeps the teachers pre-occupied with 'covering the syllabus' and may inhibit the invitation of guest speakers and other teaching strategies that engage students with their local environment. An 'open-ended' 'process-based' curriculum development model (see Elliot and Rice, 1990; Lotz, le Roux and Ward, 1998; Lotz and Oliver, 1998), within which content is not prescribed but determined in the process of engaging in environmental situations, would seem to provide an appropriate framework for the use of this teaching method. Doll (1989:250) has associated such a curriculum with post-modernity and described it as:

> a process of development rather than a body of knowledge to be covered or learned, ends become beacons guiding this process, and the course itself transforms the indeterminate into determinate.

Such a curriculum development design needs to be considered by curriculum developers in Lesotho, in the interest of developing in students' an environmental literacy that is actually responsive to their environment.

In the section below I present a synthesis of the team's emerging understandings of the meaning of environmental literacy.

6.3. EMERGING UNDERSTANDING OF ENVIRONMENTAL LITERACY

In this section I discuss the key features of the processes of development of the concept of environmental literacy among members of the research team, and describe the understandings and tensions associated with the processes. I show that the teachers in the study initially evinced some reluctance or inability to engage in the reflective process of revising and developing the meaning of environmental literacy, and attribute their behaviour to the present education system and curricula in Lesotho. I further argue that there are two orders of meanings of environmental literacy emerging from this study, and show how the team interacted with these meanings. I conclude this section by discussing the implications of the emerging meaning of environmental literacy for science teaching in Lesotho.

At the research team's first attempt to clarify and develop the meaning of environmental literacy, a number of concepts were associated with the notion of environmental literacy. These concepts included 'action' to solve 'environmental problems'; 'understanding the environment', 'awareness of the environment' etc. (see Sections 4.2.1 and 4.2.2). Informed by the principles of action research, I guided the team members to develop and clarify the meaning of these concepts. They showed some reluctance (see Section 4.2.2) to further reflect on, to restate (see Section 4.2.2) or to revise (see Section 4.3) their first definition of the concept, especially during our early attempts at the process. At one stage, at the end of the first action research cycle, Lebu and Map thought that the concepts associated with environmental literacy at the first workshop were already clear enough to the team; on other hand I found the concepts cumbersome and thought that they could be further clarified in the light of our experiences.

Retrospectively, I have interpreted their reluctance to engage in the process of reflection to develop conceptual meanings, as attributable to their predominant role as implementers of 'predefined' concepts in the classroom; their concominant possible assumption that conceptual definitions were fixed; the challenge the process presented to their set views; and the demanding nature of the task of reflecting on one's actions to construct meaning in one's own words. Looking back, I can easily associate their reluctance and apparent haste to get over the process with a dream I had early in the project about a "big book" that fell out of my hand, and my quick run "through a dense and scary forest" to retrieve it, without realising that a slower and more reflective "journey is the knowledge and the wisdom" (see Section 2.2). A persistent probing of Lebu and Map focusing them to reflect on and draw lessons from their actions during the first cycle, led to some expansion and clarification of the concepts we had used to define the concept of environmental literacy. For example the concept of taking 'action' to solve environmental problems was interpreted by Lebu to include 'discussion groups' on environmental problems, within the school context.

Much later, by the end of the project, the teachers expressed their views on the meaning of the concept with relative ease (see Section 4.3). This change could have been due the waning of their assumption that the meaning of the first definition was fixed and the development of their understanding of the meaning of the concept. At this stage, Lebu referred to his understanding of the concept as the product of a team effort of which he had been part, but also suggested that he had simply accepted the correct views of people he assumed had "spent a lot of time trying to clarify or define what environmental literacy means" (e.g., possibly, the people he encountered at the EEASA conference). This apparent contradiction in his view of the development of his understanding about the concept, was perhaps engendered by the research, which may have helped him to shift from the traditional role of being a recipient of concepts defined by 'experts', to one of being a 'co-constructor' of concepts (a negotiator of meaning within a team).

In addition, Map felt that she had not been "environmentally aware" (e.g. not taking politics into account) prior to her attendance at the conferences. Her deficit perspective on the development of her understanding suggests that she assumed that her understanding was

'developed' by others, rather than continually 'developing' through interaction with others. Reflecting on development within the African context, Chinweizu (1987:52) has argued for a shift from reliance on others for our development, as development is like learning to walk and therefore no one can do it for another: "just as nobody else can learn to walk or drive, or eat, or walk for us, likewise nobody else can do our developing for us". From this perspective environmental literacy may not be developed by simply accepting others' views about the meaning of the concept, as Map and Lebu seemed to suggest, but by first reflecting on and recognising one's own assumptions about the meaning of the concept and then engaging critically with the views of others. Retrospectively, I see that my adherence to a predefined view of environment as the interconnectedness of the biological, political, economic dimensions of life, evident in the research proposal, research team meetings and my lecturing at the University, suggests that I thought that this was the 'correct' view on which we had to rely and towards which we had to work as a team, rather than as a view to critically engage with. This could have easily made me oblivious of other useful ways of understanding environment and environmental literacy which emerged during the research project.

Reflecting on the process as a whole, two orders of meaning of environmental literacy seem to emerge. The 'first order' concerns on the **process** of defining the concept and the 'second order' of meaning concerns the **knowledge** base that members associated with environmental literacy. This was particularly clear in the case of Lebu. The first order involved him engaging with **who** contributed to shaping his understanding (e.g. the team, others), **how** his understanding developed (e.g. over time, through the sharing of ideas), and **where** it developed (e.g. at workshops) (see 4.2.2). The 'second order' of meaning of the concept concerned the **interpretation and association of the meaning of environment with environmental literacy and as knowledge to be taught in the classroom**. This meaning informs and guides action (e.g. teaching in the classroom). In this study, this order of meaning of environmental literacy shifted from relatively narrow to broader understandings.

The understanding of environment as concerned with the biophysical dimensions (e.g. plants and animals) broadened to include the causes "which are more social rather than the physical environment", "the way people live", "economy of the country" (Lebu); use of "resources", "environmental problems", "recycling" and "politics" (Map). There was not much evidence

of this emerging broad understanding of environmental literacy being translated into teaching activities in the classroom; though Limpho did attempt to raise students' awareness of the relationship between a topic on electricity and some local socio-economic and biological concerns (see 3.4.3). This seems to suggest that theoretical views on the environment and environmental literacy are not easily translatable into practice; or perhaps that the teachers in this study found the political dimensions of environmental concerns inappropriate within the science classroom. One teacher did express his concerns about the appropriateness of including politics in science class (see Section 4.2.1).

The present overemphasis of environment as exclusively concerned with the biophysical dimension within the teaching of science in Lesotho is inappropriate and the teaching and learning about environment should be informed by a broad understanding of environment (eg causes of environmental problems, politics etc), as it reflects environment more realistically as concerned with complex interactions and relationships. Within the emerging broad view of environment, the teachers emphasised action taken to solve environmental problems as an important dimension of environmental literacy in their reflections.

In mentioning action as an attribute of environmental literacy, the teachers also qualified the meaning of action. Action which people (students) are "pushed into...and find it as if it is a torture' (Map) or do "as a punishment" (Limpho) was considered as not reflective of environmental literacy (see Section 4.2.2). By deciding that forced or disciplinary action did not reflect environmental literacy, Map and Limpho seem to have been relating the concept with their school context, where students might be punished for arriving late at school by having to collect litter. As mentioned above, Lebu understood action to include students' participation in discussions on environment issues. The concept of action to solve environmental problems with the teaching of science seems appropriate in this context of Lesotho; the teachers' insights on the meaning of action provide a useful basis for further clarification of the meaning of action as an attribute of environmental literacy within the teaching of science.

My own understanding of knowledge pertaining to the 'second order' of environmental literacy developed in the study has also been informed by and developed through my

interaction with critical theories and post-colonial literature (see Chapter 1), in addition to my interaction with team members and other environmental educators at EEASA conferences. I developed the view during the research that local knowledge forms and perspectives were vital for sustainable development and environmental literacy, but also recognised that they were subjugated by the dominant Western forms of knowledge within the colonially-rooted education system in Lesotho. It was from this orientation that I discovered and engaged the team to the views of Machobane, a local farmer and philosopher. His trenchant views and the critical theories with which I engaged (see Chapter 1) influenced me to consider environmental literacy as concerned with the exploration and development of alternative knowledge within the curricula; knowledge that will restore the Basotho's *creativity,* their ability to *invent*, and to produce their own food as they did in the past (see Keegan, 1986), rather than rely on other nations for *employment* (see Section 4.3). I have thought of this perspective as corroborating a dream I had during the research (see Section 4.3), in which I courageously ran into the unknown, "from the west to the east", and discovering a village "inhabited by Africans" (i.e. a contextual curriculum), and where "peace" *(khotso)* and "satisfaction" *(boiketlo)* prevailed. This perspective was enhanced by my encounter of the views of Zwahlen (1996), the observations of the United Nations Commission on Sustainable Development (UNESCO-UNEP, 1996), and Shiva, Jafri, Bedi, Holla-Bhar (1997), who all emphasise the importance of 'traditional' or 'indigenous' forms of knowledge for sustainable development. The views of Machobane and traditional forms of knowledge were, however, not reflected in the teachers' activities in the classroom, and I did not encourage them to do so. This was probably because, at the time, we perceived these ideas as irrelevant within the context of the research and the teaching of science. In addition, two members of the team withdrew from the research soon after Machobane's involvement and so attempts to try and link indigenous knowledge in science education were not made in this study. The teaching of indigenous knowledge in the context science education provides a worthwhile further research focus (see also forthcoming EEASA monograph on the topic of indigenous knowledge in/as environmental education).

To conclude, it seems appropriate that the development of environmental literacy within the context of science teaching in Lesotho should provide and engage students with broad perspectives on environment, inclusive of the socio-political issues and causes of

environmental problems. This broad and complex view of environment better represents the complex and dynamic interactions in the environment Lesotho. The students' comprehension of this complexity may enable them to grapple with the root causes of environmental problems, and to better understand why some attempts to solve environmental problems have failed and why some may succeed in this context (e.g. understand why some communities in Lesotho have felled the trees planted by the government's 'development' programmes). Science teaching should involve students reflecting with their teachers on how science content may better be related to the local environments. However, science need not be presented as the only way of understanding the environment and solving environmental problems; in fact, learners need to be made aware that science can contribute to environmental problems in this context (e.g. the Lesotho Highlands Development Project). From this perspective, indigenous knowledge may be introduced into the science curricula as complementary, rather than contradictory, to science. For example, science teaching could involve the study of local flora with medicinal and food properties; this recognition and inclusion of local forms of knowledge into the classroom would draw students' attention to their dependence on the local environment, rather than on some distant environments for survival (e.g. 'developed' countries proving food and medicine). This could lay a strong basis for students' comprehension of the importance of conservation and appropriate management of their local environments.

In the following section I present the team's emergent understandings of the process of action research, and allude to the advantages of the method as a curriculum development process, suggesting that it is a preferable alternative to the present curriculum development model in Lesotho.

6.4. ACTION RESEARCH AS A CURRICULUM DEVELOPMENT PROCESS

In this section I reflect on the research team's engagement with the process of action research and discuss how the understandings and insights gleaned from the research process as well as the tensions we encountered may inform the curriculum development process in Lesotho. I focus on the lessons we learned with regard to the following: classroom observation; collaboration; improving practice through reflection; putting action research theory into

practice; and engaging with cycles. The implications of these for the process of curriculum development will be considered.

The present curriculum development model in Lesotho may be described as an objectives-led model of curriculum design, wherein subject contents are pre-specified as learning outcomes in the form of aims and objectives (see Elliot and Rice, 1990). In Chapter 1, I argued that this curriculum development model amounts to a form of social engineering. It excludes the majority of teachers and students from the curriculum development processes and prescribes changes in content and teaching approaches in schools on the tacit assumption that school contexts are simple and uniform (see Section 1.5.1). Contrary to this model of curriculum development, the action research method employed in this study was an attempt to engage with an 'open-ended' 'process model' of curriculum development (see, e.g., Lotz, le Roux and Ward, 1998; Lotz and Oliver, 1998) in order to develop a theoretical framework of environmental literacy and explore appropriate teaching methods. Through a participatory process of reflection, this 'process model' attempted to develop the understandings of the team towards new co-constructed and contextually relevant understandings, rather than towards pre-defined supposedly 'correct' understandings. In the next section I discuss some of the lessons we learned in our engagement with this process.

Observing Others in the Classroom

There was evidence during the research process of the teachers (Lebu and Limpho) feeling uncomfortable about my observation of their lessons (see Sections 3.4.4, 5.1.2). Winter (1989) has argued that if we observe colleagues without allowing them to observe us they may experience discomfort and anxiety as a result of the research process making them vulnerable to the research initiator's observation and interpretation. It indeed seems that Lebu's and Limpho's unease emanated from a fear of being judged by one authorised to observe them without being observed in return. This could well be the reason why Limpho asked me to teach her class (see Section 3.4.4). It therefore seems important that action research facilitators should somehow themselves be involved in teaching, for example as 'guest teachers', so that they too may be observed by the teachers participating in the research, thus equalising the power relations between them.

Improving Practice through Reflection

Lebu and Map indicated that the research process helped them to reflect on and improve their teaching (see Sections 5.3.1; 5.3.2). For example, reflecting on his teaching by drawing on students' perspectives, Lebu thought that: "it [action research] really gives the teacher a reflection from the students' point of view as to what you are doing". At the end of the project, his view was that "a chance to be evaluated by the students themselves" was "very important" and one of the useful things about the project; it also gave students the opportunity to say "how they felt...how they could improve these [ways of teaching]...how the teacher could maybe make some changes or improve [the teaching approach]" (see Section 5.3.1).

Lebu and Map also seemed to perceive their engagement with the process of reflection on their teaching as a process leading towards 'the correct teaching method'. For example, Lebu described action research as a method capable of establishing whether there was "something **wrong** with your teaching method" (emphasis added) (see Section 5.3.1). Map, stressing the value of watching a video of her lesson, thought that action research had developed her ability to continue to 'correct' her teaching: "Now I keep **correcting** myself repeatedly...even as I teach I know how to correct myself, so that I must explain something in an easy way" (Emphasis added) (see Section 5.2.2). The pedagogic assumptions of the two teachers seem to be that a teaching approach can either be 'wrong' or 'right', and that reflection 'corrects' a teaching method that was initially wrong. This is at variance with the view of reflection as a process that 'develops' a teaching method to be relatively more 'appropriate', and could have inhibited the teacher from freely exploring new and contextually appropriate ways of teaching in her concerns to teach 'correctly'. Action researchers need to be conscious of this and similar assumptions and may deal with them by subjecting them to critique through focused group discussions.

Further, Map seemed to be working towards finding, not only a correct teaching approach, but one that would *simplify* learning and enable her to "explain something in an easy way", so that students might "understand quickly". Her view contrasts with perspectives about learning informed by constructivist theories (see Bodner, 1986, Bodner *at al.,* 1997) which propose that knowledge is not transferred intact from the mind of the teacher to the mind of the learner through clear explanations, but rather occurs through active involvement of students in the

process of learning. From this perspective, it could be argued that reflection did not affect Map's understanding of how learners learn. The use of literature on learning theory during the research process could have engaged the team members to reflect critically on their own assumptions about teaching and learning. This interaction with literature needs to be considered when employing action research. However, theory from literature should inform rather than direct research activities as this would defeat the purpose of action research, to explore contextually appropriate ways of teaching.

Putting Action Research Theory into Practice

It can be argued that the theories of action research that the team members held when they started the project developed and changed as they engaged with practice in the classroom. Winter's (1996:24) view of theory and practice as "not two distinct entities, but two different and interdependent and complementary phases of the process of change" is a useful perspective from which to understand the interaction between our starting assumptions about action research and what we learned about it during the research process.

Considering our engagement with action research at the end of the project, Map thought that the method "seemed simple" when "talking" or 'theorising' about it, but that "it wasn't so easy" to "follow" in the classroom (see Section 5.3.2). The interplay between her actions and the dynamic classroom context, influenced and shaped by numerous factors, could not allow for the easy 'following' of the method. Yet, retrospectively, I realised that during the research I too had tacitly assumed that a match between the theory about the method and its 'implementation' in the classroom was the ideal we had to work towards in order to achieve the research goals (see Section 5.3.2).

Looking back at how action research was introduced to the team in the present study (see Sections 2.4.1; 2.4.2), it seems that teacher-researchers might more meaningfully engage with the method if it is presented as a process that expands or informs their already existing ways of improving practice, rather than it if is presented as a fixed body of knowledge to be 'implemented' in the classroom. In this way the socially constructed nature of the method might become apparent to the team, and members might better construct and reconstruct their understandings of the method during the research process. This should serve to develop the

teachers' confidence that they are 'trying out' the method as they understand it rather than seeking to 'implement' it correctly as prescribed. An open-ended approach that is 'conscious of the local surroundings' or responsive to the local conditions rather than a rigid attempt to implement a fixed model seems to be the appropriate way to engage with the action method method.

Contrary to his initial assumption that action research was "nothing new", by the end of his participation in the project Lebu thought that action research was "a new thing", "ntho e ncha", and felt that one cycle had been inadequate to develop his confidence about the method, especially because he had had no training in research at the local university (see Section 5.3.1). As a result of his lack of formal research experience, he explained, he got "mixed up somehow", and could not tell the difference between action research and "self-evaluation procedure". It could be argued that Lebu's limited formal training in research reflects a teacher training programme informed by the view that teachers are mere implementers of the curricula rather than curriculum developers. Lebu's views suggest that some formal training is required, in action research and other research methods, for the teachers to 'implement' the method with more confidence. Presently action research is not offered in the Department of Science Education at the local University where Lebu trained about 8 years ago, although students may be offered selected introductory topics on research within some curriculum studies courses. The Department of Language and Social Education, however, offers courses in action research, and students' teaching practice reports are based on action research.

Number of Cycles Tried Out and Their Impact on Practice

We initially planned to 'implement' three cycles during the project. However, by the end of the research Map had completed two cycles, and Lebu one cycle, while Limpho had withdrawn from the project just before the end of the first cycle. Time constraints and work load were the main contributory factors in Lebu's and Limpho's decisions to discontinue the research (see Section, 5.3). For example, Limpho attributed her limited participation to the need to cover the syllabus and to devote time to the professional studies she was pursuing (see Section 5.3.3). Ashwell (1992) and Klein (1997) have reported similar problems with time constraints in participatory action research with teachers in South Africa, and Stuart has

observed that "many action research studies end after one cycle" (1997:173). Our failure to overcome these constraints may be interpreted as a failure to engage with our context and shape it (see, e.g., Cochrane, 1996:4), and suggests that our understanding of the method was informed by an "apolitical value system" (Lather, 1986:263) and that we were uncritically orientated (see McKernan, 1991; Fien and Rawling, 1996) (see Section 2.5). It could also be argued that the time constraints inhibited the team from taking appropriate critically oriented actions. Given the advantages of action research as a process of curriculum development demonstrated in the present study, teachers who wish to undertake action research in school settings should be given time for research. They may, for example, be given a lower number of periods per week; the official thirty periods per week were described by Limpho as already "too much" (see Table 2.1).

There was also evidence in this study of the cycles being complex, with 'mini cycles' rolling inside bigger cycles (see also, e.g., Stuart, 1988); these observations are useful for future prospective action research researchers. The mini cycles that I identified in this study were incomplete (see Section 5.3.4) and their impact not determined. It seems that their completion could have added rigor by deepening teachers' understanding of the processes of teaching for environmental literacy.

In conclusion, the participatory action research engaged the team in a process of generating local knowledge and understandings about environmental literacy and teaching methods. Stevenson (1997:102) has argued that the local production of knowledge and understandings by practitioners themselves, through interaction with their own contexts, demystifies research:

> The mystification of research also can be attributed in part to the prevailing view of theory in Western society as constituting a high level of abstraction that is divorced from the realities of everyday life, and in part to the professionalisation of knowledge such that the labour of knowledge production is confined to specialists.

Elliot and Rice (1990:70) see non-prescriptive models of curriculum development, such as participatory action research, as sensible in that

> the knowledge that characterises the environmentally aware and active citizens cannot be prescribed but only determined in the process of engaging in situations necessitating an eclectic selection and utilisation of significant knowledge.

Whilst the team's engagement with action research was not without tensions and limitations, as has been mentioned above (also see Chapters 2 and 5), our employment of this method was a useful point of departure to think about, envision, conceptualise and continue to reflect on more contextually responsive strategies of curriculum development in Lesotho. This method of curriculum development seems to be appropriate for the realisation of Lesotho's education policies on environmental education (see Section 1.6.3).

6.5. REFLECTION ON ACTION RESEARCH AS A RESEARCH PROCESS

> *...even the research methodology itself may be reinterpreted and reconstituted by participants...Not to recognize the inevitability of this is to engage in cultural imperialism (McTaggart, 1997:29).*

6.5.1. Introduction

In this section I provide a reflective synthesis of the lessons that I learned about action research methodology by drawing on the experiences of the research team during the project. I also draw strongly on the work of McTaggart (1997) on 'participatory action research', as well as other action researchers. A participatory action research methodology was attempted in this study because of its potential to engage participants in a critically reflective process of transforming their practice. I comment on three important principles of participatory action research: critical reflection, collaboration and participation. This precedes a discussion on ways in which those participating in action research theorise about their practices. I will further comment on three concepts associated with theorising in action research, which emerged as important and informative features of action research methodology in the following order: evidence in action research; action research theory; and knowledge production, a product of theorising, in action research.

6.5.2. Key Experiences and Implications for the Methodology of Action Research

Critical approaches to action research

Three forms of action research have been identified in the family of action research activities: the 'technical', 'practical' and 'emancipatory' (Grundy, 1987). Within the technical approach the social world is treated as though it were a natural world (Tripp, 1990) and the emphasis is on the implementation of the pre-determined curricula, and the development of competent and effective teachers who "are instruments of change and the nature of change is reproductive" (Walker, 1990). Practical action research distinguishes between the two worlds but "accepts the social world as it is" (Tripp, 1990), and the emphasis is on "informed action to promote change in the classroom" without any "critical focus on how classroom action is structurally located". The emancipatory approach "recognizes the difference between the natural and the social worlds" and further critiques the latter in order to improve it (Tripp, 1990) through a process of educational change that promotes democracy, transformation and empowerment (Walker, 1990). Tripp has referred to action research that employed the 'emancipatory approach' as "socially critical action research". While the teachers in this study tried out new teaching approaches informed by continually clarifying understandings of environmental literacy the teachers' reflections were largely 'practical'; little attempt was made to critique the context of the education system (see Chapter 3).

The teachers were reluctant to critically reflect on their actions in the classroom in order to clarify the meaning of environmental literacy. Drawing on her experience with action research, Muhlebach (d.u.) has argued that some transition phase should be expected as teachers shift from their usual practice, which is often "a technocratic framework informed by an empiricist view on knowledge and a positivist view of educational enquiry [developed] since their initiation into the educational institutions", to an action research framework of "thoughtful and overtly reflective practice" (ibid:3,4). A positivist view of knowledge may be especially entrenched in science teachers, as scientific concepts are normally taught as an established and unquestionable body of knowledge. The 'gap' between on the one hand the science teachers' uncritical positivist culture, which in this instance was blended with uncritical local culture, and on the other hand emancipatory action research, requires some form of mediation. The role of the facilitator is critical in this regard. Part of that role would

be to guard against the team slavishly engaging in exclusively 'technical implementation' of action research. This may be achieved through the work of "ideological critique" (McTaggart, 1997:33), in which the (academic) facilitator shares knowledge that could help the participants to question the value of their gendered, colonised, nationalised or westernised perspectives (McTaggart, 1997).

Tripp (1990:164) observed that most teachers that he had worked with in action research projects "find socially critical questions emerge as they proceed"; and that action research starts small and grows to critique institutions which might lead to the reform of broader systems of educational practice (Kemmis and McTaggart 1988:24). This suggest that critical reflection evolves overtime. From this perspective it is also true that some action research projects may only develop skills but "not necessarily shift into a critique of the contexts of practice" (Walker, 1990), as in the case of this study. In this study action research was burdensome for teachers (e.g. See Sections 5.3.5 and 6.4), and never evolved into an emancipatory form.

Less burdensome forms of action research may be proposed for this context, based on the experiences of the research team. Participants could explore practices which already exist in their school context which can enable or support a critically reflective dialogue. This could be achieved early in the research, as part of reconnaissance, with a view to explore how action research theory could inform the existing 'reflective' practices to make them more rigorous.

The socially critical awareness developed by a critically reflective process of action research, can give rise to a defeatist feeling of failure to transform the broader practice of education. This feeling was reflected in my early drafts of the last chapter of this thesis. This was also noted by my supervisor, who helped me to focus on concrete changes that the study had achieved. McTaggart (1996:245) has argued that it is inappropriate to talk about action research as if "nothing short of the revolution will do", stating that the referent of participatory action research is rather, "'are things better that they were?', not 'Are we emancipated yet?'". His perspective about emancipation is that it is bound to be a slow process since,

> (t)he political, cultural and linguistic practices which make the world an unsavoury place for many people did not arise overnight, and will take sustained effort and tolerance of slow progress and setbacks. (1996:245).

Collaboration

Collaboration is one feature of participatory action research methodology (Kemmis and McTaggart, 1988:15; Fien, 1996). The participation of various invited guests (e.g. teachers from a number of schools, staff from the Institute of Education and the National Curriculum Development Centre) and my own interaction with 'critical friends' (e.g. at conferences) in our early research planning meeting and subsequently when the research team shared the findings, was very useful in terms of: the input of ideas they made, their critique of our work, moral support, allowing other experienced researchers to share useful ideas, and facilitating reflection by providing a variety of critical perspectives. The consistent presence of experienced researchers, who critiqued our work, at our reflection meetings and the conferences we attended was very useful. We usually had different teachers attending our meetings, at the environmental centre, as the invited schools would send different teachers; many of the invited schools never attended our meetings. The broadening of the involvement of teachers as collaborators was therefore not possible in this context.

The collaboration between the research team members at other stages of the research (e.g. lesson planning and implementation stages) was rather limited, due to the physical isolation of the team members. We only collaborated as a whole team at the beginning of the research project for a broad planning, and at the end of the cycles to share our findings and broad action plans. In terms of action research literature, the collaboration of the research team at all stages of the research is essential, and may be enhanced by two or more teacher researchers being at the same school. Such an arrangement may, for example, enable the teachers to observe each other's lessons, comment on each other's plans, and share ideas and problems concerning their work, without waiting for the facilitator.

Participation

McTaggart distinguishes between 'participation' and 'involvement' in action research:

> Authentic participation in research means sharing in the way research is conceptualised, practised, and brought to bear on the life-world. It means ownership, that is, responsible agency in the production of knowledge and improvement of practice. Mere involvement implies none of this and creates the risk of co-option and exploitation of people in the realization of the plans of others. (1991:28).

I largely facilitated, initiated, organised, planned, co-ordinated the research activities during the research; there is little evidence of the teachers taking a role in initiating the research activities and controlling the project. This study may therefore be regarded as not having been participatory. Whilst I do not think that this was equivalent to 'doing research on teachers', their participation was not "authentic" (McTaggart, 1997). This might have also resulted largely from the project design: individual teachers in three separate schools undertaking class activities with me as the co-planner and classroom observer at scheduled times. This arrangement might have encouraged both a poor collaboration, as mentioned earlier, and the facilitator/researcher driven process of action research which emerged. A team of teachers in a school undertaking action research together could enable greater teacher participation in and control of project activities.

Other possible factors that could have inhibited the teachers from initiating research ideas and action plans are: The pressure from teachers' routine work; having introduced the project to the teachers as my study with a university, it is likely that the teachers would have expected me take a lead in the project; the teachers' lack of confidence to do research because the method was presented as a complex process.

These conditions suggest a participatory action research process that is anchored in schools and controlled by teachers themselves; such control cannot be authentic if the research is an outsider initiated process of implementing a 'technique' that is 'squeezed' in the teachers' crowded schedules. The objective of sharing action research theory with teachers should be to inform or enrich their already existing practices/culture of 'reflection' on or discussions about their teaching, so that they may engage in such practices with a more critical language and

understanding. For example, staffrooms in many school that I have visited during university teaching practice in Lesotho are used by teachers for chatting about their classroom experiences; I always note how teachers often discuss students' behaviour and class performance and not their own practice of teaching. These staffroom talks could be enriched to become more critical about the teachers' own practices and the broader context of teaching.

Theorising about our practices

One important feature of participatory action research from the literature is that it involves people in theorising about their practices (McTaggart, 1997). There is evidence of the research team formulating some theories as we subjected the meaning of the concepts of environment, environmental literacy and appropriate teaching approaches to "critical scrutiny through the participatory action research process" (see McTaggart, 1997:36), at our reflective group meetings, and during my individual interviews with teachers (see Sections 4.2 and 4.3).

When facilitating discussions during the meetings and when interviewing teachers I tried to avoid expressing my own views and insights out of concern that the teachers might consider them as the correct answer, and shy from expressing their own (e.g. see Section 4.2). McTaggart refers to this tension as an important issue that needs to be addressed in participatory action research, and has associated it with the culture of the groups, institutions and society involved in the research:

> ...there is still a reasonable expectation that academics will be imperialistic in their relationship with workers (e.g. teachers) because of the ways in which academics typically come to participation, because of their command of particular specialised discourses, and, perhaps, because of the deference and uncertainty of workers (teachers) who have been forced concretely and hegemonically to adjust to being told what to do. (1997:33)

In future, I would freely share my views with teachers as they could be a useful resource in discussions. By sharing my views I might raise "the kinds of issues which could turn a practical action research project into a socially critical one" (Tripp, 1990:164). But I would also heed McTaggart's words, drawing on Fay (1987), that, "Academic participants (or others) may bring social theory to the group's attention, but the way in which this is done must scrupulously avoid academic imperialism" (1997:38). Thus, I would engage fully in

discussions and help teachers to critique their own perspectives, but with great care not impose my own views on them. This perspective is recommended for facilitators of participatory action research.

What counts as evidence in participatory action research

An 'open-minded' and 'open-eyed' approach to what counts as evidence in action research (McTaggart, 1997:37; Kemmis and McTaggart, 1988:13) enabled me to undertake the research with a flexible approach. By drawing on my dreams as a basis for critical self-reflection on knowledge (see Section 2.2 and 4.3), the participatory action research opened up new ways of knowing. I have come to understand action research itself as a self-reflective and open-ended process of learning that opens up new/contextual ways of knowing and understandings, and as a way of improving practice. Participatory action research should employ locally existing practices and ways of knowing to facilitate a critical reflection on practice in order to improve it. It is a contextually responsive process of research that draws on unexpected data as the research progresses. From this perspective participatory action research becomes "a living process changing both the researcher and the situations in which he or she acts" (McTaggart, 1997:40).

This study suggests that whilst the keeping of journals might provide useful opportunity for self-reflection in other contexts, it is incongruent with the culture of teachers in the context of this study. None of the teachers kept a journal in spite of my suggestion at the first project planning meeting that we do so. I did not continue to encourage them to keep one when I realised the amount of work they had, and the time constraints which they experienced. My own daily recording of research activities (i.e fieldnotes) was also a new practice, and was difficult to achieve. Perhaps oral based ways of reflecting on activities of the research would be appropriate in this context; for example short regular meetings could be held after school or at break wherein teachers share reflective stories about their teaching.

Action research theory

With hindsight I realise that the attempt to train teachers about action research theory in the first planning meeting had a strong orientation of cultural imperialism. In my collaboration with an institute of education we attempted to train the teachers on how to 'implement' action research properly disregarding contextual factors (see Section 2.4). The process was presented enthusiastically as a new idea of empowering the teachers to be researchers; as a kind of technique that would transform the education system if implemented well. I also in my concern to implement the method correctly, engaged in an almost endless reading of action research theory (See Section 2.2).

Action research theory needs to be understood and presented to others as a theory that emerged from particular contexts in response to social problems. The emphasis that action research is a social construct that embodies certain cultural methods/features, which could be incongruent with the local conditions is essential. This could provide a basis for exploring locally existing ways which could be informed or enriched by the action research theory to facilitate a contextually appropriate, critical, self-reflective practice. From this perspective action research is not 'added' to the teachers' workload as a new set of fixed ideas.

Producing knowledge

In trying out our ideas through the action research process of planning, critically informed action and reflection, our knowledge about the meaning of environmental literacy, teaching approaches and the context of the research increased. Three forms of knowledge outlined by McTaggart (1997:36) were clearly produced in the present study in the context of clarification of the concept of environmental literacy: "knowledge developed by the workers; knowledge shared by the group; and knowledge developed by the academics" (see Section 6.3). The shared knowledge needs to also lay emphasis on the knowledge about the research method itself. If action research is seen as a process of opening up ways in which participants can enrich, sharpen, inform and further develop already existing ways of reflecting on practice, people are more likely to make sense of such a process and find ways to become more fully involved in it.

6.5.3. Conclusion

The enhanced understanding of action research in the context of this study parallels the insights I developed from my encounter with the old man in my dream (see Section 2.2): action research methodology as a slow journey, rather than a hasty process of acquiring knowledge, which is conscious and critical of social surroundings in local contexts, in order to transform them. It is a process of appropriating, enriching and reconstructing locally existing ways of critical reflection and action; as if slowing down hasty local journeys/practices. Locally existing ways of critical reflection in contexts where action research is employed need to be identified and critically engaged with during the research. A reconnaissance stage of action research could entail an investigation of local practices that could aid an informed critical action and reflection, in the context of research. This in itself constitutes an important dimension of the transformation of contexts and empowerment of the research participants.

The congruence and incongruence, between aspects of proposed models of action research in the literature and the context in which action research is employed need to be considered with care by researchers, for their appropriateness and inappropriateness. This will resolve tensions and discrepancies associated with action research as an emancipatory process in other contexts, but and as a burdensome and unworkable research model in others.

The introduction of action research to teachers should not emphasise the cyclic model of action as a method or technique to be implemented in the classroom. This can foster a technical implementation of action research. The emphasis should rather be placed on case studies of different cultural settings in which models of action research were introduced to open up processes in which the participants could empower themselves and work towards the transformation of contexts and practices. On this basis the researchers could then explore similar or different locally appropriate ways of initiating their emancipation and the transformation of their practice. Action research theory in the literature should be used to inform the participants about key principles (rather than techniques) and ways in which other educators have initiated emancipatory curriculum development processes; and care should be taken by participants not to slavishly implement the model from the literature.

6.6. REFLECTION ON THE THEORETICAL FRAMEWORK OF THE STUDY

Reflecting on how the theoretical framework, outlined in Chapter 1, informed this study, I realise that the interaction between theory and practice is a complex process in which the two influence each other. In this section I discuss some dimensions of the theoretical framework which influenced my orientations during the project.

The perspective of post-formal thinking and its concern with "other ways of knowing" (Kincheloe and Steinberg, 1993), and post-modernist (Lather, 1991; Doll, 1989) concerns with a critique of and departure from Western modernist paradigms, underpinned by scientific rationality as the basis of knowing influenced my orientation to this study greatly. They sensitised me to take the views of the teachers seriously; to listen to local voices on the subject of Lesotho's education systems and that of Machobane in particular: to perceive Sesotho as an oppressed language essential for learning, and to attempt to 'liberate' it in my write-up of the present study; and to regard my own dreams as a useful source of research insights. These local 'voices' and perspectives were useful in that they illuminated the socio-economic, cultural and political context of the present study, and clarified research situations. It was through these local voices that colonialism and its legacy emerged as an important influencing set of themes which informed and clarified my understanding of some research situations.

Further, the concept of a *holistic* view of environment (e.g EEPI, 1994; Haggis, 1991), which oriented our construction of the meaning of environmental literacy, may be associated with post-formal thinking, which is informed by post-modern perspectives. Kincheloe and Steinberg (1993:308) state that

> Post-formal thinkers recognise that relationships, not discrete objects, should be the basis of definition of science and humanities. From this perspective the physical and the social worlds are seen as dynamic webs of interconnected components. None of the parts of the webs are fundamental, for they follow the dance of their relationship with the other parts. The nature of their interconnections shapes the form the larger web takes. The educational implications of such a realisation are revolutionary. The uncovering and interpretation of the dance becomes a central concern of teachers and students.

They further associate a fragmented disciplinary-based teaching with modernism:

> Post-formality assumes the role of the outlaw, as it points out modernism's tendency to fragment the world. Indeed, post-formality recognizes none of the official boundaries that define our separateness. (ibid: 310)

I interpreted the *integration* of disciplines as a form of holism and traced its existence in the context of the science curriculum to the early 1970s in Lesotho (see Section 1.5.2). Kincheloe and Steinberg argue that "*holism* implies that a phenomenon can't be understood by reducing it to smaller units; it can be appreciated only by viewing it as ... an *integrated* whole" (Emphasis added) (ibid:313).

As mentioned above, a holistic view of environment as characterised by the interconnectedness of the economic, social, biophysical and cultural dimensions strongly oriented me in developing the meaning of environmental literacy. I stressed this perspective at the first sessions on clarifying the meaning of environmental literacy (see Section 4.2.1) and in the research proposal that I shared with the teachers.

Moreover, the research team's engagement in the process of reconstructing the meaning of environmental literacy represents a shift from the subordinate position of teachers as mere implementers of predefined decontextualised concepts to one of being developers of conceptual meaning. From this perspective, the research process can be seen as break from dependence on Western-rooted curricula concepts to the contextualisation of knowledge through a locally-based process of co-construction of conceptualise meaning (see Cochrane, 1996:4; Stevenson, 1997; West, 1993).

However, whilst we developed some contextual insights and understandings we did not draw on our merging broad understandings of environmental literacy to interrogate and expand the boundaries of the established science paradigm[9] in classroom teaching. This is exemplified by the teachers' reluctance or failure to 'tamper' with the science discipline by drawing 'politics' into the classroom (see, e.g., Sections 3.4.3), and retrospectively, my own failure to propose the exploration of indigenous knowledge. Thus, whilst the process of contextualisation of

[9] Thomas Kuhn (1922-1996) has used the concept in many ways in *The Structure of Scientific Revolutions*.. It is here used to mean a 'disciplinary matrix' - commitment, beliefs, values, methods, outlooks, etc., shared across a discipline (see Schwandt, 1997).

concept meaning in the study may be described as 'conceptually developmental' (that is, developed the concept of environmental literacy), it was not 'transformative'.

Whilst I found the orientation to be "gut-wrechingly critical about the social surroundings" (Kanpol, 1996:112), from the perspective of critical pedagogy and liberation theology, appropriate for this study, it was never reflected in the classroom context. However, my polemical publications during the research process, *It is rubbish to say that environment is just about rubbish*, which I subsequently shared with the team members, reflected a critical perspective of my social surroundings during the period of the project. In this publication I attributed Lesotho's environmental problems to the irrelevance of the education system and criticised those in positions of power for focusing on trivial environmental matters (e.g. emphasising littering as an environmental issue of national importance) rather than on root causes of environmental problems. Kanpol's (1996) perspective of critical educators seems to be appropriate for those who teach for environmental literacy in Lesotho. Drawing on Heschel, Kanpol sees critical educators as those who are "intent on intensifying responsibility, is impatient of excuse, contemptuous of pretence ... his words are often slashing, even horrid - designed to shock rather than edify....The prophet is concerned with wrenching one's conscience from the state of suspended animation". It seems appropriate that teachers should play this critical role to develop students' critical awareness of environmental issues. This perspective is in line with Firth's (1996:21) understanding of the role of environmental educators' in their engagement with critical pedagogy in the classroom: 'socially critical' teaching approach "foregrounds for young people the relationship among knowledge, authority and power in the generation of knowledge". In this context, such a role might well involve exploring and making apparent the intentions of those in authority in, for example, focusing people on 'petty' environmental problems (e.g. littering) rather than on the root causes of environmental problems.

The process of generating local knowledge through participatory action research informed by the perspectives of contextual theologies (e.g. Cochrane, 1996) and socially critical theories (e.g. see Bacchus, 1990; Greenall Gough and Robottom, 1993 and Lather, 1986 in Section 1.3) has sensitised me to the contextual and socio-political nature of school curricula in Lesotho. It now seems to me essential that curriculum developers in Lesotho critically engage

with imported (Western) curriculum knowledge and theories in adapting them to Lesotho. Further, critical theories (e.g. Bacchus, 1990; Firth, 1996) have oriented me to attempt to critically understand, during the research and since, the colonial roots of the school curricula in Lesotho in terms of the relations of dominance, submission and control and to continue to question the appropriateness of the present reliance of educators in Lesotho on predefined Western curricula and conceptual meanings.

The constructivist assumption that the teacher can easily "facilitate" the construction of students' knowledge by interfacing new information from the disciplines with students' understandings and experiences (e.g. Kincheloe and Steinberg, 1993:301) through student-centred, interactive methods and negotiation of meaning with them (e.g. Bodner, 1986; Bodner *et al*; 1997), was problematic in this study. The engagement of students in interactive processes of learning (e.g. group discussions) was inhibited by their inability to express themselves well in English. The large class sizes also seemed to subvert student-centred teaching methods: not all students had the opportunity to 'negotiate' concept meanings with the teacher during a lesson, and the teachers' attempts to involve and interact with more than 40 students in a lesson were problematic (e.g. in Map's class a lesson became long and monotonous, while my own experience as a guest speaker bears this out). It can be argued that these contextual factors may encourage science teachers to attempt to 'transmit' knowledge through teacher-centred strategies rather than collaboratively construct shared understandings with students. Moreover, it became evident that small-group work, where in theory all students enjoy the opportunity to participate in the learning process, could not provide all students with access to meaningful learning due to the students' inability to engage in discussion. Whilst small group work does seem to hold much potential for students' active participation in the process of learning, this method needs to be developed through further research. Such research should take into account teacher training in group work, students' use of English and Sesotho during discussions, and students' constructive participation. Based on the findings of this study and the impressions I developed when English was used as a medium of instruction in the classroom, Sesotho seems to be an appropriate language of instruction through which students can better communicate in discussions and construct understandings about their local environments.

To conclude, whilst the team had not developed a 'definition' of environmental literary, nor 'effective' teaching methods for the development of the concept by the end of the project, the research team's engagement with a reflective process of action research developed their insights and understandings about the what environmental literacy and the teaching of science to develop environmental literacy in the classroom could mean (and not mean) in this context. This process encountered the research team with contextual constraints of teaching and learning, and the colonial legacy in which they were rooted: for example, it became apparent that the use of English in the classroom inhibited students' to communicate and learn, that the crowded classroom conditions were inappropriate for students active involvement in the learning, and the examination driven curriculum characterised by predetermined content made it difficult to try new ways of teaching.

These contextual constraints have crystallised the need to transform the education system to make schools more appropriate for the development of students' environmental literacy. Curriculum developers in this context need to consider a shift from the present curriculum development model to a more participatory curriculum development model(s), such as the participatory action research employed in this study: whilst our engagement with/in this method was not without limitations (e.g. the teachers' reluctance to engage in reflection), the method had the potential to allow for the clarification of local understandings of environmental literacy, and to develop the our insights about appropriate teaching method for the development of students' environmental literacy.

Finally, it seems appropriate that educators with an interest in environmental education in Lesotho should explore ways of establishing and expanding networks of groups of interested educators (teachers, lecturers, researchers. etc.) to engage in participatory research projects to transform the education system in Lesotho so as to contribute better towards sustainable living and development. In the present study, Lesotho Educational Research Association was mentioned by some teachers with an interest in environmental education research as an association within which such a network might begin; there was also the perception that the association was for lecturers only (see Section 5.4). It is, therefore, important that divisive tensions stemming from the apparent stratification of educators into 'lecturers', 'teachers' and 'researchers' be anticipated, acknowledged and dealt with appropriately if such collective

initiatives are to be a success. The association members could for example, achieve this by continually reflecting on and being open about experienced tensions and resolving them through discussion; and exploring new unifying labels for their profession roles, e.g. 'educators'.

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APPENDIX 1

P.O. Box 87
Maseru, 100
23-10-95

Dear.....

PROJECT ON THE TEACHING OF JUNIOR SCIENCE

We are so glad you are going to be part of the research team. We hope you will find it challenging and enjoyable.

We would like to hold a two-day workshop for all the members on Friday and Saturday, August....., at the Masianokeng Environmental Centre. We have attached a draft programme.

This will be a very important meeting at which we shall bring our ideas together and collectively plan the first phase of the project. So if the dates are not suitable for you, please let us know immediately and we will change them.

We have enclosed the following documents in order to enlighten you more about the project:

1. Copy of a research proposal. This proposal serves as a basis for the project. However should you have any suggestions, they will be accommodated provided they are within the framework of the proposal.

2. A paper titled 'Action Research: field perspective' by Patricia Wood, 1988.

We hope that you will begin to see that the adoption of "Action-Research" in this project implies that the research team will control what happens.

We do not want to influence the way you teach. Our objective is to help you find out what is effective in the context of Lesotho classrooms for achieving the aims you set.

In similar vain we are not looking for a "model way of teaching". We don't believe there is such a thing, we are rather interested in sharing ideas about teaching that can work for us. Moreover the project is not designed as an "experiment" to prove or disprove a theory, but as a "case-study" to generate new hypotheses.

In short the aim of the project is to offer you opportunity to try out, with support form each other, some of your ideas, and to reflect together upon them. We assume that there are things you would like to change in your classroom": We can jointly work out how we can go about this at the 2-day workshop. Using action research technique, we will together explore aspects of your teaching, and your pupils learning, that you see as significant, and to monitor what happens in your classroom.

We are not looking for specific "results" about how to teach; rather we are interested in the processes of teaching/learning, and how these may be influenced by various factors (some of which are under teacher control).

We hope that the end-product of this project will be new ideas about teaching Junior Science. Perhaps the team will be able to generate hypotheses about teaching and learning. These can then be tested out in a later cycle of action research (in 1996), by yourselves. Such potential theory grounded in experience, may be of more use to teachers in Lesotho, than theoretical models imported from abroad. We shall, however, review literature on the existing teaching/learning theories and philosophies - we will make available this literature to you. You should bear in mind, however, that our main focus is to try to formulate our own generalisations that are based on reflection and analysis of our own problems and practice in teaching Junior Science. Our role is to facilitate your doing this, not to impose any pre-conceived idea of our own.

Please try to do the following before August.....

1. Read the enclosed articles and make critical notes and questions.
2. Jot down a few ideas to use under the headings given for the morning Session of Friday, August ....

We look forward to seeing you there, and to working with you over the next 6-8 months.

Regards,

Tšepo Mokuku

APPENDIX 2

Team Effectiveness Questionnaire — Task

Directions: Place a check mark along each line (scale), showing where you would rate you team. Discuss your reactions with your team. Where there are differences, try to clarify what you need to do to help the team work better.

Task Functions

1. How clear are the **goals** of this team?

0	1	2	3	4	5	6	7
Utter confusion		Clear to a few		Fairly clear to most now		Clear focus, shared by all.	

2. How strongly **involved** do we feel in what this team is doing?

0	1	2	3	4	5	6	7
Couldn't care less		Not much interest		Interested		Deeply involved	

3. How well do we **diagnose** our team problems?

0	1	2	3	4	5	6	7
Avoid, pretend they do not exist		Slight attention		Considerable attention		Face frankly, analyse with care.	

4. How appropriate are our ways of working and **procedures** for our team goals?

0	1	2	3	4	5	6	7
Defeating our purpose		Not much help		Often seem useful		The best possible means to our ends	

5. How well do we **integrate** contributions from various members?

0	1	2	3	4	5	6	7
Each goes it alone, disregards others, no summary or integration		Slight attention to others' ideas		Considerable attention to using ideas of others		Each speaks, builds directly on others' points	

6. How do we usually make **decisions?**

0	1	2	3	4	5	6	7
We do not	One person's silence taken as consent	Two people	Minority	Majority	Pressured agreement	True consensus	

7. How fully do we use the **resources** and creatively of our members for accomplishing goals?

0	1	2	3	4	5	6	7
No one contributes freely, resources unused		Only a few contribute		Most members contribute a great deal		Everyone contributes fully and creatively	

APPENDIX 3

A Suggested Approach of teaching Junior Science with an environmental perspective

Topic: eg Observation (Form 1)				
The connection between the topic and the local environment.	The environmental problems/issues in the local community and (science) topic.	Sources of information on the topic & the related E. issue/problem	Suggested teaching strategies	Solving environmental problems related to the topic
-How is the topic related with the economic, social, cultural, political and the biophysical aspects of life? (eg Pollution: students use their senses to identify pollution in the local environment)	-what/who are the causes of the environmental problem(s)? -who is affected by the environmental problem(s)? -how serious are/is the problem(s)?	-the victims of E. problems -those identified as responsible for E. problems -institutions involved in the study/solution of E. Problems -students	-interviews (with those listed under column 3), field-trips, excursions, discussion, Debate, Bulletin board, Guest speaker, Relevant literature, Role-play and simulation, Group work, quizzes, construction of concept maps, newspapers/ magazines	-action research strategy (leading to contact with the people associated with the E. issue).

APPENDIX 4

PUPILS' QUESTIONNAIRE

We would like to know your views about the trip to the dam. Your views will help your teacher know how to organise similar trips better, in the future.

We realise that, if you remain anonymous you will be free to say all that you feel and think. So, DO NOT WRITE YOUR NAME ON THIS QUESTIONNAIRE.

SEX:.....
AGE:.....

1. Did you like the visit to the dam?

.....

2. What did you like about the visit? Why?

.....

3. What did you not like about the visit? Why?

.....

4. Did you learn anything new? Explain.

.....

5. Were you surprised by anything? Explain.

.....

6. What would you suggest your teacher should do, next time you have a similar trip?

.....

7. What would you suggest your teacher should not do next time you have a similar trip?

.....

8. Boys were grouped from girls during the discussion. Why was this?

.....

9. Would you like to have more similar trips? Why, or why not?

.....

10. Do you think that this dam is important? Yes/ No.

If yes, how is it important?

.....

APPENDIX 5

STUDENTS' INTERVIEW

Lebaka leo ke le bitsitseng ka lona ke hore, ke tlo fumana maikutlo a lona mabapi le hore na tichere ea lona e le rute ka tsela efe, e tla etsa hore le utluisise le ho rata science. Le bue sohle seo le batlang ho se bua, ke tla fitisa maikutlo a lona ke sare "nyeo o itse...." kapa "mang mang o itse...".

Ke le kopa hore, ho tle ho buoe a le mong ka nako. Hape le bue haholo.

1. Le ile la utloa ho le joang ha tichere a re le ilo kha metsi letamong?
2. Na batho ba bangata ba sebelisa letamo leō u khileng metsi ho lona?
3. Le bone melemo ea hotla le metsi a tsoang letamong e le o fe?
4. Ha le bona ke hobaneng tichere a ne a sa re le sebelise metsi a tsoang pompong?
5. Ha ho thoe "pond water is polluted" ho boleloang?
6. Na le bona ho hlokahala hore metsi a letamo a se ke a ba "polluted"? Hobaneng?
7. Lintho tse entseng "pollute" metsi a letano leo u khileng metsi ho lona haholo ke life? Ha u nahana tse ling ke li feng, tseo u sa li bonang?
8. Le bona e ka ha motho a ka etsa "board " e kholo e nang le molaetsa (mohlomomg o tsoanang le oo le o ngotseng "lipostareng" tsa lona) eaba o e hloma pela letamo, e ka thibela batho ho ts'ilafatsa letamo leo?
9. Ke mang ea ratang ho ka etsa joalo, ha a ka fumana lintho tse ka etsang "board"?

APPENDIX 6

Students' Interview Responses on Littering

QUESTION	RESPONSE/COMMENT	REASON
How do you feel about students who throw paper, tins, bottles, rubbish, plastics on school grounds?	- I feel bad. (2) - Ke e ke utloe hole hobe *(I feel bad)*. (2)	they "pollute". (2) ba baka bohlasoa *(They cause untidiness)*. (2)
Do you sometimes throw rubbish on school grounds?	Sometimes. (4)	We play far from dustbins. (1). Ha re na kuitlisiso *(We lack undertanding)*. (1) Ha ke tsebe hore na ke hobaneng (*I don't know why)*. (1). We are not told to use the dustbin at home. (1). Re be re tsoafa ho lahlela ka dustbining *(we are lazy to throw into the dustbin)*. (1)
What do you suggest people should do with tins, bottles, papers that they don't need?	- Throw them into dustbins (1) - Notice board must be used. (1) - We should have dustbins in class (2). - We should have dustbins in the villages. (1). - Take litter to the dustbin even if its very far (1).	- Should stop polluting (1) - Notice board should remind people not to litter (1). - There is no dustbin in our class (1). - The presently used paper boxes get torn easily (1). Re seke ra baka bohlasoa *(so that we do not cause untidiness)* (1). - -
What do you think your class can do so that we cannot see any more paper, plastics and tins all over.	- Collect the papers (2) and burn it (1). - Maseru City Council should give us plastic bags to collect rubbish (1). - Our class representative should speak to other student about litter at the Assembly. (2) - Must use dust - bins. When they are full, the rubbish must be burned (1).	- We have done this before with Maseru City Council before (1). - - - Other students should listen (1) - -
I understand student are always told NOT to throw rubbish on school grounds, but they continue to do so. How can this problem be solved?	- Those who litter must be punished (3).	- Punishment will make them understand what is meant by not throwing rubbish (1).
Do you think you have enough dustbins at school?	- Yes (3) - No (2)	- - In our classroom there are dustbins (1).

NB: English translations in Parenthesis and in Italics.
Key:
-- reasons not provided because, the student was not asked or probed to provide one.

APPENDIX 7

Students Group Reports: The advantages and disadvantages of electricity on environment

Advantages of Electricity	Disadvantages of Electricity
Group1 report • It gives us light and heat • helps us to cook and iron • used for electric machines eg typing, washing.	**Group1 report** • electric shock and death if used carelessly • short circuit can burn the house
Group2 report • electricity takes a shorter time than using a prima-stove. E.g. when ironing and washing our clothes.	**Group2 report** • It can be dangerous and may sometimes burn houses.
Group3 report • electricity helps us to cook better than a prima-stove. • Prima-stove makes our pots black and electricity doesn't • electricity lights up the streets at night, and we can see strangers who may strangle us.	**Group3 report** It uses a lot of money
Group4 report • 'when lighting with electricity it helps us to pay at the end of the month'. • 'When ironing with electricity we don't need more fuel for heating the iron'. • 'electricity helps people to light inside and outside their houses'	**Group4 report** • It can burn clothes when ironing. • 'ironing charges a cost'.
Group5 report • electricity helps light easier that using gases. • the light help us see at night • It helps to heat water	**Group5 report** • It may hurt us if not used carefully • useful when cleaning water in the reservoir.

NB. The quotations marks in the table indicate students' exact words. These are used especially when the meaning of students' sentences may not be very clear. Even where quotation marks are not used, students own words have largely been used, to retain original meaning.

Continuation of Appendix 7

Advantages of Electricity	Disadvantages of Electricity
Group6 report • It helps us cook faster than using paraffin-stove. • It helps in generating machines in big factories.	**Group6 report** • It's too expensive to pay
Group7 report • It gives people light so that they can see clearly at night. • It helps people to cook faster • It helps to iron our clothes	**Group7 report** • sometimes it is dangerous to use electricity. • May be dangerous for people who do not know how to use it. • People spend lots of their money paying for electricity. • You might get a shock if you touch electricity with wet hands.
Group8 report • It helps boil water. • It gives us bright lights. • It gives us warmth in winter. • It helps us to cook and iron.	**Group8 report** • It is expensive. • Sometimes it is dangerous it is dangerous if you touch the plug with water. • It is expensive.
Group9 report • It helps us when boiling water • It faster than prima-stove	**Group9 reports** • accidents caused by electric trains.
Group10 report • It is better to use electricity than batteries for a radio. • It helps in the use of lifts fitted in tall building. • It helps in boiling water to kill the germs.	**Group10 report** • If more electricity is used in the radio, it will damage the radio.

NB. The quotations marks in the table indicate students' exact words. These are used especially when the meaning of students' sentences may not be very clear. Even where quotation marks are not used, students own words have largely been used, to retain original meaning.

APPENDIX 8

Personal Preparation Notes

Class: Form C2.

Sections of the syllabus on which to prepare the lessons: PC3-PC4 on pages 53-54. These sections could be linked with BC11 on page 18, and others.
(Discussion: Mon. at 2:30).

Electrical Energy (Pc3)

Relate to other forms of energy used in Lesotho: use of coal, solar energy, firewood etc.
Some advantages of using Electricity: does not cause air pollution (Air pollution: as a result of chemical reaction of Carbon in Coal/wood with oxygen giving off carbon dioxide into the atmosphere).
Problems associated with the use of electricity:

- If it is generated from water in a river/dam, the temp. of water increases, and this disturbs the organisms living in the water. (Consider the LHDA).
- If is generated from coal: as in Sasolburg (SA), caused air pollution-the pollutants from the coal power stations in South Africa, are reported to reach Lesotho and other neighbouring countries (IUCN, 1994). Consider air pollution and health/respiratory diseases (and global warming).
- Expensive: those who cannot afford electricity, use the cheaper sources of energy (eg coal) which pollute the environment.

Students activity: How much do you know about your city Maseru?

- where does electricity used in Maseru come from?
- which places have electricity and which places don't? Name them.
- what can you say about the people who live in these places?
- in places where there is no electricity what do people use for cooking and light?
- what are the advantages of using electricity for cooking and lighting over other energy sources?
- when do you see a lot of smoke in the air in Maseru? How can this be prevented?

Radiant Energy (Pc4)

Solar energy is an alternative for air polluting sources of energy.
Advantages and disadvantages: (invite a guest speaker from the ministry).
Students may prepare questions to ask the guest. The following may be included:

- who is presently using this form of energy?
- is the installation of solar system affordable?
- will solar energy solve the problem of air pollution in Maseru? Under what conditions is this possible?

APPENDIX 9

Pupils Questionnaire

This questionnaire is not a test. Your answers will help us know how guest speakers may teach you better.

Please answer all the questions very carefully and accurately.

We realise that, if you remain anonymous you will be free to say all that you feel and think. So, DO NOT WRITE YOUR NAME ON THIS QUESTIONNAIRE.

SEX:.....

AGE:.....

1. Did you like the presentation on solar energy?

Yes	No	Not Sure

Why, or why not?

.....

2. Did the guest speaker say anything you liked or that interested you?

Yes	No	Not Sure

Explain:

.....

3. Did the guest speaker say anything that you did not like?

Yes	No	Not Sure

Explain:

.....

4. The information presented by the guest was related to what I was taught by my science teacher.

Yes	No	Not Sure

If yes, how was it related?

.....

5. The information presented by the guest is relevant to my daily life.

Yes	No	Not Sure

If yes, how is the information relevant:

.....

6. I am going to ask my parents to install solar energy at home:

Yes	No	Not Sure

Explain.

.....

7. It is my responsibility to pass the information about solar energy to other people:

Yes	No	Not Sure

Why do you think so?

.....

8. Did you ask the guest any question(s)?

Yes	No

Why or why not?

.....

If you asked the guest a question, what did you ask her?

.....

Were you satisfied with the answer(s) that she gave you?

.....

9. Would you like to see guest speakers coming to your class regularly?

Yes	No	Not Sure

Why do you think so?

.....

10. Would like the guest speakers to speak in Sesotho?

Yes	No	Not Sure

Why do you think so?

.....

11. Which topics would you like the guest speakers to come to talk about?

.....

12. If there is anything else you would like to tell to your teacher about the presentation on solar energy write it below?

.....

13. What source of energy do you use at home for:
heating?.....
lighting?.....
cooking?.....
heating water.....

APPENDIX 10

A Questionnaire For The Guest

Sex.....

Please answer all the questions very carefully and accurately.
Your answers will help us know how guest speakers may teach better.

[DO NOT WRITE YOUR NAME ON THIS QUESTIONNAIRE]

.....

1. Did you like the presentation on solar energy?

Yes	No	Not Sure

Why?
.....

2. Did you like the students?

Yes	No	Not Sure

Why?
.....

3. The information I presented is relevant to students' daily.

Yes	No	Not Sure

If yes, how is the information relevant:
.....

4. I encouraged students to ask their parents to install solar energy at home:

Yes	No	Not Sure

How?
.....

5. Students can play an important role in transmitting information about solar energy to

other people:

Yes	No	Not Sure

Why do you think so?

.....

6. The students participated well during the presentation.

Yes	No	Not Sure

Why do you think so?

.....

7. Would you like to visit more schools?

Yes	No	Not Sure

Why do you think so?

.....

8. Would you like to speak in Sesotho in your future presentations?

Yes	No	Not Sure

Why do you think so?

.....

9. If there is anything else you would like to tell the Maseru High school science teacher about the presentation on solar energy write it below?

.....

APPENDIX 11

HOW CAN THE TEACHING OF JUNIOR SCIENCE SOLVE LESOTHO'S ENVIRONMENTAL PROBLEMS

There are several factors which a person must first consider and within these factors, lie a number of options. The "factors" remain constant. but the "options" are variable.

The "factors" are constant because humanity is constant and it is humanity that causes the environmental problems that we face today. We, as teachers, and we as school Administrators have a number of options open to us to correct the deficiencies caused by past human errors and/or neglect to establish a course of action for our students- who are the beneficiaries of our efforts. We not only hold the "options" to correct the past neglect and the past mistakes that humanity has made, but we also have opportunities to correct these imbalances.

Firstly, we must address a captive audience. These would be our students. When we have the attention of our "captive" and attentive audience, we must then determine exactly what are the Environmental Issues that we face as individuals and that we face collectively as a nation.

The best approach to this is to find out what issues are close to or are "dear" to the hearts of the students. What are they truly concerned about concerning the Environmental Issues in Lesotho? Students have to realise that the future of this country and the future of their families and these issues are now squarely on their shoulders. They are the mechanism to deal with these problems and their reaction or action taken by them beginning now will determine how these problems will be solved.

To assist our students how to address these problems, they must personally and collectively become involved in recognising the problems of the Environment and then become involved in the "Problem Processing" of these issues.

Some suggestions along these line are:

1. The school Administrators should establish or set aside one week which could be (school name) Environmental week. Within this week, one day should be established where all our scientific emphasis would be placed upon the issues of Environment and how emphasis would be placed upon the issued environment and how it affects the individual, the home, the community and the nation.

There again individual responsibility should be stressed.

2. Classroom participation then should be exercised after the establishment of Item 1 above.

The students may have their own ideas of what Environmental Issues are important to each one as an individual. Some of these issues may be:

a) Water problems
b) Rubbish problems
c) Air problems
d) Ugly sights (wrecked autos, abandoned vehicles, etc.)
e) Energy problems
f) Population explosion

This list is not conclusive as there may be others that the students themselves may have and that they are concerned about.

The teachers and the students then should establish ONE item that could be worked on as a class project. Each student should be required to make notes as at the end, a history of their activities should be written as an essay with recommendations from each student on how he or she would correct or solve the problem.

Classroom activities should include a tour or visit to one of the specified "sites" or Ministries for a direct consultation with the Activity or Ministry on the issues. Questions and Answer session should be encouraged. Again each student would be required to take notes as these issues would then be discussed in detail upon returning to the classroom. In the respect of the classroom discussion, each student should be encouraged to implement a plan whereby individual and collective (all students) participation would help in eliminating Environmental Problems.

Some suggestions that would be advisable would be for the entire class to tour the water/sewage plant and Ministry and see first hand what are the problems in purifying our water. A project of cleaning the filth on the streets and the rubbish and the scum from the dam could be undertaken.

The rubbish problem is definately one that should be corrected. It should be established that the "rubbish" scene in Lesotho is not only an ugly sight to the Basotho people but certainly doesn't leave a good impression with the tourist industry. In this respect the problem of rubbish, abandoned vehicles and wrecked vehicles could be discussed and ways of ridding the country-side of these unsightly objects could be discussed. (filling of dongas etc)

Air Pollution:
Attention could and should be brought to the attention of the problems encountered by breathing or inhaling of smoke, coal burning units such as at 60 Minutes Cleaners, exhaust from the thousands of vehicles that are being added to our roads daily and other related situations.

Energy:
Alternative energy sources and how to implement the programs concerning renewable energy. (Solar systems, Water tanks on or for each residence etc.) For this, experts in the field could be brought into the classroom and speak to the class and also "Field

Trips" by the entire class could be taken for one day to a site or sites that are now in this business to see first hand how "energy" in a specific field works.

Population Explosion:
Again, Experts from the pertinent Ministries could be asked to present an hour's "discourse" to the entire school on the subject (Planned Parenthood, Ministry of health, Doctors etc.)

Students may also have some input into these items and certainly should be encouraged to make or offer suggestions on these and other items of interest.

The school should make transportation available either through Goverment Transport or Private Transport. Students should be informed to bring their own lunch and drinks and NOT TO LITTER THE SITE OR AREA THEY ARE VISITING.

With cooperation from the school Administrators, students and the various Agencies and Organisations, the students would surely learn how to be more responsible and it would also give them a "sense of pride" of belonging to and attending such a school that would implement programs of this nature.

Do not forget to alert the media (i.e. newspapers; radio, TV) about what the school is doing.

Limpho