

**ENVIRONMENTAL EDUCATION CASE STUDIES FOR CURRICULUM
DEVELOPMENT IN SCIENCE TEACHER EDUCATION**

THESIS

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by

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DECLARATION

It is hereby declared that this dissertation is my own work, and has not been submitted for any degree in any university. All the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

Ally

Alan S Pillay

ABSTRACT

ENVIRONMENTAL EDUCATION CASE STUDIES FOR CURRICULUM DEVELOPMENT IN SCIENCE TEACHER EDUCATION

Science student teachers' participation with practising teachers in developing curriculum in environmental education for implementation in schools has been a neglected field. This study focuses on the collaboration of science student teachers with practising teachers in developing an alternative curriculum for environmental education compared to existing traditional practices in most schools in South Africa. The science teacher educator, as the researcher, used action research or elements of it to facilitate the process. The action research component served as an inquiry into, and improvement of, the PRESET/INSET curriculum development model for teacher development.

This dissertation reports on four case studies of curriculum development and environmental education in science teacher education practised at the University of Durban-Westville from 1991 to 1996. Innovative strategies serve as the basis of interventions in four primary school contexts, each representing a case study on its own, yet sequentially linked as action research cycles. The case study approach served the purpose of illuminating the curriculum development process with the intention of generating grounded theory through action research or elements of it. The outcomes of a survey of the status of curriculum development in institutions offering science teacher education in KwaZulu-Natal are also presented to support the need for an innovative approach to the PRESET/INSET curriculum development model.

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TO.....

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

- ANC - African National Congress
- BEd - Bachelor of Education Degree
- BPaed - Bachelor of Paedagogics
- BSCS - Biological Sciences Curriculum Study
- COTEP - Colleges of Teacher Education Policy
- CASME - Centre for the Advancement of Science and Maths Education
- DET - Department of Education and Training
- DEC - Department of Education and Culture
- GREEN - Global Rivers Environmental Education Network
- HDE - Higher Diploma in Education
- HOD - House of Delegates
- HOR - House of Representatives
- INSET - Inservice Education and Training
- MEd - Master of Education
- NQF - National Qualifications Framework
- NEPI - National Education Policy Initiative
- NGO - Non-Governmental Organization
- PRESET - Preservice Education and Training
- PSP - Primary Science Project
- RDDA - Research, Development, Dissemination and Adoption
- SEP - Science Education Project
- SEDP - Science Education Development Project
- USA - United States of America
- UK - United Kingdom

CHAPTER ONE

INTRODUCING THE STUDY

1.1 Introduction

Science student teachers' participation with practising teachers in developing curriculum in environmental education for implementation in schools has been a neglected field. This study focuses on the collaboration of science student teachers with practising teachers in schools. My science student teachers and I used action research or elements of it to engage with practising teachers in developing an alternative curriculum for environmental education compared to existing traditional practices in most South African schools. The action research component served as an inquiry into and improvement of the PRESET/INSET curriculum development model. In this dissertation I therefore report on case studies of curriculum development and environmental education in science teacher education practised at the University of Durban-Westville from 1991 to 1996. I will hereafter use the terms "students" and "student science teachers" synonymously. The use of the terms "practising teachers" and "teachers" will pertain to school-based practitioners.

The purpose of this chapter is to provide the rationale for the study, define the research in terms of the research problem and the research questions, outline the role of action research as a response to the research problem, describe the context of the study, and discuss the scope and limitations of the study. It also gives an overview of the dissertation, which includes the proposed relationship of Chapter 1 with the proceeding chapters.

1.2 The rationale for the study

Current national education policy developments in South Africa are based on a consensus that an outcomes-based approach to curriculum be employed, because it empowers teachers to play an active role as curriculum developers (NCDC, 1996). This policy development forms the basis of two assumptions:

- a) Science teachers have tended to implement curricula as given to them and to an extent in isolation from each another and from outside influences. They appear to lack the skills, the will, the opportunity and the means by which they can develop curriculum which breaks this isolation. Their preservice teacher education institutions have largely disciplined them to function as curriculum implementers.

The problems inherent in such an approach need to be addressed by institutions of teacher education so that teachers will be able to relate to educational changes in South Africa following a new political dispensation. Most of these institutions, therefore, need to restructure their programmes for initial teacher education (PRESET) by seeking and attempting innovative strategies to empower teachers to function and perform as reflective practitioners. Competent curriculum development skills are required to be developed by students in collaboration with their peers during PRESET, and also with and among teachers during INSET. This would enable them to be equipped to engage with the challenges of a new educational policy

aimed at eradicating traditional practices which are teacher-centred. Teacher development through a PRESET/INSET curriculum development model may serve to enable such a process so that the gap between student teachers and practising teachers could be narrowed.

- b) Science teachers have worked in isolation from one another due to a prescriptive system of education which implemented curricula in the form of subjects which were strictly discipline bound. Such a system did not provide for, or encourage, scope for integration across subjects. Breaking the boundaries between disciplines in an integrated approach to curriculum development becomes a necessary responsibility for teachers. Such an approach may encourage teachers to work together in planning alternative curricula which become more significant to the life-world of the child.

There are several innovative approaches or strategies which can be used to support such an integrated approach to curriculum development in the context of a primary school:

- a) Participatory, collaborative curriculum development with student science teachers, science teacher educators, and science teachers which is focused in the context of a primary school.
- b) Cross-curricular curriculum development involving other teachers and subjects in the school.
- c) Environmental education which provides important common ground ✓

relating to cross-curricular issues and community involvement and which makes it easier to develop an alternative curriculum.

- d) Community problem solving which both links learning to the community and can be set in the environment where many community problems lie (Wals et al, 1992).
- e) Provision of the opportunity for both serving science teachers and student science teachers to draw on one another's strengths.
- f) Action research, or elements of it, which obliges the participants to monitor and reflect on their practices, thus enabling them to constantly assess, modify, and redesign processes.

Such innovative strategies are designed to facilitate a process which shifts teachers, through a school-focused preservice/in-service intervention, out of the mode of functioning simply as curriculum implementers to one of functioning as curriculum developers.

The case study approach subscribed to in this research serves the purpose of illuminating the curriculum development process with the intention of generating grounded theory through action research or elements of it. The innovative strategies, referred to above, will be the basis of interventions reported as a descriptive analysis in four primary school contexts, each representing a case study on its own, yet sequentially linked.

1.3 The research problem and the main research questions

The Faculty of Education at the University of Durban-Westville offers a four year Bachelor of Paedagogics degree (B.Paed), a one year post-graduate diploma in education (Higher Diploma in Education or HDE), Bachelor of Education (B.Ed), and a Master of Education Degree (M.Ed). The latter is offered through coursework and dissertation or through dissertation only. Science Education is offered as a three year major course in the B.Paed degree. The major in Science Education may be coupled with a major in any one of a number of courses: English, Zulu, Mathematics Education, Geography, History, and a few others such as Integrated Arts Education. All students studying for the B.Paed degree enrol for a third major, viz., Education 3, during their fourth year of study. It is in this fourth year that they complete a compulsory six week school-based teaching practice session as part of a national norm for certification. They are also involved in two week observation periods in schools early in the second and third years which serve as a focus for campus-based teaching practice comprising discussions and workshops.

Curriculum development practices in the Science Education Division of the Faculty of Education at the University of Durban-Westville have been reviewed regularly over a period of ten years (from 1980 to 1990). Prior to this period (and my appointment as a science teacher educator) the formal process of curriculum development, as part of the courses offered, was embryonic in nature. Discussions with my colleagues Naidoo and Brookes (1991) confirmed that the first attempts at such curriculum development

were confined to the lecture rooms of the Faculty. This was the first stage of curriculum development (i.e., prior to 1980) in the Science Education Division. Students were encouraged to develop curriculum materials related to a topic or topics selected from the primary school science syllabus. This exposure to curriculum development did not meet expectations, viz., that, as teachers, these students would continue the process. It appeared to the science teacher educators, upon reflection, that the lack of opportunity for implementing the curriculum materials in a school context during the preservice education of the students could be attributed to the lack of carry-over into schools. It was also apparent that the teachers, with whom our students worked on entering the teaching profession after completion of their preservice education, did not have appropriate curriculum development skills. This was attributed to a lack of exposure to adequate curriculum development practices during their preservice teacher education programme.

An amendment to the process of curriculum development was deemed necessary. As the second stage of curriculum development (1980 to 1990) in the Science Education Division, it was decided by the science teacher educators that the students adopt a strategy of developing curriculum materials with a view to implementing these in a school context after obtaining consent from the teachers concerned. It was observed, after negotiating such a process with the school, that the teachers failed to participate in the teaching during implementation, leaving the work entirely to the students. They requested that the students return to their school

the following year to implement a similar process.

An analysis of these events by the science teacher educators showed that the science teachers felt disempowered due to a lack of curriculum development skills. This tendency on the part of the teachers to depend on outside intervention compelled the science teacher educators to grapple with the following **research problem** which is posed as a series of questions: Can the process of curriculum development for student science teacher education be transferred to the reality site of the school to enable the student science teachers to collaborate with practising teachers in developing an alternative curriculum? Would such collaboration promote the transfer of curriculum development skills to the teachers in a developmental process? Can this process be viewed as a school-focused INSET strategy to compensate for the lack of curriculum development training in the teachers' PRESET education obtained from institutions of tertiary education in South Africa?

It was felt that the students would benefit from the reality site intervention as aspirant teachers and as curriculum developers by acquiring the skills of collaboration in a new context while still being engaged in their pre-service education.

The stated problem gave rise to the following specific **research questions**, which evolved as the research progressed and are presented in that order:

1. What role does action research play in the implementation of participatory, collaborative strategies and the illumination

- of the curriculum development process?
2. What is the current status of curriculum development in institutions of teacher education in South Africa?
 3. Are student science teachers and practising teachers capable of developing an alternative curriculum in environmental education through a cross-curricular approach?
 4. How do student science teachers view themselves in relation to such joint curriculum development processes?
 5. How do practising teachers view themselves in relation to such joint curriculum development?
 6. What is the nature of the collaboration between student science teachers and practising teachers?

These research questions gave the research direction by providing a framework for data collection and analysis during the third stage of curriculum development (1990 to 1997) in the Science Education Division.

The curriculum development process was planned as a series of linked action research case studies designed in response to the research problem and questions listed above. Action research is grounded in the principles of involvement and improvement (Walker, 1990). The involvement in this research occurred through collaboration between students and teachers at the school with the purpose of producing an improved curriculum package. It was thought that the failures of the prescribed curriculum developed by the Research-Development- Dissemination- Adoption model (RDDA model) of curriculum development (Marsh and Huberman, 1984) would

be overcome by this involvement of teachers at grassroots level. It was also thought that teachers participating in action research would become more critical and reflective about their practice - a feature which would enhance empowerment for the educational reconstruction in a post-apartheid South Africa (Walker, 1993).

The qualitative nature of the action research was designed to illuminate a situation which was being researched with the intention of improving it while the research was in progress. It is therefore described within different school contexts as a series of linked case studies involving a descriptive analysis of a curriculum development process. Such an approach is opposed to a conventional, empirical research situation of formulating, testing and proving a hypothesis and suggesting an improvement after the research has been conducted - an improvement which will not necessarily be carried out. As a result, the research problem as formulated earlier will be used to guide the research in place of a hypothesis.

1.4 The need for a radical change in the approach to curriculum development

The term curriculum development is used in the context of this research to refer to a process which transcends the prescribed curriculum by being innovative, creative, participatory, and evolutionary. It usually results in a curriculum package adapted to its demographic context, i.e., the nature of the school population and the surrounding community. I agree with

Cornbleth's (1990) view of the curriculum as "a contextualized social process" rather than as a syllabus document produced by a syllabus committee as happens in South Africa. Such a committee has usually comprised subject specialists who advocate an objectives model in which curriculum is viewed as a product. This committee may have included education planners who lacked appropriate knowledge of curriculum theory and who had succumbed to implementing political ideologies of the state in planning the curriculum (Brookes, 1995).

Until quite recently the science curriculum in South Africa was designed according to the RDDA model, or an incomplete form of it. The RDDA model advocates research by curriculum theorists in producing a curriculum which is then developed further until a package emerges, followed by dissemination to schools for adoption and adaptation by teachers as they implement it in classrooms (Havelock, 1970 in Popkewitz, 1984). The nature of the implementation of such a model in South Africa poses problems because it has major weaknesses, such as a lack of consultation with and participation by teachers at the grass-roots level. This disempowers teachers and results in adoption and implementation failure owing to its top-down approach. There is also very little or no research into the curriculum and this has resulted in packages (syllabi) being imported from other systems of education. Such packages are usually not well adapted to the needs of science education in another country. The lack of a research basis for determining the syllabus also results in the absence of any form of evaluation of the implemented curriculum

(Brookes, 1995). An erosion of the culture of participation of teachers, who prefer instead to work in isolation, has generated an outdated transmissive approach to teaching science in schools. Such an approach conflicts with the progressive approaches advocated at some institutions of teacher education.

In view of what has been discussed above, my assumption is that a radical change in approach to curriculum development is needed to replace the RDDA model, leading to the collaborative participation of teachers at grass roots level becoming paramount. Such an approach would enable teachers to play a major role in determining the curriculum in science and thereby improve the chances of its successful implementation. A democratization of educational practices could generate a culture of participation in curriculum development in South African schools, which is required in the current context of political and educational reconstruction and transformation (White Paper on Education and Training, 1994). Colleges of Education and Faculties and Schools of Education at Universities have a major role to play in this process since they educate teachers at both preservice and inservice levels. This has immediate relevance for the re-education of the existing generation of science teachers so that they, as reflective teachers, may also contribute to the process of educational change through curriculum development within an action research framework.

Because teachers in South Africa generally lack the experience which would enable them to function as curriculum developers, I

chose to prepare my science student teachers as curriculum developers. I also chose to give them the chance to do this in the context of specific schools. The RDDA model, however, does not take context variation into account. The usual prescriptive, set curriculum produced has to be implemented irrespective of a wide variety of contexts, such as urban and rural areas. Elliott (1991) maintains that action research is context related. Psychometric methods ("quantitative/empirical methods") are rejected in favour of qualitative methods which identify and describe the significant variables operating in particular contexts. Action research is one of the qualitative methods which enables research into different contexts in which practitioners find themselves.

I, therefore, conducted the action research over a period of six years in different contexts - semirural (a totally Indian school), and periurban (two partly integrated schools, and a totally Black African school). The intention was to enable the students and teachers to collaboratively develop a curriculum relevant to the school context. An environmental education theme, "water education", was chosen by the teachers which enabled a cross-curricular approach in developing such a curriculum.

In order to confirm the need for the implementation of curriculum development in PRESET, a part of this research will put the rest of the research in context by focussing on a survey aimed at an analysis of curriculum development practices in South African institutions of teacher education. The majority of teachers who

hold valid teaching qualifications have been "trained" in Colleges of Education. The majority of non-white teachers qualified at colleges of education which were under the coercive control of the Department of National Education in the former system of apartheid education which was viewed as racially oppressive and with curricula designed to support an inferior system of education. These are tertiary institutions only in name and are regarded by their critics as providing a teacher education curriculum which lies between a post-secondary and pre-tertiary level of instruction (Salmon and Woods, 1991).

1.5 The assumptions, scope and limitations of the study

I made the following assumptions were about the research:

- 1.5.1 The transference or relocation of the process of curriculum development from the University to the schools would serve to empower teachers to develop a culture of participation through collaboration with science student teachers.
- 1.5.2 Such a process would enable the establishment of a preservice/in-service strategy for curriculum development.
- 1.5.3 Teachers would develop the skills of curriculum development through collaboration with science student teachers.
- 1.5.4 Elementary action research skills would be developed by students and teachers to enable them to improve their practice through involvement.
- 1.5.5 Teachers have little or no experience of curriculum

development and action research.

I realised that the complexity of the South African system of education was largely inherited from the apartheid era of separate schooling through racial segregation and unfair funding. Such a complexity resulted in a diversity of school contexts ranging from urban to rural parameters. I therefore needed to extend the field-work for the research over a longer period of time than anticipated to enable me to improve the "validity" (authenticity) and "reliability" (transferability) of the qualitative research. There was hence a need to select a semi-rural school and peri-urban schools of varying race compositions and degrees of resources as part of the scope of this study.

The student teachers involved in the study had a variety of other subjects, apart from Science Education, included in their teacher education curriculum. Experience with an assortment of subjects assured me that a cross-curricular approach to curriculum development would be possible in a primary school. Primary schools also have a degree of flexibility built into their time tables which easily accommodate integrated approaches to curriculum development.

Taking an entire class of science student teachers to a school to work with teachers can be regarded as a peculiar curriculum development strategy. I have not found such an approach documented, although standardised school-based teaching practice approaches occur. The nature of such an approach further

supported the need to conduct the study over an extended period of time.

The following limitations to the research approach were noted:

- a) Schools had to be chosen on the basis that the principal would have a democratic approach to education. Such a principal would have to be amenable to changes which would require his/her entire staff to contest a prescriptive curriculum which he/she (the principal) had been entrusted to implement. Consequently, some schools which were very close to the University campus could not be considered for the project due to the negative attitude of their principals to supporting curriculum development.
- b) It was difficult to arrange for meetings between students and school staff, the latter being available only at the end of a school day. This meant that students had to be removed from their lectures on campus to enable them to collaborate with teachers at the school, and this had implications for their academic responsibilities. The success of the curriculum development process, therefore, was dependent upon a highly negotiated arrangement between student teachers and school personnel, especially to enable students to plan special days (e.g. Awareness Day) and to teach during school time.
- c) A further constraint involved the financial cost of such a process which can fail due to lack of funds alone. For example, funds were needed to transport student teachers to schools on several occasions and for pupils to embark on

excursions related to environmental education.

- d) Student teachers have a limited or insecure background as researchers or even as action researchers. They may not be capable, due to their other academic responsibilities, of becoming adequately involved as action researchers. The teachers, similarly, are not generally accustomed to a culture of school-based research, and due to time constraints posed by a demanding workload, may not be willing to function as fully fledged action researchers. Their actions, however, during the participatory engagement with student teachers in contesting the curriculum, may contribute as elements of action research.

The research approach had to be modified to suit the above constraints.

1.6 The relationship between chapters in the dissertation

An attempt is made in this study to relate the chapters to form a coherent whole. Chapter One elucidates the rationale for the research. A literature survey is conducted in Chapter Two which supports the rationale for the research developed in Chapter One. Chapter Three outlines the research methodology used and this is further elaborated on in Chapters Four, Five, Six, and Seven, each representing a case study per school context, and a cycle in the action research spiral. Each action research cycle in the study reflects the following:

1. An actual description of each case study
2. An analysis of each case study

3. The lessons learned from each case study and how these influenced the next case study.

These case studies each represent an action research cycle leading to the next in the spiral. Each case study is also analysed so that an emerging picture of curriculum development can be realised. A synthesis chapter follows. The research conclusion and implications are presented Chapter Nine.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature survey aims to support the rationale developed in the previous chapter by developing a conceptual framework for the research. It is driven by looking at the extent to which this research is justified in the light of existing research and developments in the field of education in general, and science education in particular.

The concept of curriculum and curriculum development to which I subscribe, as opposed to predominant concepts and practices, is presented to enable the reader to understand my initial position. The status of curriculum development in schools and institutions of teacher education locally and internationally are reviewed. In doing so, models of curriculum development in which the state uses the RDDA model for curriculum development as opposed to an Action Research model are described and analysed.

The role of the Non-Governmental Organisation (NGO) movement in South Africa and other national initiatives in curriculum development and teacher development are presented and supported by international developments in these fields. The significance of cross-curricular thematic approaches to environmental education is explained in relation to this research by using an example based on a "water" theme. To develop this point, reference is made to the planning and implementation of a cross-curricular thematic strategy in environmental education in a

South African secondary school.

The ways in which action research and collaboration among teachers relate to each other are illustrated with reference to examples of participatory action research locally and internationally, as well as by using my research approach in environmental education designed for community problem solving. Reference to research conducted in pre-service science teacher education is also presented, and finally an attempt is made to relate curriculum development for environmental education to preservice education and training.

2.2 Curriculum as a concept

2.2.1 Concepts of curriculum:

Several concepts of curriculum have been proposed by researchers in education. The varied interpretation of the curriculum concept has ranged from a broad, general perspective to a narrow specific view (Stenhouse, 1991). Kelly (1979) states that curriculum is a term which is used with several meanings and a number of different definitions. It has been used to denote the content of a particular subject or area of study. It has also been used to refer to the total programme of an educational institution. He concedes that both these dimensions are important, but it is the rationale of the total curriculum that must have priority since it would seem that once it is established on a firm basis, the curriculum of individual subjects should fall into place. He also states that it is better to confine the use of the word curriculum to those activities that are planned or are the result

of some intentionality on the part of teachers and planners.

2.2.2 Curriculum as a product: ✓

The intentionality on the part of planners referred to above has been presented to teachers in the form of a syllabus document which reflects a technical interest, and does not recognise the teacher as a professional. Such an interest implies that the teaching act is product-orientated with the pupils being the recipients of a product. The teacher, as an implementer, is expected to reproduce in the classroom a set of plans or programmes represented in various curriculum documents and syllabus statements aimed at bringing about the desired learning in the pupils.

Sometimes the outcome of the implementation of a set of curriculum plans is not envisaged in terms of human product, but is oriented to a material product, perhaps a well-written essay. Kelly (ibid) regards this reproductive view of curriculum as a view which suggests that the purpose of a teacher's work is to reproduce in the students a product-oriented curriculum. However, it will be argued that such a fixed product is never fully achieved by teachers in the classrooms.

2.2.3 The official curriculum and the actual curriculum: ✓

Kelly (ibid) distinguishes between the official curriculum and the actual curriculum. He refers to the official curriculum as that which is laid down in the syllabuses, prospectuses, etc., and the actual curriculum being that which is covered in the

practice of the school. He goes on to state that since pupils and teachers are human, the realities of any course will never fully match up to the hopes and intentions of those who have planned it. Stenhouse (1991) claims that, "We as educators cannot lose sight of the fact that curriculum study must ultimately be concerned with the relationship between intention and reality, if it is to succeed in linking the theory and practice of the curriculum".

Cronin Jones (1991) alludes to the curriculum with a view similar to Kelly (1979) and Stenhouse (1975) by maintaining that implemented curricula are often quite different from intended curricula, i.e., there is an apparent incongruence between intended and implemented curricula in science which is influenced by science teacher beliefs. For example, in a case study of curriculum implementation processes in a fifth-grade science class, Smith and Anderson (1984, in Cronin Jones, 1991) found that the teacher and curriculum developers held different views of the concept of learning and the nature of science, resulting in a marked difference between the intended and implemented curriculum.

Clark and Elmore (1981, in Cronin-Jones, 1991) reported that teachers adapt curricula to fit their knowledge, priorities, and unique classroom settings while Brophy and Good (1974, in Cronin-Jones, 1991) reported that teachers influence curriculum implementation by deciding which topics and activities are appropriate for the students. These studies show that teachers'

perceptions and beliefs play a critical role in the curriculum implementation process. It appears that these perceptions hinder the effectiveness of curriculum implementation. Further, each teacher has his or her own subjective view and teachers are not generally receptive to the implementation of new curricula.

Cronin-Jones's (1991) study, as well as the qualitative and quantitative studies of curriculum implementation, indicate that teachers significantly alter intended curricula to make them more compatible with their own teaching contexts and belief systems. As a result, implemented curricula are often quite different from intended curricula. He goes on to suggest that to ensure more congruence between intended and implemented curricula, curriculum developers should put more effort into determining and considering existing teacher belief structures before developing new curricula. Although curriculum developers cannot readily change existing teacher beliefs, they can develop intended curricula which are more congruent with real world teaching contexts and do not deviate significantly from existing teacher beliefs. He suggested that this problem could be overcome by developing an easy-to-use teacher's manual or an inservice programme to prepare teachers to engage with the process of bridging the gap between the intended and implemented curriculum.

2.2.4 The curriculum as a contextualised social process:

Grundy (1987) maintains that teachers and pupils are already engaged in curriculum practices. It is these (practices) which will influence curriculum change. She suggests that if these

practices fail to conform to the ideal of an intended curriculum,
it will not be productive to critique them on the basis of such
failure because the curriculum is a social construction or a
cultural construction. The curriculum of a society's schools is
an integral part of the culture of that society. Grundy also
acknowledges that if we are to understand the meaning of the
curriculum practices engaged in by people in a society, we need
to know about the social context of the school.

Cornbleth's (1990) view of the curriculum is similar to that of
Grundy (1987). Her conception of curriculum also stands in
contrast and opposition to the prevailing product conception of
curriculum as a document or plan (i.e., the intended curriculum
designed by a curriculum designer from outside the school). She
conceives of the curriculum as what actually occurs in school
classrooms, i.e., an ongoing social process comprising the
interactions of pupils, teachers, knowledge, and milieu. She also
goes beyond Grundy's (1987) definition by not merely
acknowledging the role of the context of learning in curriculum
practice, but also stating emphatically that curriculum as
practice cannot be understood adequately or changed substantially
without attention to its setting or context, i.e., curriculum is
contextually shaped.

While Grundy states that the curriculum emerges from the dynamic
interaction of action and reflection, Cornbleth argues that this
interaction (i.e. action and reflection) also involves setting
(context). Reflection could be directed toward context as well

as action. Grundy, as described earlier, acknowledges but does not pursue contextualised influences. Hence, Cornbleth's view of curriculum as a contextualised social process appears to be more appropriate.

2.2.5 A personal view of curriculum:

I agree with Cornbleth's view of the curriculum as a "contextualised social process". As Chapters Three to Seven show, I facilitated the development of curriculum with students and teachers through a process which attempted to reflect this approach. This process was aimed at shaping the curriculum contextually (Cornbleth, 1990) by relating to both the structural and socio-cultural aspects of a relevant curriculum. Cornbleth (1990) refers to structure as the established roles and relationships, including operating procedures, shared beliefs, and norms. She considers structural context at several layers or levels, from the individual classroom to the school organisation, to the national education system. Her concept of socio-cultural refers to the environment beyond the education system/structural context. Her view of the socio-cultural context is very pertinent to the underlying assumptions of this research when she includes demographics, ^{teacher} social, ^{in socio-cul} political, and economic conditions, traditions and ideologies, and events that actually or potentially influence curriculum. ✓

On the basis of this thinking, I pose the following questions, which I have tried to answer in the case studies undertaken in this research:

- a) Should curriculum developers work with teachers to develop curriculum adapted to the context of the pupils?
- b) Should teachers be given the opportunity and freedom as professionals to develop curriculum at grass-roots level of the educational hierarchy in state education departments?
- c) What are the implications of this for the creative and innovative talents of teachers?

The mismatch between the official (prescribed) curriculum and the actual (implemented) curriculum provides sufficient justification and support for the questions posed above. This is due to the potential for curriculum development which teachers have as professionals and which becomes implicit in the actual curriculum implemented by them as opposed to the intended curriculum. It also implies that they are capable of functioning as reflective teachers. This is further supported by Brookes et al (1993:14) who state that, "Teachers develop by reflecting on their teaching, not by being instructed on how to do it".

In terms of Cornbleth's (1990) views, this research was designed to investigate how the socio-cultural context could be built into the curriculum in the structural contexts of the classroom and school. This involved transferring the process of curriculum development from the university campus to schools representing contexts which varied significantly in their social and cultural make-up. Students and teachers were given the opportunity to co-create curriculum in environmental education, to suit the needs of the classroom, school and socio-cultural context in each case.

The RDDA and Action Research models for curriculum development will now be outlined, and the relationship between action research and its potential for curriculum change within schools will be analysed.

2.3 RDDA as a Model for Curriculum Development

2.3.1 The RDDA Model:

Education in most countries has favoured "scientific" approaches to curriculum development. According to Havelock (1970, in Popkewitz, 1984) the Research-Development-Dissemination-Adoption/Adaptation (RDDA) model for curriculum development involves external, rational, and objective research processes which generate curriculum materials for a curriculum proposed by the state. This is followed by a process of development of the curriculum materials as packages for schools by curriculum theorists situated away from these reality sites. Thereafter, the curriculum packages are disseminated for adoption by schools.

These dissemination/adoption strategies enable the new curriculum to be communicated to teachers or to be implanted in schools for teachers to implement (see Figure 1 on page 27). This centre-to-periphery model for curriculum development represents a deterministic model for curriculum change. It is functionally hierarchical with planning and development of the curriculum being carried out by education planners whose concerns for the overall education system are far removed from the concerns of the schools influenced by the model. The RDDA model is based on the following rationale, viz., the assumption that the management of

change through external and rational processes of curriculum development is both possible and desirable. It, therefore, views teachers as implementers of the curriculum.

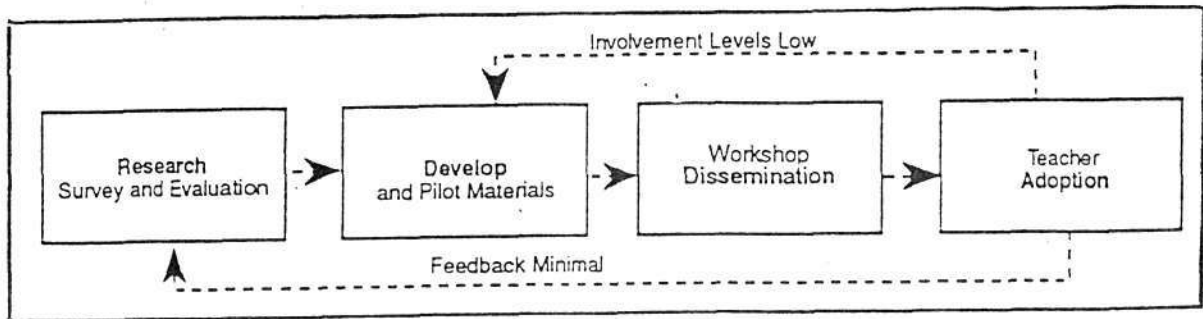


Figure 1: The RDDA Model for Curriculum Change.

Modified from McNaught et al (1990)

"Social engineering" and "centre-to-periphery" models of change have dominated the policies and actions of curriculum development movements especially in developing countries. Here human and financial resources are very limited and support infrastructures for more teacher-centred and participatory variations of these models are minimal (Havelock, 1970 in Popkewitz, 1984).

2.3.2 Criticisms of the RDDA Model:

The RDDA model for curriculum development has been criticised for several of its weaknesses in addressing curriculum issues. Pappagianis (1982) and Popkewitz (1984) view the development and implementation approaches to change as having proved to be surprisingly weak. Their repeated failure has most often been ascribed to communication weaknesses, insufficient or poor

evaluation, and a lack of teacher participation (Eisner, 1985 in Robottom, 1991). Curriculum projects have generally centred their efforts on trying to improve evaluation research and dissemination communication. This may have been a waste of effort as many of the key findings of prevailing approaches to curriculum development can be traced to flaws in the underlying assumptions of deterministic models of change.

Popkewitz (1984) suggests that the limited successes of the centre-to-periphery curriculum projects are not a result of communication and management weaknesses alone. Their notable failure to achieve more than superficial and short-term change may best be ascribed to flaws in their underlying rationale - the assumption that the management of change through external and rational processes of curriculum development is both possible and desirable. He states that one cannot capture, control and manipulate the social world in a similar way as one can with natural phenomena. He also argues that common to most of the efforts of reformers is the belief that the problems and solutions to schooling lie in the scientific management of its environment. There is an erroneous tendency for educators to see scientific management and its offshoot, the human engineering approach, as successful in industry, agriculture and space programmes, and therefore, as a plausible way to deal with social problems such as those found in schools.

Some commentators on curriculum have noted several other weaknesses in the deterministic RDDA model for curriculum development with respect to implementation practices:

Cornbleth (1990) maintains that the RDDA model for curriculum change seems to have very little impact on classroom practice. She states that the RDDA model is a documentary conception of curriculum and curriculum change. It presents a predominant, technocratic conception of curriculum as a document. It is a rational management model of curriculum making and therefore represents a persistently technocratic view.

Grundy (1987) states that important aspects of curriculum development are portrayed through the RDDA model as taking place away from the sites of classroom practice, and only penetrating such sites as fully formed prescriptions to be put into effect at the chalk-face.

2.3.3 The situation in South Africa:

In South Africa, science education for schools has been centrally planned by the state. The deterministic RDDA model formed the dominant process of curriculum development. The general pattern in science education, however, is that the model used is a "watered-down" version of RDDA. Due to the tendency of the fragmented education system to import curricula from overseas, and especially the UK, the RDDA concept was reduced to a DA (Dissemination and Adoption) model (Brookes, 1995). Samuel and Naidoo (1992) state that there was very little evidence to show that research and development did occur. It appeared that an imported curriculum, developed and researched in another context, was disseminated to schools for adoption by teachers. Such a curriculum had been deterministically administered by state

employed subject advisors who coerced teachers into accepting it as obedient civil servants. The culture of teaching and especially learning became seriously eroded as teachers struggled to interpret a curriculum which excluded their participation in its planning and development. Adoption, adaptation and implementation failure occurred especially in disadvantaged school contexts in South Africa where large numbers of unqualified and under-qualified teachers were employed. Furthermore, the political agenda at that time discriminated against non-white races. Educational oppression was endorsed in the constitution as reflected in the Bantu Education Bill of 1953 (Rose and Tunmer, 1975 in Walker, 1990).

Marsh and Huberman (1984) refer to such curriculum dissemination as a high control condition with administrators relying on their formal authority to try to get things done the way they want them to be done, by exerting influence over people, processes and the use of resources. In the high-control "authority model", the authority-innovation-decision-making system of Rogers and Shoemaker (1971, in Marsh and Huberman, 1984) is worthy of note. They claim that this model is crucial in such formal organisations as educational systems. In such a model there are two distinct groups of decision-making individuals, the superordinate group and the subordinate group. The major decisions are made by the superordinate group, who initiate and direct curriculum development and its dissemination. Members of the subordinate group are chiefly concerned with implementing decisions made by the higher status group. As a result their

functions are confined to communication and action (see Figure 2 below).

The situation reflected above was generally the case in most of the teacher education institutions in South Africa until recently. There appeared to be a total lack of autonomy especially in the ex-DET, ex-DEC, and ex-HOR Colleges of Education where the curriculum was prescribed by the state. Salmon and Woods (1991) claimed that:

"The existing provision of the curriculum in KwaZulu (in Natal) is a highly contentious one. Originating from the DET in Pretoria, it is essentially a highly prescriptive package of course structures, compulsory subjects, and period allocations. All subjects have to conform to the core syllabi, from which nothing may be removed and little can be added: the current curriculum is already so full that there is little space for anything else".

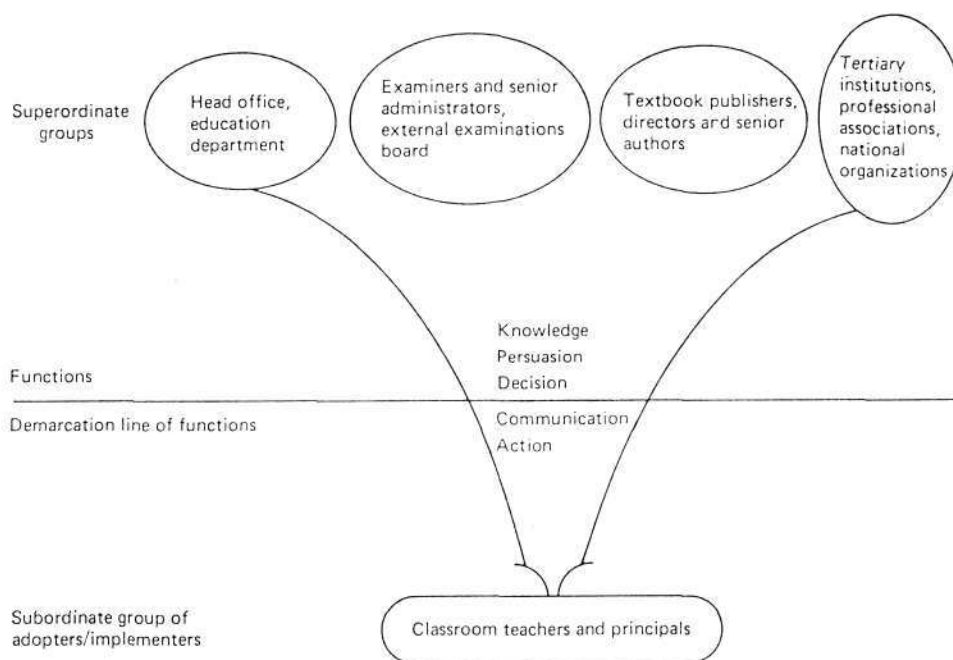


Figure 2: An Authority Model for a State Education System.
(Adapted from Rogers and Shoemaker, 1971 in)
Marsh and Huberman, 1984)

Under such circumstances, the initiation and development of possible curriculum innovations by teacher educators became an almost impossible task.

The current situation is in keeping with new developments in education associated with the election of a new democratic government. A nationally determined policy for teacher education was developed by COTEP (Colleges of Teacher Education Policy) and was gazetted in September 1997 (Samuel, 1997). The COTEP document has specified new national norms and standards for accreditation for teacher education degrees and diplomas in South Africa. The national norms and standards conform to the National Qualification Framework's (NQF's) requirements by providing flexibility for teacher educators, especially in colleges of education, to develop curriculum related to the content for eight learning areas prescribed by the Ministry of Education (Samuel, 1996). In a personal communication, Samuel (1997) expressed apprehension that, due to their lack of experience/capacity in curriculum development, teacher educators in colleges of education may resort to implementing content from the previous system, and not developing new content related to the eight learning areas.

A degree of semi-autonomy prevailed in South Africa in Colleges of Education of ex-HOD and ex-HOA which had some flexibility in developing curricula which, although moderated by sister universities, had to be subject to the national norms and standards of the State. According to Levy (1993), there appears

to be greater flexibility in the teacher education curricula of universities which offer teaching degrees and diplomas. Subjects, their content and assessment patterns are moderated by other similar tertiary institutions. Some of these institutions have taken advantage of the flexibility by engaging in innovative practices in curriculum development. The Science Curriculum Group of the National Education Policy Initiative (NEPI, 1992 a) has reported that curriculum development processes have been instituted in South Africa which engage with all the key interest groups in the country. This involvement would require agreement on a framework of national objectives around which the curriculum would be built. Levy (1992) stated that one option was to combine INSET with curriculum development along the lines followed by the Maths Education Project at the University of Cape Town. The INSET teachers who worked with the project developed innovative materials and explored methodological possibilities. PRESET teachers continued to work with the project and were potentially ongoing change agents.

2.3.4 The situation in other countries:

In certain countries, which Ruddock and Kelly (1976) categorised as "confined systems", innovation could only be directed by the central authority, the National Ministry of Education. This authority might be advised by a specialised agency which might licence or promote experiment at the periphery, e.g. in individual "pilot schools" as is the case in Zimbabwe and Zambia. However, the decision to approve a curricular change could only be taken at the centre. Such countries at the time of writing of

Ruddock and Kelly (1976) were, for instance, France, Denmark, and Ireland. Such "confined systems" might have small areas of latitude in which individual schools might innovate. But, these have been confined to such small proportions of the syllabus that the new element of knowledge introduced has been almost forced into a superficiality of treatment. This has been a common model for curriculum innovation, and exceptions are rare.

The above situation, currently, may still be true for France, but has changed in Denmark and possibly Ireland. According to Vithal (1996), the Scandinavian countries do not have a centralised curriculum and curriculum development at the periphery is generally encouraged. In the United Kingdom (UK), innovation at the periphery was permitted with decisions about the curriculum being made by the head teacher and others in the individual school (Kelly, 1979). However, the introduction of a National Curriculum in 1991 restricted this freedom and was viewed with great dissatisfaction and disappointment by teachers. Donnelly (1995:99) claims that, "Teachers regarded the implementation of Sc1 of the National Curriculum in secondary schools as an imposition based on a centralised written document which embodied ideas which were not the common currency of practising teachers. It was highly prescriptive in relation to teachers' practice".

On the other hand, Marsh and Huberman (1984) report that on the Australian scene there has been a backlash against school-based curriculum change, with most parties now favouring central curriculum authorities in the determination and implementation

of curriculum reforms. In the USA, there have been several successful examples of "top-down" curriculum dissemination. They claim, however, that there is clear evidence that a number of top-down approaches have also failed, but so too have many teacher-managed approaches at the grass-roots level.

The recent introduction of an Outcomes-Based Education system in South Africa has resulted in the Ministry of Education providing directives to teachers in the form of learning areas which conform to the national norms and standards of the NQF. The NQF has developed these directives/learning areas in the form of a learning/curriculum framework. This is a set of principles and guidelines which provides both a philosophical base and an organisational structure for learning/curriculum development initiatives at national, provincial, community or school-based levels (NCDC, 1996). School-based teachers, like teacher educators, will be given the flexibility to develop contextualised content related to the prescribed learning areas. This is in keeping with one of the NQF's intentions of achieving a fundamental restructuring of education by encouraging new and flexible curricula.

The participation of most of the teachers at grassroots level in contributing to such a process of curriculum development for the first time in their professional careers may not be successful unless they are exposed to an empowerment strategy. This may be provided through action research. The following discussion, therefore, shows the role of the action research model for

curriculum development as a means to overcome the weaknesses inherent in the RDDA model for curriculum development.

2.4 Action Research as a model for curriculum development

Stenhouse (1991) defines curriculum development as the applied branch of curriculum study. He states that its object is the betterment of schools through the improvement of teaching and learning. The characteristic insistence of curriculum development is that ideas should encounter the discipline of practice and that practice should be principled by ideas. He goes on to review the curriculum development movement as an attack on the separation of theory and practice, and suggests the need for a change of approach from the product model of RDDA to a process model of curriculum development through action research.

The integration of theory and practice and the emergence of new and more theory related to practice is possible through the process of action research. Walker (1990) maintains that action research is qualitative research which is grounded in the principles of involvement and improvement. It is described as research for practitioners who are determined to improve their practice. It differs from conventional empirical research in that improvement of a situation occurs during the research and not after the research findings are published. The involvement of practitioners occurs through a process of collaboration in improving a situation or context. Since teachers are practitioners, action research is their form of research. The action research model which was used in this research is

presented in Chapter Three as Elliot's (1991) revised version of Kurt Lewin's model (in Carr and Kemmis, 1986).

Carr and Kemmis (1986) explain that action research has developed out of the need for a form of research which is sensitively attuned to the world of practice and the concerns of practitioners, and capable of building systematic understandings about practice through the critical reflection of practitioners. They also claim that action research has the potential not only to improve practice but also the situations in which the practices are carried out. Their definition of action research is the most widely accepted:

"Action research is a form of self-reflective enquiry undertaken by participants (for example, teachers and pupils) in social (including educational) situations in order to improve the rationality and justice of (a) their own social and educational practices, (b) their understanding of these practices, and (c) the situations in which these practices are carried out".

Curriculum development in the school serves a very important function of enabling teachers to function as professionals. Both curriculum development and research into teaching should provide a base for this professionalism through action research. Stenhouse (1991) maintains that teachers cannot change (from implementers) to curriculum developers through a change of heart only. There needs to also be a refinement of professional skills achieved through the systematic study of one's own teaching. Any curriculum innovation is centrally concerned with the betterment of teaching, and teaching is a process of development. Stenhouse states that curriculum development must rest on teacher development and that it should promote it and hence the

professionalism of the teacher. Curriculum development translates ideas into classroom practicalities and thereby helps the teacher to strengthen his practice by systematically and thoughtfully testing ideas to improve his practice.

Action research, as a practitioner's research (Walker, 1990), can therefore serve as a powerful tool to drive the process of curriculum development to improve an education situation through involvement of teachers. The Commission on Teacher Education (1995) was given the task of establishing an operational framework for teacher development and support in South Africa. Their report indicated that teacher education curricula in PRESET do not prepare teachers to undertake research. Chapter Three provides further references and more details pertaining to action research and the extent to which I, as a teacher educator, attempted to engage my students as future practitioners in this form of research.

2.5 The role of teacher development in curriculum development

Teachers are the vital link between curriculum innovators and the actual learning experience of pupils in the classroom. The RDDA model for curriculum development's view of teachers as mere implementers of the curriculum has had a disempowering effect on them by denying them professional rights. The lack of congruence between the intended curriculum and the actual curriculum shows that the act of presenting teachers with curriculum packages which are "teacher proof" in the hope of these being conveyed to pupils usually results in implementation failure.

The untenability of centrally-developed curricula shows that there is a need for a marked change in approach and attitude with respect to the role of teachers in curriculum innovation and development. Research in teacher education should focus on the reality site of education, viz., in schools where practice occurs, and not be dislodged from it. The important relationship between research and practice is implicit in Stenhouse's (1991) view: "If those of us who are interested in the improvement of schools by research, i.e., by reflective questioning and constructive criticism, we must ensure that theory is about practice". The practice which he refers to occurs at schools, and in order to change the traditional practices of teachers, a teacher development process is needed.

2.5.1 Some aspects of curriculum development in recent history:

At this stage it is necessary to briefly provide an outline of the history of curriculum development portrayed by research relating to a report for the Council of Europe (1976) by Ruddock and Kelly (1976). The picture presented was one of great activity in curriculum development at national or regional centres, but a comparatively disappointing response from the teaching profession as a whole. The 1960's seemed to have been the great decade for curriculum development, but at least until 1968, this development was left largely in the hands of agencies which assumed that their function was simply to determine what new elements of knowledge should be introduced into the curriculum and then present these as a "package" to the teachers who would convey them to the pupils.

There was even a fashion, perhaps derived from North America, for what were called "teacher proof" programmes, that is, packages of instructional materials, visual aids, etc., which could be put into the hands of any teacher for direct transmission to the pupils. All the teachers had to do was to follow the instructions. The 1970's have witnessed a marked change from this kind of attitude, which could never have been acceptable at the upper secondary level. This change is well expressed in the following quotation from the report of the sub-committee on curriculum development set up by the Bildungsrat in the Federal Republic of Germany in 1971 (Ruddock and Kelly, 1976): "Curriculum reform, if it is to come about, must come through the teachers. If it is attempted solely from above, without teacher cooperation, curriculum reform risks being nothing but a hollow gesture".

The other end of the spectrum to the "confined" or centralised system is presented in England and Wales where there was until 1991 no control of the curriculum either by central or local authority and where the teachers' unions protested violently at the mere suspicion that it might be introduced. This situation has changed substantially, as indicated previously in this chapter, due to the introduction of a National Curriculum in the UK in 1991.

In South Africa, the rigid and inflexible state controlled system of education of the apartheid era relegated teachers to the role of subordinate implementers of curriculum. In an attempt to

address such disempowering implications for teachers, reference is made to the non-governmental organisations in South Africa which have made a major contribution to teacher development in science education through curriculum development. The discussion which follows provides several examples of their direct contribution. It also focuses on international attempts at involving teachers in curriculum development to shift them away from outmoded traditional classroom practices. A more detailed account is presented to support information provided earlier.

2.5.2 The role of the NGO Movement in South Africa:

Brookes (1997) stated that the school science curriculum in South Africa prior to 1970 was developed according to the hierarchical model of curriculum development typical of the RDDA version. It had its roots in traditional British sources. Its revision was influenced largely by the American BSCS and British Nuffield Projects and its implementation was of a top-down approach. The year 1969 saw the introduction of the first "new" Physical Science syllabus for standards 9 and 10 which was influenced by American sources. The standards 6, 7 and 8 Physical Science syllabi were based on a UK model. There was some teacher involvement due largely to the influence of the national conventions for teachers of science which were hosted for the first time in the latter part of the 1960s.

The curriculum, textbooks, and teacher education were manipulated for ideological purposes and used as instruments of propaganda and indoctrination. State-determined history, religion, value

systems, culture and gender roles had been imposed. Official policies on examinations and teaching methods encouraged the memorisation of large amounts of information, and discouraged both teachers and students (pupils) from developing their initiative or critical thinking (Draft Policy Document, 1994). Such a situation created a climate which frustrated and angered pupils and teachers, especially from Black African communities. By the mid 1970s, teacher involvement had stagnated because of the oppressive effect of the Bantu Education Act which had a profound influence over an extended period.

As the conflict in South Africa developed, especially from June 1976, there was a paradoxical contradiction about government control in Black schools. The government exercised both more and less control. Officially schools had to do what they were told, but it became progressively more difficult to exercise control meaningfully. As a result, the level of external meaningless control became sharper through pressure by police, the security forces and by sanctions on school staff who stepped officially out of line. External school examinations were strictly maintained to enforce submission to curricula. At the same time, there was little direct influence from government sources on what teachers actually did. It was at this stage that the international community's concern about political engineering of educational provision in South Africa led to support of the NGO Movement which attempted to intervene to alleviate the crisis. The NGOs essentially filled the gap and substituted their work for what should have been provided and/or encouraged by education

departments (Brookes, 1997).

It is interesting to note that because the denial of educational rights was an intrinsic part of minority rule, and constituted a frontal attack on the human dignity and life chances of the majority of the people, the struggle for equal citizenship and the struggle for equal education became completely identified. As a result, schools, colleges, and universities became arenas of political education and action, and the target of infiltration and repression by the security forces of the Apartheid regime. Thousands of students and teachers became victims of police or military action, and thousands were detained or fled into exile. Many were killed (Draft Policy Document, 1994).

Levy (1993) states that, given the large number of unqualified and under-qualified teachers in South Africa, and the progressive abdication by the state authorities of full responsibility to support and develop these teachers, numerous initiatives in the university and non-governmental sector emerged to deal with the ongoing crisis. Her survey reveals many worthwhile and vibrant projects in South Africa. She claims that it was crucial that innovation and curriculum development in the country should inform national curriculum development process and science education policy formulation in order to prevent a replay of the previous education dispensation where curricula were determined by faceless experts. Policy makers need to recognise the non-governmental organisations as a rich source and allow for their ongoing autonomy whilst providing mechanisms for their input into

policy formulation and the curriculum development process.

Kahn (1994, in Levy, 1994) claimed that there were more than one hundred NGOs in South Africa which were active in science and mathematics education. They offered services to both students and teachers in syllabus-related work as well as career and vocational education. These NGOs provided a significant means of innovation, maintaining and building morale, and a platform for the development of alternative approaches in education. This NGO sector had been proactive through innovation in terms of materials, techniques, and processes. Despite (past) political obstruction, the space had been found for experimentation in terms of (educational) approaches and modes of organization. Worthy of note and of particular significance to this research are NGOs such as the Primary Science Programme (PSP), Science Education Project (SEP), the Centre for the Advancement of Science and Mathematics Education (CASME), the Science Curriculum Initiative of South Africa (SCISA), and FULCRUM.

SEP and PSP were two of the early NGOs which were concerned about teacher involvement. They realised that the content-laden science syllabus prescribed by the state could not be changed. Such a syllabus served as a constraint to teacher development. They decided that they had to accept the syllabus in its given form and to re-work the way it was used to change the meaning of what was taught by traditional methodology and replace this with alternative inquiry-based approaches. This resulted in the process of science teacher education involving a mixture of

teacher development and curriculum development. These NGOs presented their approaches at national science teacher conventions and elsewhere so as to awaken and alert teachers to the realities of an outdated system of science education in South Africa at broader fora.

The PSP, SEP, and CASME: In what follows, I present a description of the role played by PSP, SEP, and CASME in working within the system to assist in teacher development in the face of the state's abdication of its responsibilities.

a) **The Primary Science Programme (PSP):**

Glover (in Levy, 1994) describes the PSP as a national NGO with the primary goal of improving the quality of science teaching and learning in South Africa, through a core of competent primary school teachers. One of its guiding principles (significant to this research) is the necessity of the empowerment of teachers for self-development and professional growth within a collaborative learning environment that builds on the teacher's knowledge and experience.

PSP workshops are interactive. In the process of discovering the science that lies beyond the textbook page, teachers are also encouraged to consider teaching methods other than the traditional "chalk and talk". Visits are made by PSP facilitators to schools where they can assist teachers in applying workshop experiences in the real classroom. In this way teacher development becomes an exercise in curriculum development.

b) **The Science Education Project (SEP):**

This project was initiated at Fort Hare University in the Ciskei in 1978 under the directorship of John Rogan. It was a curriculum development and science teacher education project. Its materials (teachers guides, kits, worksheets) were used for the first time that year at six Black African schools in that region (SEP, 1978). It soon spread to KwaZulu-Natal where it became firmly established under the regional directorship of Brian Gray and gained some support from the Department of Education and Culture (SEP, 1983). In-service programmes for teachers of Standard 8 Physical Science were offered at the rate of one day per three weeks during the year. Gray (1981) states that SEP, as a curriculum development and teacher development project in KwaZulu-Natal has been able to make significant progress towards effecting real change in the classroom. It has seen teachers starting to take collective responsibility for their own professional growth, producing their own curriculum materials, and a general positive change of attitude towards the teaching and learning of science. It was through his influence that the Department of Education granted permission at the end of 1982 for SEP to become involved in colleges of education. SEP saw this involvement with the colleges as significant, logical and important. It was hoped that, through such regular contact through workshops arranged with the staff at the colleges, the Project might have a positive influence on the preservice science education of prospective teachers.

In a presentation at a national research conference in Cape Town, Davies (1995) claimed that that SEP as an NGO was well known for its innovative approach to the teaching of secondary school science. SEP had always perceived itself as helping teachers to help themselves. The Curriculum Development Unit (CDU) of SEP produced teaching and learning materials that allowed teachers to choose their preferred teaching style - a choice which logically extended to the learners and their learning style.

Davies (ibid) stated that the staff of the CDU of SEP were themselves teachers and teacher trainers with strong views about and much experience of teaching and learning in Africa. SEP favoured a child-centred approach to teaching and learning. While earlier SEP materials reflected a process approach to teaching science, more recently a constructivist approach had been incorporated as a science education strategy.

SEP was very sensitive to the reality of classroom contexts in South Africa, especially of under-resourced and overcrowded classrooms. It was planning the development of strategies to assist teachers to overcome these problems and to design materials to support pupils to learn more meaningfully under such circumstances.

SEP claimed that it rated teacher empowerment very highly in the processes and products it hoped to place on the market. Enabled teachers were likely to make a significant difference in our society through their impact on learners in the classroom. The

Teacher Advisory Group (TAG) of SEP acts as a forum for teachers to be involved in the early planning and later review sessions. Teachers were drawn into writing materials via writing workshops. Teachers reviewed the packages as a whole and were involved in school-based trialling of the package. SEP's hypothesis was that this involvement would lead to growth in teachers as curriculum developers in their own right, thus disseminating these skills to a wider circle of teachers. Its staff had met many teachers at workshops who had the potential to develop their skills further through involvement in this process. Measuring this change represented a further research challenge for the future.

c) **The Centre for the Advancement of Science and Mathematics Education (CASME):**

Volmink (in Levy, 1994:272) reported that:

"The Centre understands that although the present curriculum reflects the content one would find in most industrialised nations of the world, the relevance of the content and the way it is taught does not actually reflect the needs of the community, nor is the implementation based on sound pedagogic practice. We realise that most teaching is very exam-oriented and that little 'real' science and scientific thinking emerge from science and mathematics teaching. Thus the Centre accepts the need for curriculum reconstruction in a way that the broadest community base can benefit from science and mathematics education, that teachers feel that they are co-designers of the programmes they have to teach and which reflect a humane and cognitively defensible pedagogy".

The report above appears to be contradictory to the findings of Ndimande (1996) who conducted a case study of CASME's workshops with teachers of Physical Science. He indicated that CASME had a tendency to develop materials **for** teachers and recommended that the Centre should develop materials **with** teachers. He also suggested that more teachers needed to be trained by CASME in the

Teacher Leadership Course (TLC) so that a greater pool of workshop facilitators may become available to lead teachers in curriculum development. An evaluation of CASME resource centres by Pillay and Rothwell (1995) confirmed that these centres were grossly under-utilised by teachers in the rural areas. They recommended that the CASME TLC programme could be used as a dynamic means to empower teachers at the grassroots level to use the resource centres for curriculum development. Further support for Ndimande (1996) and Pillay and Rothwell (1995) has been provided by Moodley (1996) who studied the effectiveness and quality of Physical Science teaching in two ex-DET schools, one a lower performing school and the other, a higher performing school. He recommended that networking among teachers of science (for curriculum development) should incorporate an exchange of ideas, skills, physical resources such as suitable curriculum materials, and the setting of common examination papers.

d) **SCISA and FULCRUM:** Unlike the PSP, SEP, and CASME, SCISA and FULCRUM attempted to subvert the existing curriculum by posing a structural obstruction to the state's irrelevant curriculum. They proposed and attempted more radical experiences of change for teacher development. Presented below is a brief description of the views held by SCISA and FULCRUM pertaining to curriculum development and teacher development.

i) **The Science Curriculum Initiative of South Africa (SCISA):** According to Raubenheimer (in Levy, 1992), SCISA is an initiative that arose out of concerns of various science educators that no

one seemed to be doing anything about science curriculum development and yet were complaining about it. One of the specific aims of SCISA is to develop alternative curriculum development processes that are linked to the professional development of teachers, so that the teachers are actually involved in the process of curriculum development. Teachers must be part of the development so that they will implement the policies and the alternative approaches and materials in the classroom. SCISA's approach was substantially different from PSP and SEP in that the latter worked within the existing curriculum in stimulating curriculum development among teachers and failed to involve them in the development of alternative curricula.

ii) **The FULCRUM Teacher Education Project:**

The FULCRUM Project is a network of college of education lecturers, staff from education NGOs and representatives of the former KwaZulu Department of Education and Culture. One of the aims of FULCRUM was to find ways of improving the quality of teacher education in KwaZulu-Natal and to "break the mould" related to an outdated teaching practice approach. Soobrayan (1995) reported that:

"FULCRUM does not agree with conventional ways of training teachers which focus on either academic content or practical skills. Its philosophy is based on a participatory approach to teacher education. At the heart of this philosophy is the belief that teaching is a life-long learning process requiring action, self-awareness, autonomy, collective learning skills and problem solving skills. Teachers are seen as potential 'agents of change', not 'subjects for remedial education'. They should come to recognise that their professional development is an ongoing process of action and self-reflection".

The bold initiatives undertaken by SCISA and FULCRUM as NGOs

occurred at a time when South Africa was experiencing a political transition from an oppressive apartheid system to a democratic transformation of the system. Other national initiatives were also in progress, which attempted to resolve the government's abandonment of its obligation to the education of the oppressed masses. In the following section we see moves leading back to resumption of government responsibility, due to the political changes, for meaningful involvement in school curricula.

2.5.3) **Other National Initiatives:**

a) **National Education Policy Investigation (NEPI):**

NEPI was a project of the National Education Co-ordinating Committee (NECC) conducted between December 1990 and August 1992. The object of this initiative was to interrogate policy options in all areas of education within a value framework derived from the ideas of the Mass Democratic Movement (MDM). It was an attempt by the MDM to provide an alternative policy to inform the developing political dispensation with respect to education. The NEPI Research Group on Teacher Education claimed that as part of the legacy of apartheid, the capacity of South Africa's teaching corps is limited in several dimensions, as are the capacities of teacher educators and their institutions. NEPI regarded a teaching corps of quality and substance as a necessary condition for educational transformation, a condition which made teacher education and development the pivot of coherent and viable national policy (NEPI, 1992 b).

This is summed up by Pendlebury (in NEPI, 1992 a) as follows:

Pendlebury, in a report on the teacher education research group, indicated the following as one of the responses to the question: "Which virtues of current teacher education do you think should be carried forward into a future education system?"

Response: " Innovative, reflective, and critical approaches at Colleges and Universities which have recently been engaged in curriculum revitalisation. The ideas could, as far as they are appropriate to different circumstances, be shared by other institutions engaged in teacher education".

The African National Congress (ANC), one of the major political organizations involved in the struggle against Apartheid and the Nationalist Government, also developed a policy framework for education and training.

b) The ANC Policy Framework for Education and Training

The ANC, in its Policy Framework for Education and Training discussion document (1994), proposed the following principles for teacher development:

- 1) The development of a national system in which the management and professional support of teachers is conceived as a coherent and integrated process.
- 2) The support and professional development of teachers shall be a central aim of the management system.
- 3) Teacher appraisal, supervision, and inspection shall be linked to the professional development of teachers.

In the policy framework of its Reconstruction and Development Programme (RDP, 1994:67), the ANC clearly indicated the kind of teachers needed so that the above principles may be fulfilled in an attempt to finally eradicate apartheid and ensure the building of a democratic, non-racial and non-sexist future:

"The reconstruction of education and training requires a body of teachers, educators, and trainers who are committed to RDP goals and competent in carrying them out. This requires that they are able to understand and respond to the challenges of the new approaches to the curriculum, method and delivery and certification which an integrated system of education and training demands. They must dedicate themselves to enhancing the quality of learning and achievement through-out the system ".

With the election of a democratic government in South Africa in 1994, a White Paper on Education was developed which served to entrench teacher education policy.

c) **The White Paper on Education:**

According to the draft White Paper on Education and Training in South Africa (Department of Education, 1994), The Ministry indicated that, "It regards teacher education (including the professional education of trainers and educators) as one of the central pillars of national human resource development strategy, and the growth of professional expertise and self-confidence is the key to teacher development". It also stated that, "The national and provincial councils will be responsible for the redesign of teacher education programmes. Given the magnitude of the task, and the cost factors, it is essential to base as much teacher education work as possible on distance education lines, with strong professional support. The formulation of a

qualification structure expressed in terms of minimum criteria and competencies must be developed". This is an essential step in the upgrading of teacher education programmes.

(Note: The White Paper proposed that the teacher education sector is a joint responsibility of the national and provincial governments, since the 90+ teachers' colleges will fall under the provincial Departments of Education, and teacher education conducted in universities and technicons falls under the national department, whereas the many NGOs involved in teacher education may belong in either category. Teacher education belongs at present both within higher education and within the "college/school" (CS) sector.)

2.5.4) **Some International Developments**

The discussion which follows shows some developments in teacher education internationally, especially in Britain. It presents the Nuffield project, which influenced science education in South Africa, and the more recent Salter's Project which show/s a high degree of teacher involvement. It has to be emphasised that the work was done with better quality classes, often more enthusiastic and competent teachers, and for academically oriented courses. The Salter's Project, in a more contextual way, drew teachers strongly into the process of curriculum development.

a) **The Nuffield Science Teaching Project**

The work of the Nuffield Science Teaching Project began in 1962.

At that time many individual school teachers and a number of organisations in Britain had drawn attention to the need for a renewal of the science curriculum and for a wider study of imaginative ways of teaching science subjects (Nuffield Foundation, 1966). According to Sparrow (in Schools Council Research Studies, 1973) the Nuffield projects were finally introduced in England in 1965 at a time when curriculum developers were certain that much irrelevant and out-of-date material was being taught in schools, and that they could replace this outmoded curriculum with something much better, more relevant to the times and more interesting. They were determined to introduce new materials, new subject content, and new methods of teaching, such as the inquiry method, into schools.

The ideas for the new content came from both outside the classrooms and within it, from universities and colleges, and from teachers who were called upon to introduce new materials. The Nuffield projects were run for teachers by teachers. Apart from the role of other stake-holders, the process of curriculum development proposed by the Nuffield project ensured that teachers, through their work in teachers' centres and inservice training courses, played an increasingly important part in curriculum development. Tawney (in Schools Council Research Studies, 1973) states that the curriculum model proposed enabled the potential customer (the teacher) to be invited to inspect the design process instead of merely the end product, and even to contribute to the process.

The Nuffield A Level Biological Science Project will be presented to illustrate the principles of teacher involvement discussed above. Kelly (in Schools Council Research Studies, 1973) reported that this project was set up in England in 1965 to determine the needs of sixth form Biology education. It was an attempt at meeting these needs by introducing relevant and effective innovations, and thereby providing the framework for successful implementation. The project's evaluation involved a range of people, among whom were teachers. Teachers were seen as the focal group; it was recognised that the validity and acceptability of the curriculum development process must depend on their professional judgement. Among some of the responsibilities assigned to teachers were the following:

- a) They were requested to submit items for the construction of examinations.
- b) They evaluated the use of the materials and teaching and learning strategies.
- c) They were given the opportunity to rate the role of objectives in biology.
- d) In setting up school trials of the materials and processes, teachers formed area school groups which were given the task of mutual assistance in administering the trials. They were also given the opportunity to provide a regular source of evaluation through discussion.
- e) The area groups of teachers were also responsible for acquiring materials needed for the work and administration of the scheme in their schools. This

also involved assistance with inservice training of teachers after the trial period.

Kelly (ibid) stated that an interesting implicatory objective of the Nuffield Project was to ensure that the scheme could be fitted into a strategy of future curriculum development. He also viewed the Project as only a beginning, and one that had an element of imprecision about it.

b) The Salters Project:

This Project was initiated in the UK in the mid-1980s. It was a curriculum development project sponsored by a group known as Salters (Ramsden, 1994). Science curriculum materials were developed by the University of York Science Education Group (UYSEG) to encourage more young people to pursue their study of chemistry beyond year 9 (age 14) of schooling. With the advent of the National Curriculum in the UK, in which science became a foundation subject for all pupils, the materials were revised into a science course to cover the whole of the secondary age range (11 to 16). Ramsden (1994:448) reports that currently, more than 500 schools in the UK have pupils following one or more of the Salters' courses and materials are being adapted for use in the USA, Belgium and Russia. Additionally, Salters' materials are influencing developments in The Netherlands, Swaziland, and New Zealand.

Ramsden (ibid) stated that one of the design criteria which underpinned the development of the Salters' materials was:

The ideas and concepts selected and the contexts within which they are studied should enhance young peoples' appreciation of how science:

- contributes to their lives or the lives of others around the world.
- helps them to acquire a better understanding of their environment.

She also mentioned that the method of development was characterised in particular by:

- the practitioner-based developmental model (teacher development)
- the influence of educational research on the development of the materials.

She continued that, "Most crucially, the key learning outcomes for each activity were identified. This provided the facility for teachers to adjust or substitute alternative activities should they so wish".

The teachers' materials were written with three potential audiences in mind:

1. the heads of science departments/faculties in schools who would need to develop schemes of work for their particular location based on the resource materials.
2. experienced teachers who might want support in the form of guidance on teaching less familiar materials or using novel activities in lessons.
3. the needs of new teachers who would be likely to require considerable support in a number of different areas.

The developmental model brought together all the major stake holders. These included teachers, science education lecturers from York University, and industrialists. They participated in

workshops which finally produced draft versions of units which were then passed on to unit editors, who were teachers drawn from a range of schools to be based at York on secondment for one or two years to work on the materials. Figure 3 below illustrates the developmental model for the production of the course units, with its emphasis on teacher participation in both the planning and implementation phases.

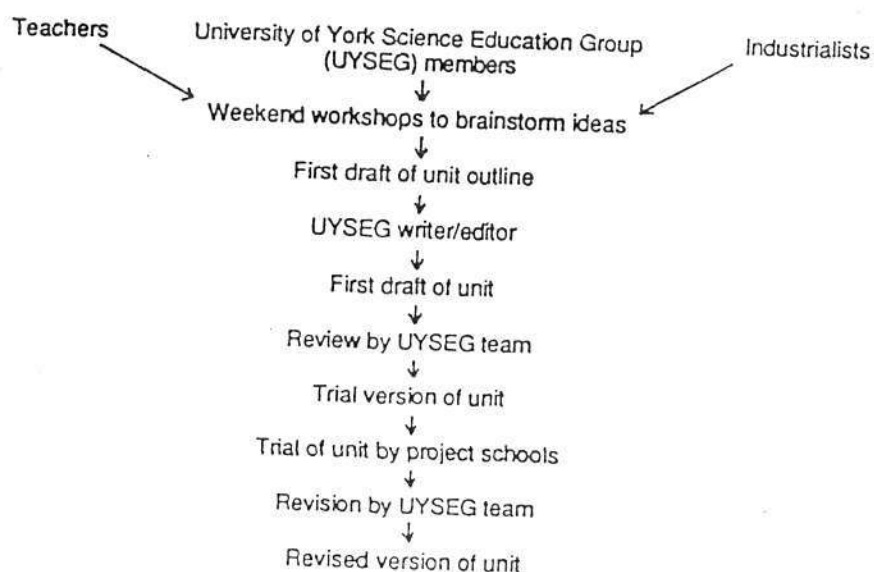


Figure 3: The Salters' Developmental Model

The Salters' experience in Swaziland, Southern Africa: Lubben et al (1995) reported on a research and development project to develop and evaluate learning materials using a technological approach to science education. The Salters' model (Ramsden, 1994) was used in the development of an INSET package designed to introduce these to teaching in Swaziland, a developing country. Their evidence supported the view of Naidoo and Samuel (1993, in

Lubben et al, 1995) that given appropriate opportunities, teachers in Southern Africa can be active and creative participants in curriculum development, although the vast majority do not initially see themselves as materials producers. Lubben et al (1995) claimed that the production and presentation of lesson materials by the teachers, their behaviour over the workshops, their dialogue with workshop facilitators, their written feedback and their behaviour during the pilot stage all supported the notion that considerable professional growth took place through their involvement with curriculum development. They regarded this growth as being indicative of curriculum empowerment (through the Salters' developmental model).

During a personal communication with Ziervogel and Hobden (1997), two CASME science teacher educators, it was reported that their proposal applying for funding from Salters' to run an in-service curriculum development project in KwaZulu-Natal was successful. An overseas facilitator was willing to assist with the project. They were very disappointed when the offer to two science subject advisors from the Department of Education was turned down. This resistance to change was viewed by CASME as an obstacle to teacher development in science education in South Africa. Lubben, et al (1995) claimed that evaluation of curriculum renewal in developing countries has shown that innovations in the syllabus, examinations, textbooks, or teaching strategies are generally resisted by teachers. Black and Atkin (1996), however, maintain that while innovation in science curriculum draws a "cloud of pain and risk" over teachers' heads, it indubitably stimulates

the professional growth of teachers as nothing else can. Teachers have found that involvement in innovation helps them to reflect on their practice. Black and Atkin state that innovation challenges tradition; between innovation and tradition there will be dialogue.

The international development reflected above has presented excellent examples of how an overseas government fulfilled its responsibility for teacher development related to improvements for science education at schools. As indicated earlier, the teachers involved were more competent to deal with the challenges of educational change. Due to the disempowering nature of the policy of Apartheid in South Africa, the need to develop capacity among teachers, as indicated in the NEPI report, becomes a responsibility which the newly elected government has committed itself to fulfil. However, the case of the failed CASME initiative to implement a Salter's model for curriculum development in a local provincial education system, may serve as a deterrent to education transformation and teacher development.

In the light of national and international attempts in curriculum development and teacher development, it becomes necessary at this stage to focus on research findings on PRESET and INSET as strategies for curriculum development and to finally relate these to environmental education as they pertain to this research.

2.6 PRESET and INSET as Strategies for Curriculum Development:

What does research show?

2.6.1 **PRESET:**

PRESET occurs as a form of initial preparation or training for teachers. It usually occurs as a full-time programme offered at colleges of education and universities. Completion of a degree or diploma in education entitles the student teacher to gain entry into a school as a professional practising teacher employed by an education department.

Early approaches to teaching practice were developed along traditional patterns of teaching involving transmission of concepts from teacher to learner. An applied science conception was generally prevalent which involved a behaviouristic approach in which the preservice teacher was compelled to teach according to fixed models representing how teaching should occur, irrespective of context. The development of the theory of constructivism introduced a changed approach to teaching practice with teaching focusing on the development of conceptual change.

Fensham and Northfield (1993) stated that putting constructivist ideas into practice required restructuring the teacher education programme. They also claimed that the introduction of action research to further develop constructivist ideas in classroom settings was another development which impacted on teacher education internationally especially in Australia, USA, and Britain. Time was found where teachers could interact over professional issues and share experiences. The informal aspects

of teacher education became very important for the professional development of the teachers and provided further evidence that curriculum change is possible if the conditions for teaching could be altered.

Fensham and Northfield (1993) also stated that of all research in science education, research in the arena of education for (preservice) science teachers is the least popular. They also stated that the Secondary Science Curriculum Review in England and Wales from 1982 to 1987 saw the recognition that the professional development of science teachers is the critical factor in improved science education. There was a realization that more attention must be given to the education, both initial (preservice) and inservice, of science teachers. The paradox was that it was surprising that research on teacher education is so limited when, for most researchers in science education, it is the most immediately available field; i.e. most researchers in science education are also science teacher educators who are responsible for programmes of education that are so rarely researched.

Another problem for research according to Fensham and Northfield (1993) is that pre-service teacher education takes place via formal programmes in institutions that severely constrain what is possible. It is thus a flawed arena that is unattractive for research except in exploratory settings that are able to transcend the constraints (e.g. UDW). In-service education is a more informal process that has its own constraints, but it has

proved to be more compatible with the features of research in science education that are so hard to sustain in the preservice situation.

2.6.2 **INSET:**

According to Gabel (1993), inservice education takes place in a context with certain purposes that are related to that context. It takes place in a particular place and is conducted by particular persons for a particular purpose. For example, it takes place for the professional development of individual teachers, or for the implementation of a new curriculum programme. It is conducted in some degree of isolation from, or association with, pupils, teachers, and/or other professional personnel from the teachers' school. Inservice education is provided for the potential benefit of a teacher's instruction and its degree of success will be judged by competencies that the teacher acquires or by improvement in that teacher's teaching.

The ultimate goal of INSET is not only to develop individual teachers, but also to develop institutions. According to Bolin (1989, in Ndimande, 1996), teachers who have been empowered to run INSET efficiently have an interest in the whole school rather than merely their own individual classrooms or responsibilities.

Raubenheimer (1992/1993, in Ndimande, 1996) classifies INSET models broadly into two groups. The first group consists of those models which are prescriptive and in which the teacher is seen as a consumer of INSET, i.e., the deficit model (applied science

model). The second group consists of those models in which the teachers are seen as equal partners whose active participation is essential to the success of the programme, i.e., the growth model.

In a report on the Teacher Education Research Group in South Africa, Pendlebury (NEPI, 1992 a) indicated the following as one of the responses to the question: "Do you consider in-service teacher education to be an important project for the future? Response: "The majority of respondents pointed out that INSET is crucial both for alleviating current problems of underqualification and for the revitalization of the school curriculum. As one wrote, "INSET should be viewed as on-going teacher development and support. There will never be a time when this is not necessary". Several respondents regarded INSET as a necessary condition for overcoming the teaching habits and doctrines perpetuated under apartheid's oppression.

According to the ANC's Policy Framework for Education and Training (1994), teachers invest heavily in formal study which is often totally disconnected from their professional work. Upgrading teacher qualifications is thus delinked from improving their professional competence. INSET is treated as completely separate from PRESET in colleges of education and is often poorly developed. Creative INSET work is done by subject specific NGO's, most of which operate on a small scale. Each NGO or project must negotiate its niche in the system with one or more departmental authorities, and its funds with one or more donor agencies. Their

work thus tends to be fragmented and their effectiveness is seldom systematically evaluated.

The discussion document of the ANC also suggests a new approach to in-service education or teacher development which is linked to the concept of "whole school review" to career paths and to the continuous challenges of educational transformation, and not necessarily to pay-scale increases.

In a case study of participatory curriculum development through INSET, Naidoo (1992) confirmed that teachers, while initially resisting participation in the curriculum development process, were willing to participate if it revolved around their curriculum problems (context). He observed that significant features of collaborative teacher participation in curriculum development seemed to be the co-creation of context by the teachers, the need for institutional support, the production of curriculum materials, and the need for networking (see also Moodley, 1996). Savage (1995) stressed that classrooms were changed by teachers and not by externally developed curriculum materials. Therefore, teachers need to be empowered to take an active role in curriculum development during INSET.

2.6.3 Linking PRESET and INSET:

INSET should be an integral part of every teacher's professional life. There has been a growing call for INSET to be linked to the preservice education and training (PRESET) of teachers in order to make teacher education a continuous process (COTEP, 1995 in

Ndimande, 1996). The problem of de-linked PRESET and INSET programmes was highlighted by Hofmeyer and Jaff (1990, in Ndimande, 1996) as follows: "The problem is that, if the initial training is weak and does not provide an adequate base for INSET, then INSET is forever remedial, attempting to repair PRESET deficiencies instead of meeting the ongoing needs of serving teachers for renewal". Ndimande (1996) suggested that college and university teacher educators and their students should go out of their institutions and participate in INSET activities in order to maintain contact with classroom practitioners in schools.

A collaborative approach to school-based teaching practice involving a triad of the practising or resident teacher, the teacher educator, and the student teacher was suggested to enable a learning partnership. Such an approach has been put into practice at the University of Durban-Westville where this research is based.

Goodlad (1990, in Fensham and Northfield, 1993) showed that such a relationship is not easy to establish. His larger study showed that only one in 29 institutions of teacher education in Australia had established procedures to develop and support collegial working relationships. Fensham described preservice science teacher education as an obvious but difficult arena for research. He concluded that preservice teacher education takes place via formal programmes in institutions that severely constrain what is possible. It was thus a flawed arena that is unattractive for research except in exploratory settings (as

explained above) that are able to transcend the constraints, but it has proved to be more compatible with the features of research in science education that are so hard to sustain in the preservice situation. My attempt in this dissertation to establish a preservice/in-service link in curriculum development is partly aimed at addressing this difficulty and contributing to the difficult arena of research identified by Fensham as science teacher education.

2.7 Curriculum Development for Teacher Education through Environmental Education

The process of curriculum development proposed in this dissertation occurred within the framework of environmental education as it pertains to the South African context. Environmental education in South African schools is not offered as a subject discipline. It is suggested in science curricula (Biology/General Science) as a biophysical emphasis (ecology) and succumbs to a narrow view of the environment. Recently the Council for the Environment recommended that environmental education be offered in schools as a separate subject (Council for the Environment, 1993). This recommendation was severely criticised by the Environmental Education Policy Initiative (EEPI) as being a parochial view. A holistic view of environmental education is presented below and emerges from some historical trends and recent developments (O'Donoghue, 1993).

Early responses to the environment crisis were geared towards protecting endangered wildlife in nature reserves. Educational

methods were therefore initially centred on nature experience and information about conservation problems so as to create awareness. The idea as expressed above was simply to make people aware of the environment as natural ecosystems. Teaching ecology and environmental education were seen as the same thing. Early fieldwork focused on the show and tell, experiential, solitaire, and guided questioning approaches. These methods were aimed at changing attitudes, values, and behaviour. Coupled with such approaches was the realization and need to do something about environmental problems. However, the multitude of problems presented to pupils became so overwhelming that it created a sense of "action paralysis" which failed to solve the very problems outlined.

The next trend was to move beyond traditional subject-based information into meaningful life-world concerns. The idea was that learners would become more aware if they researched information about environmental issues through project work and would thus do something about problems. Slowly, active learning within fieldwork and problem-solving activities in the environment started to characterise broader, more participatory, more local and more action-centred approaches to environmental education. A broader picture of the environment began to be conceived in which environmental problems were linked to political, social, and economic processes which impact upon the biophysical aspect of the environment.

The narrow nature-centred methods were replaced by a socio-

ecological picture of the environment which put people at the centre. This was followed by environmental education becoming an interactive challenge of learning and planning together, followed by action-taking to bring about change. Environmental education had thus moved from nature experience to learning about problems to a participatory process of action research and community problem solving (Wals et al, 1992) which this dissertation also reports on.

A pilot study of a cross-curricular technique was conducted by the Fish Hoek Senior High School (1987) in the Cape Province of South Africa. It emerged from a staff development workshop which highlighted the problem and concerns of a transfer of knowledge across subjects. One of the questions posed was related to pupils' failure to spell in History or calculate in Science when they could demonstrate these skills quite adequately in English or Mathematics classes respectively. The school decided to embark on a curriculum development project based on a cross-curricular approach related to an environmental development. The staff were convinced that the pupils had learned more effectively during the project than they had for many a year in their classrooms due to developing a theme during their teaching across all subjects.

Very recent international developments related to innovations in Science, Mathematics and Technology indicate that these subjects were no longer taught as isolated disciplines. The innovations were aimed at developing an interdisciplinary curriculum. In a report on 23 international case studies, Black and Atkin (1996)

showed that the organisation of school science was changing. No longer were school science and mathematics more or less confined within the traditional disciplines of Chemistry, Biology, Physics, Earth Science, Algebra, Geometry, and Trigonometry. New curricula were emphasising inter-relationships among these fields (and sometimes with yet others). Elementary schools had organised their work in this way for many years, but the growth of these patterns in secondary schools was quite new, as the twenty three studies suggest. The PING project in Germany aimed to explore how human beings related to nature. For example, a unit on water for grades 5 and 6 was called "Myself and Water". The fundamental purpose of PING was to make school science more relevant for students by showing how science contributes to their lives and to the life of the community (Black and Atkin, 1996).

The difference between a preferred environmental education curriculum and existing school curricula is quite extreme. The existing contrasting practices suggest an extensive list of curriculum and pedagogical contradictions between environmental education and schooling. While an environmental education curriculum should be inter-disciplinary and focus on real needs and practical problems, school curricula are discipline based and emphasize abstract, theoretical problems. Addressing this paradox is partly the basis of this dissertation.

South African teachers generally have not been exposed to a culture of curriculum development due to the culture of implementing a prescriptive curriculum being imposed on them by

the state. The new democratically elected Government has recently introduced a change in education policy to include an "outcomes-based approach to education and training" which will be implemented in the foundation phase in 1998. Environmental education will be considered as a phase organiser to be developed across the curriculum. Such a change in policy will require teachers to engage with environmental education as a process of curriculum development. Such a development will promote the need to view the biophysical environment as an entity which is of common concern to all who live in it. It is now possible for teachers to discuss problems of an environmental nature in all subject disciplines in schools. This improves the scope for collaboration to be developed among teachers especially where such a culture of participation may not have existed. The potential for environmental education as a basis for curriculum development for teacher education therefore becomes highly possible and appealing to teachers.

2.8 Environmental Education and Preservice Teacher Education

UNESCO-UNEP (1988) reports that attempts at focussing on the environment in school education internationally has been far from satisfactory. It claims that apart from other reasons for this situation, the most important factor has been the inadequacy of personnel trained in environmental education. The great need for both teachers and teacher educators trained in environmental education has been felt in both developing and developed countries. Several regional meetings of experts in environmental education sponsored by UNESCO in 1976 and 1977 also expressed a

need for teacher training as an essential requirement in the development of environmental education.

The UNESCO-UNEP (1988) report also refers to the Tbilisi Conference (1977) which considered the training of personnel, including preservice and inservice teachers and all others connected with education and environmentally linked matters, as a priority activity. The Conference recommended "intensive teacher education, and not merely orientation, is essential if the present fragmented approaches of traditional education are to be transcended in favour of a holistic, global approach". It also suggested that "interdisciplinary and multidisciplinary treatment of issues would require a thorough change in both the outlook and content preparation of teachers and teacher educators".

According to the report, preservice teacher training programmes vary greatly from country to country as well as from institution to institution. Aware of a necessity to introduce environmental dimensions in the preservice teacher training curriculum, some countries have introduced environmental education training for teacher certification. For instance, a few countries like the USA, the former USSR, and Thailand have made courses in ecology and conservation of natural resources compulsory for teacher certification. In other countries like Bulgaria, training in ecology is a requirement for the qualification of teachers and instructors in science subjects particularly those having links with the environment.

There are also many other countries in the world which do not offer environmental education courses in their teacher training colleges in any form. Nevertheless, with few exceptions, training courses do not provide sufficient background to develop desirable competencies in preservice teachers to enable them to infuse an environmental dimension into their teaching. In fact, very few teacher training programmes have been designed to develop all desired competencies in preservice teachers to prepare them for acquiring and transferring environmental education knowledge, skills, and attitudes successfully and effectively in classroom teaching.

2.9 Conclusion

While the research which forms the basis of this dissertation was in progress, I was interviewed about the project for a contribution to a book called *Projects Speak for Themselves*. Levy (1992) in this report indicated that, "In moving the site of curriculum development to the school, the example of a project at the University of Durban-Westville is worth noting. Here the PRESET teachers plan their classroom activities in collaboration with the staff at the school (INSET) where they would carry out their teaching practice. Within an action research framework, curriculum development and teacher development occur together, with the school staff participating, reporting, reflecting and adapting the work of the project. The teachers become used to the idea of curriculum as a process that one adapts in schools". This report indicates that my study takes full cognisance of some of the problems associated with science teacher education and attempts to address these through a preservice/in-service link.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The methodology employed during the research was a case study approach with elements of action research. Cohen and Manion (1989) refer to a case study as being an observation or investigation into the characteristics of an individual unit - a child, a clique, a class or a community. The purpose of such observation is to probe deeply and to analyse intensively the multifarious phenomena that constitute the life cycle of the unit with a view to establishing generalizations about the wider population to which that unit belongs.

The case study approach reported in this dissertation was an investigation which involved science student teachers at the University of Durban-Westville (UDW) participating in curriculum development projects with school teachers at four different schools. In the process of investigating the participatory curriculum development which occurred, it must be pointed out that the case study took two forms:

- a) The case study was an observation into the way UDW developed its approach to such curriculum development interventions.
- b) The case study represented four cases of curriculum development interventions in the four participating schools.

Similarly, the elements of action research can be looked at from the University of Durban-Westville's point of view, and from the point of view of the participants in each case. With respect to

the University, the action research was much more complete in that I, as a science teacher educator, was involved in a series of linked action research cycles in investigating and improving the nature of the kind of curriculum development used, and hence my own practice as a teacher educator. With respect to the students and the teachers involved, they never went further than two cycles and often only one. There were elements of action research in that the participants worked towards both investigation and improvement in the projects. However, the school teachers did not document their action research, and the student teachers did so only during the last action research cycle.

The action research was aimed at illuminating interventions in school situations of science student teachers from the University of Durban-Westville and teachers. These interventions were negotiated curriculum development projects, each of which will be referred to as "the project" and a case study in this dissertation. The field-work for the research spanned a period of six years from 1991 to 1996. Four primary schools were included in the study. These schools are referred to as School A (1991) in Tongaat, School B (1992) and School C (1993 and 1994) in Reservoir Hills (Durban), and School D (1995 and 1996) in KwaDabeka (near Clermont, Durban). The schools are not identified by their names for the sake of anonymity.

The description of the methodology falls essentially into two parts. The first part lays out the different aspects of the

studies chosen, viz., action research, the use of environmental education, "water" as a fitting topic and the reasons for the use of qualitative research by a participant observer. In the second part, the research instruments, data collection methods and the meaning of trustworthiness in this kind of research are described. The two parts enable the data analysis in the following chapters to be better understood as they (the data) unfold to illuminate the nature and meaning of the curriculum development process in a series of different contexts.

3.2 Action research as a strategy

I used elements of action research as a strategy to involve students and teachers in a collaborative process for curriculum development aimed at improving their practice as teachers. In the process, I also used a more complete version of action research to improve my practice as a teacher educator. Walker (1990) states that action research enables teachers to develop their classroom skills, to see incremental changes in their work and to take some control over their working lives in ways not previously imagined. With reference to the South African context prior to the advent of democracy, she indicates that taking control of classroom work was not in the interest of education authorities such as the Department of Education and Training (DET) which treated teachers as instruments of policy rather than as professionals and sought to control all aspects of their working lives.

Fostering professional development may well be a strategy which

progressive teacher organisations might encourage to empower teachers to question and contest the powerful bureaucratic control exercised by education departments. Walker (ibid) warns, however, that while the teacher research movement which developed during the 1970's in Australia, Britain, and America provided us with a useful body of literature on the theory and implementation of action research, we need to recognise that such work has developed in a context of relatively greater teacher autonomy, better educated teachers, and a situation altogether less contested and volatile than our own.

I have to emphasise that the school contexts which I chose comprised teachers whose initial teacher education programmes lacked curriculum development as a formal component of their preservice curriculum. Such school contexts only served to emphasise the need for the kind of research methodology which was implemented in the case study and is presented hereafter.

Research conducted by Noffke and Brennan (1991) with student teachers using action research sees it as a way of working toward a student teaching experience that provides opportunities and structures which facilitate and enhance the students' development as reflective teachers. They have a strong conviction that action research provides a lever to "unpack" the complexities of thinking about teaching and schooling and to improve the quality of student teacher practices during their field experiences.

This affirms my personal conceptualization of curriculum

development as occurring within the context of action research for the improvement of an educational situation. Therefore, I have related the process of curriculum development to promote a materials development activity involving students, teachers, pupils and teacher educators. I have developed a working definition of curriculum development to suit the context of the research. I regard curriculum development as a process or exercise which transcends the prescriptive curriculum (syllabus) by being innovative, creative, participatory, and evolutionary. It usually results in a curriculum package adapted to its context.

Such a working definition suits Cornbleth's (1990) view of the curriculum as a contextualised social process. The evolutionary nature of the contextualised curriculum package refers to its flexibility to become adapted to future contextual changes. The participatory nature of the development of the curriculum package ensures that it becomes a product of innovation and creativity on the part of teachers. The role of the teacher becomes a dual one: that of a curriculum developer and an implementer, a role which he/she is denied in the top-down RDDA model for curriculum development which enforces only the latter. Action research is viewed as a necessary process which enables and empowers teachers to develop an alternative contextualised curriculum through contestation of the existing curriculum or syllabus as it is commonly referred to in South Africa.

Elliott (1991) agrees with processes which enable teachers to

produce their own curriculum. This research project aspired to enable teachers to generate an alternative curriculum to the existing prescriptive syllabus. Elliott states that teachers need to develop the ability to realise an alternative to the traditional pedagogy which has so long prevailed in classrooms. This would involve teachers in communicating across some of the long established boundaries in initial (PRESET) and in-service (INSET) teacher education, e.g., between the primary and secondary sectors and different subject areas (a cross-curricular approach). Teachers committed to an innovative pedagogy require support from one another if they experience difficulty in realising their aspirations (as individuals) in practice. Elliott argues further that the improvement of teaching is not so much a matter of getting better at implementing an externally designed curriculum, but of developing one, whether it be self initiated or initiated by outsiders. Curriculum development in itself constitutes a process of teacher development.

During the research I encouraged a learning partnership between teacher educator, student teacher, and practising teacher. There was also a pre-service/in-service link which is endorsed by the following view of Halsey (1972, in Stenhouse, 1991):

"The emergence of a healthy tradition of curriculum research and development depends upon a partnership of teachers and curriculum research workers. And such a partnership depends on the sharing of this tradition. The development must be through cooperation and towards a more solid basis for that cooperation. The key factor would seem to be the induction of teachers into such a tradition in the course of initial training and the accessibility of the tradition to experienced teachers through inservice education. Research workers have a contribution to make; but it is the teachers who in the end will change the world of the school by understanding it".

In view of what has been stated by Halsey, I believe that curriculum development at the "grass-roots" level of teachers may not be possible without an action research strategy which would enable them to collaboratively reflect upon their practice for its improvement.

The action research model which I used in this research to support curriculum development approximates Elliott's (1991) revised version of Lewin's Model. The term action research was first coined by the social psychologist Kurt Lewin. Lewin's model involves a spiral of cycles represented in Figure 4 below:

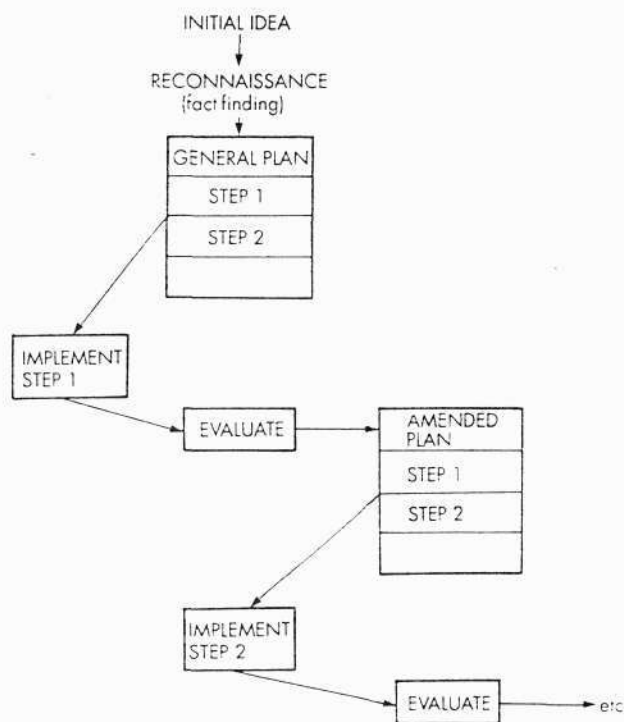


Figure 4: Kurt Lewin's model of action research as interpreted by Kemmis (1980, in Elliott, 1991)

The basic cycle of activities is:

- a) identifying a general idea

- b) reconnaissance
- c) general planning
- d) developing the first action step
- e) implementing the first action step
- f) evaluation
- g) revising the general plan

From this basic cycle, the research then spirals into developing the second action step, viz., implementation, evaluation, revising the general plan, and then developing the third action step, implementation, evaluation, and so on, as illustrated in Figure 4.

Elliott (1991) revised the above model because it implied that those who used it assumed that the general idea can be fixed in advance, that reconnaissance is merely fact finding, and that implementation is a fairly straight-forward process. He argued that:

- a) the general idea should be allowed to shift,
- b) reconnaissance should involve analysis as well as fact-finding and should constantly recur in the spiral of activities, rather than occur only in the beginning,
- c) implementation of an action step is not always easy, and one should not proceed to evaluate the effects of an action until one has monitored the extent to which it has been implemented.

In the light of these criticisms, Elliott elaborated the spiral of activities as shown in Figure 5 on the next page.

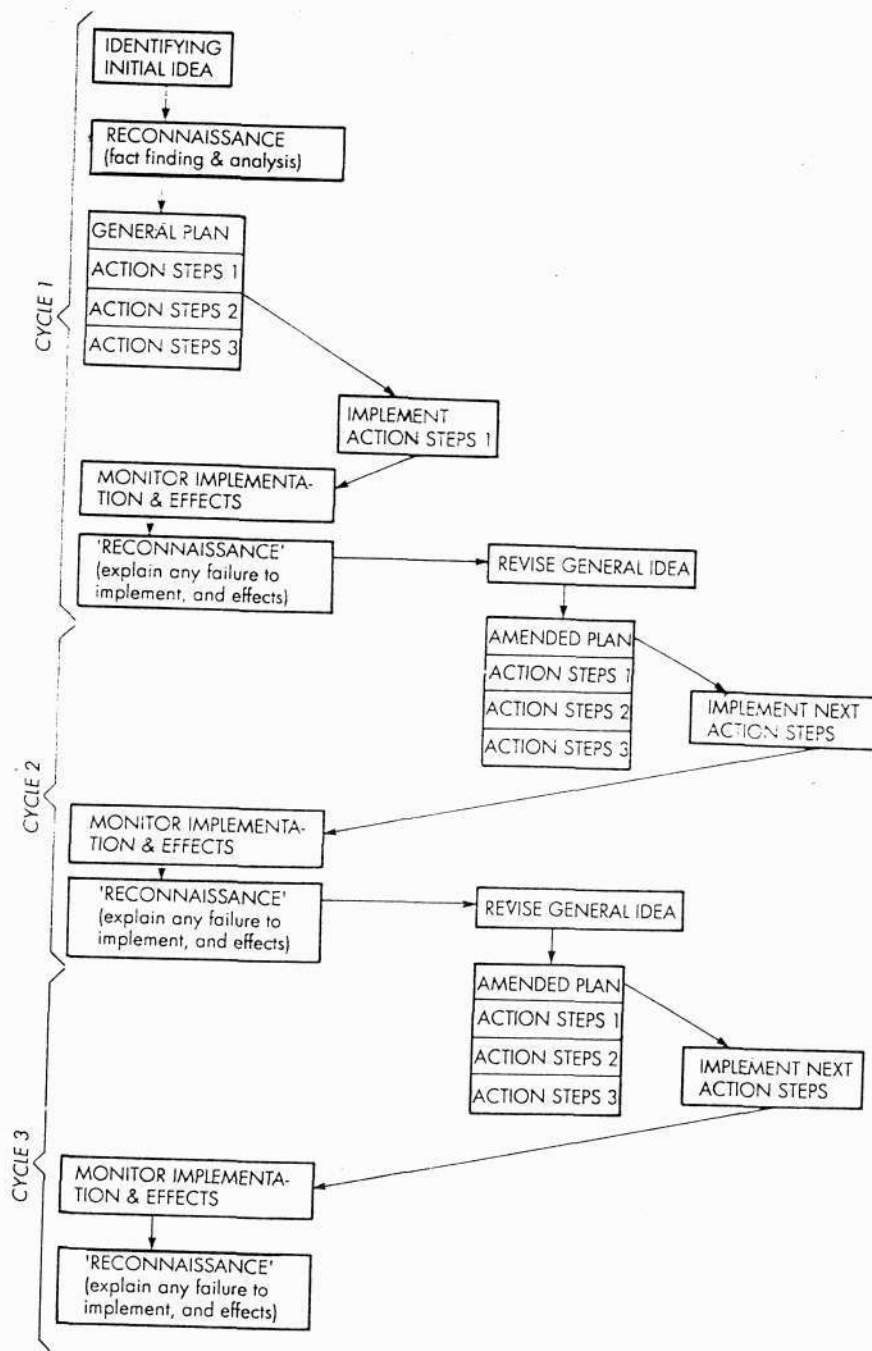


Figure 5: A revised version of Lewin's model of action research (Elliott, 1991)

Chapters Four, Five, Six, and Seven are developed to reflect the cycles of action research involved during the field work as case studies on which this report is based. Elliott (1991:48) states that, "The fundamental aim of action research is to improve practice rather than to produce knowledge. The production and utilization of knowledge is subordinate to, and conditioned by this fundamental aim ". The model illustrated in Figure 5 helps to unify inquiry, the improvement of performance, and the development of persons in their professional roles. Elliot claims that action research is designed to resist the temptation to simplify cases by theoretical abstraction but will use and even generate theory to illuminate practically significant aspects of a case.

The revised model of action research spells out quite clearly that the process of evaluation should not occur at the end of the implementation of action research or from the outside. Stenhouse (1991:29) has argued that, "Evaluation should not be a specialised role (of action research), but should be integral to reflexive practice". It appears from Elliot's revised model of action research that since amendments (critical moments) drive the action research in a spiral, the evaluation should occur frequently during the research by the participants. The revised model emphasises the need to monitor implementation and effects with each cycle in action research. The monitoring can be viewed as a process of continuous evaluation. The action research model which I used was similar to that of Elliott's (1991) revised model.

3.3 Environmental education as a curriculum development strategy

I preferred to conduct the process of curriculum development within the framework of environmental education since it enables teachers from all subject disciplines to relate to it quite easily. This is in keeping with O' Donoghue and McNaught (1991:396) who concluded that, "Environmental education could not function either as an alternative concept of education or as a discrete fieldwork methodology. It could, however, be seen as a necessary approach to education and thus as a focus for curriculum innovation". They consequently treat environmental education as, "A sensitizing construct for curriculum reconstruction in a society under threat from environmental degradation". I consider such a concept, viz., environmental education as a sensitizing construct, as most appropriate in fostering a cross-curricular approach to curriculum development in a school context, and therefore used the theme "water".

Ramsey and Hungerford (1989, in Robottom and Hart, 1993) state that, "The most important skill development in environmental education is that associated with citizen participation in environmental problem-solving, and it has long been recognised that the key goal of environmental education is the acquisition of responsible environmental behaviour". Given that the ultimate aim of environmental education is the acquisition by students of responsible environmental behaviour, the key educational question in environmental education concerns the operationalization of this concept (Robottom and Hart, 1993). In this research I

attempted to involve the community by encouraging both pupil and parent participation in the solving of environmental issues/problems. This helped realise the practical aspects of this operationalization.

air poll
The topic "water" was chosen as a theme in the research project because of its relevance to the serious drought which ravaged southern Africa in the 1980's and the pollution of its water resources. There is a serious imbalance in the distribution of rainfall in South Africa in which 80% of the rain falls where 20% of the population lives (O'Keeffe, 1986). Despite large scale water management projects, the water crisis has reached alarming proportions in southern Africa. The sub-continent's water resources for an expanding human population and vital economic growth are under great threat from catchment destruction and pollution. In 1991 about 20 000 people, mainly children and the aged, died as a result of water-borne diseases and about 80% of all medical expenditure in Africa can be traced to poor water and sanitation (O'Donoghue, 1993).

The high fatality rate is an indication of a demand for water quality monitoring by southern African society. It prompted scientists to study river systems and their catchments in an attempt to solve the problem. The scientific knowledge produced through this investigation has been used by Global Rivers Environmental Education Network (GREEN) Support Services (Southern Africa) to develop low cost water quality monitoring kits as a techno-scientific innovation for cheaper and easier

river study. The water testing kits and supporting materials have been developed and distributed to teachers through a group called SHARE-NET. I used these low cost water quality monitoring kits as a tool for problem solving in the environment since, according to O'Donoghue (1993), so many people were dying of water-borne diseases. This research project was therefore designed as a curriculum response to a poor, demanding society for low cost water quality monitoring. I attempted to involve the school and its surrounding community in the project as an empowerment strategy for survival.

Wals et al (1992) make a desperate call for community problem solving in environmental education programmes as a means to reduce wide ranging environmental stress which has led to both the degradation of the biophysical environment and a corresponding decline in the quality of life. The view of the environment and environmental issues as an inter-linked array of political, economic, social and biophysical environmental factors (see Figure 6, page 88) has prompted the need for a community problem solving strategy. A lot of concern has been shown by the younger sections of the population in respect of the pollution of the environment. Jensen (1993, in Uzzell et al, 1993) states that surveys have revealed a sense of powerlessness among all sections of the population, and an inability to turn concern into competence, i.e., knowing how to act to solve the environmental problem in a technologically dominated society.

The low cost water quality monitoring kits have been produced by

SHARE-NET in collaboration with GREEN as tools to develop action

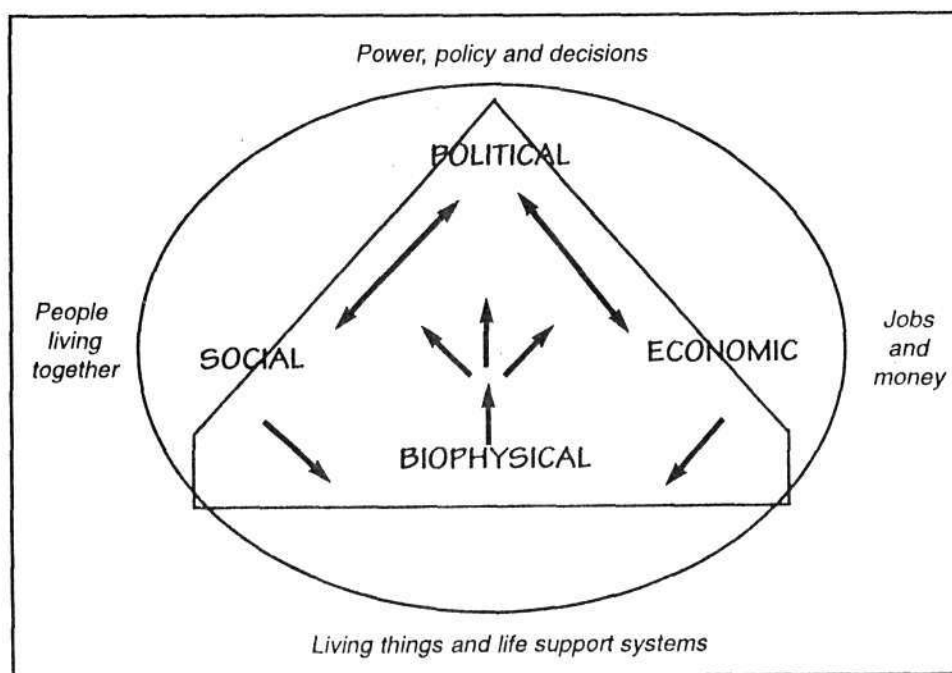


Figure 6: A holistic perspective of the environment (O'Donoghue and McNaught, 1991)

competence in the environment to confirm levels of water pollution. These techno-scientific devices enable children and adults to conduct a water study in rivers with almost immediately available results. The tendency for samples of water to be tested in a sophisticated laboratory and the results made known to pupils several weeks later creates a mystery in the minds of children about science. The use of the kit to demystify science is, therefore, a very useful development in environmental education. It encourages a socio-constructive approach to using science and technology due to the cooperative learning strategy implied in its use.

Baron and Misovich (1993, in Uzzell et al, 1993) state that children socially construct their attitudes and knowledge within social interaction. They will not effectively internalise "messages" from significant others over a long period unless the social influence process involves a sense of negotiation and socio-cognitive conflict. Attempts to impose environmental values upon children, through environmental encounters and messages may be ineffective because such an approach fails to appreciate the active role of children as decision-makers.

The water testing kits which were used in the research are useful tools in a constructivist approach to teaching and learning because of their empowering nature in developing action competence to solve a problem in the environment.

3.4 "Water" as a theme for a cross-curricular approach

I chose water as a theme in this research because its problematic nature in South Africa enabled me to facilitate a cross-curricular thematic approach which made environmental education central to the process of curriculum development. This decision records the need for a cross-curricular approach in schools to address environmental issues using an issue-based approach (e.g. "water") to develop the concept across all subjects as a pervading theme.

Lancaster (1990) indicated that a rigid division of the curriculum into subjects tended to interrupt the children's train of thought and interest and in the process hindered problem

solving. Uzzell et al (1993:3) stated that it was a delusion to believe that we can compartmentalise the different areas of our lives as if no interaction occurs between them. Robottom and Hart (1993) argued that many of the forces acting against expansion and improvement of environmental education in schools were political in character. They quoted the example of the struggle for resources engaged in inter-disciplinary environmental education within the context of a disciplinary subject based curriculum.

History shows that collective action is usually more productive than individual efforts in political struggles. These studies confirm that there is a need to break down the boundaries separating knowledge in schools through a process of integration. Bernstein (1989, in Stenhouse, 1991) stated that integration depends on the capacity of those involved to hold on to a particular open attitude to knowledge. It also depends upon the abandonment of the idea of knowledge as a possession and a source of power to be dispersed grudgingly to those who accept the system hierarchy.

3.5 Qualitative research

I place the action research case studies in the broad category of qualitative research, because I wanted to obtain an overall impression and a more complete picture of what happened in an intervention in a particular school context. I did not want to test a set of precise hypotheses. As Bogden and Biklen (1982, in Fraenkel and Wallen, 1990) suggested, "Qualitative researchers

are not putting together a puzzle whose picture they already know (as in empirical research). They are constructing a picture that takes shape as they collect and examine the parts." I therefore endeavour in Chapters Four to Seven to produce an emerging picture of curriculum development as it progressed in the four school contexts.

In this inquiry I attempted to document or portray the experiences of students on campus and in schools during their interactions with teachers. I was more interested in the quality of a particular activity, viz., curriculum development for science teacher education in environmental education. Research studies that investigate the quality of relationships, activities, situations, or materials are frequently referred to as qualitative research (Fraenkel and Wallen, 1990). This type of research differs from other methodologies in that there is a greater emphasis on holistic descriptions, i.e., on describing in detail all that transpires in a particular activity or situation rather than on comparing the effects of a particular treatment as in experimental (empirical) or conventional research.

The case study approach involved observations which occurred over an extended period of time and enabled me to develop a more intimate and informal relationship with those I was interacting with during my participant observer role. The environment of the school was more natural than that in which experiments are usually conducted. Cohen and Manion (1989) stated that

case studies are a 'step to action'. They begin in a world of action (as was characteristic of this intervention) and contribute to it. Their insights may be directly interpreted and put to use for staff or individual self-development, for intra-institutional feedback, for formative evaluation, and in educational policy making. Case studies present research or evaluation data in a more publicly accessible form than other kinds of research report. They are capable of serving multiple audiences.

3.6 The researcher as participant observer

I realised that I could, to the best of my ability, answer the research questions posed in Chapter One by participating in the situation or setting which was being observed. As a facilitator and researcher of curriculum development using a qualitative research methodology such as action research, I attempted to limit the manipulation of variables and control of individuals to a minimum by encouraging a horizontal power relationship at all times.

Fraenkel and Wallen (1990) warn of "an observer effect" because the participant observer is likely to focus the attention of the group on the activities of the researcher and away from their normal routine, thereby making their activities no longer typical. The data reported may also tend to reflect the biases and view points of the observer (researcher). However, I have indicated that this research was intended to serve as an intervention for educational change by enabling the participants

to question their practices and co-create an alternative curriculum to the prevailing decontextualised one. My role as participant observer enabled me to have access to a number of different methods and techniques of data collection which could be flexibly used. It also offered a means of relating research to those in a relatively low status role in the education system such as pupils, student teachers, and practising teachers.

Fraenkel and Wallen (1991) define data as "The kinds of information researchers obtain on the subjects of their research". Research instruments are devices used by researchers to collect or gather data. The whole process of collecting data is called instrumentation. Instrumentation involves the selection or design of the instruments and the conditions under which the instruments will be administered.

3.7 Research instruments and data collection

The research instruments were developed and evolved as the research progressed due to the uncertainty of the nature of the intervention at the reality site of the school. I could never be sure about what to expect next - a typical characteristic of action research. This explains my need to present the research instruments in a chronological sequence due to their evolutionary nature. The reason for developing a specific research instrument for a particular context will be explained for each case study presented in the proceeding chapters.

In the interest of obtaining data that reflected the views of the

participants in the programme and captured the outcomes of their critical reflections and activities, I used a range of data collection instruments. These are listed below and thereafter described in some detail to show how they were used to provide the information required to answer the research questions:

- a) 1991: Action planning meetings between science student teachers and practising teachers, the minutes of which are attached as Appendix A.
- b) 1991 to 1996: My personal diarised descriptive analyses of contexts and interventions which have been partly incorporated into the case studies in Chapters FOUR to SEVEN and represented more fully in Appendix B.
- c) 1991 to 1996: Photography (Appendix C) and video taping.
- d) 1992: Formal (structured) interviews (Appendix D) with participants in the project (science student teachers, a school principal, and practising teachers. Unstructured interviews (Appendix E) with pupils, and practising teachers. A short report on an interview with a parent of a pupil during the Open Day programme.
- e) 1993: A questionnaire which assessed the status of curriculum development practised in institutions of teacher education in the Province of KwaZulu-Natal (see Appendix F)
- f) 1995: A post-implementation questionnaire

addressed to the science student teachers who participated in the curriculum development project at School D (see Appendix G).

A questionnaire addressed to fourth year science student teachers who participated in the project during their third year and were expected to have implemented the skills of curriculum development acquired during school-based teaching practice in their fourth year (see Appendix H).

- g) 1995 to 1996: A sample of some of the curriculum materials produced by the student teachers (Appendix I).
- h). 1996: A questionnaire addressed to the practising teachers at School D prior to the introduction of the project (see Appendix J).

I will now explain how I developed the above mentioned research instruments, each of which pertains to one of the three categories listed below:

3.7.1 Written response type instruments:

Four questionnaires were developed to elicit written responses from the subjects of the study. The items used in the questionnaires included a few selection type items. Such items

presented a set of possible responses from which the respondents had to select the most appropriate answer, e.g., questions requiring "yes" or "no" as a written response. The majority of the items were supply type questions - some of which were closed while others were open-ended. These latter items requested the respondents to formulate and then supply their own answers. The closed items were short answer types which required the respondents to supply a word, phrase, or number as the answer to a question.

3.7.2 Structured (formal) and unstructured (informal) interviews:

Nine interviews were conducted at School B. Most of these were structured, in-depth interviews which were organised by using predetermined questions.

These interviews were recorded using audiotapes. Fraenkel and Wallen (1990) state that a major difficulty in participant observation is the fact that much that goes on may be missed by the observer. This is especially true if several behaviours of interest are occurring rapidly in an educational setting. They suggest that these obstacles may be overcome by the researcher using audiotapes and videotapes. One of the advantages of such recordings is that they may be played several times for continued study and analysis and may also be heard by other interested persons to offer their insights. Observations and reviews of field notes (diary), made by myself as the researcher, served to identify specific questions which emerged and were then asked during interviews to gain deeper insights into situations and to

clarify misconceptions and ambiguities. The purpose of the interviewing was not only to listen to the words of the participants in the study, but also to derive meanings and motivations, and to identify conflicts. Interviews were designed to discover how individuals interpreted the social world around them and how these interpretations were used as a basis for their actions. They were also used as a means of validating data acquired through other research instruments by triangulation. A degree of flexibility was built into the interview schedules to enable them to pose additional questions related to issues pertinent to the research.

Two kinds of items were used in the interviews: ✓

- a) fixed alternative items - these were a few and allowed the respondents to choose between two or more alternatives.
- b) Open-ended items - these were several and were mixed with the fixed alternative items. These items were designed to supply a frame of reference for respondents' answers, but put a minimum of restraint on the answers and their expression. ✓

The group interviewing technique used with the science student teachers, according to Watts and Ebutt (1987, in Cohen and Manion, 1989), has potential for discussions to develop, thus yielding a wide range of responses. Here a group of people who have been working together for some time with a common purpose are the subjects of the interview. A similar purpose prevailed

in the group questionnaire administered to these science student teachers. Transcripts of the interviews are presented in Appendix G.

3.7.3 **Observation and field notes:**

I used videotapes of some phases of the planning and development process and all the phases of the process of implementation of the project in every school which participated in the project. These tapes served as important direct observation evidence for the research and helped me to evaluate the process of curriculum development and the curriculum materials developed by the student teachers and pupils. The videotapes of all the schools studied will be made available upon request.

I regularly recorded descriptions of the project and critical moments within it in a reflective diary. I encouraged my science student teachers to do the same. A sample copy of my field notes for the school contexts is presented in Appendix B. These field notes are basically descriptive and partly reflective. The descriptive aspect of the field notes attempted to portray the settings of the schools, the people in them, and how they operated according to my observations. It also includes accounts of particular events and a detailed description of the sequence of events pertaining to the planning, development, and implementation of the projects.

The reflective aspects of the field notes present my thoughts and speculations about what I was learning, ideas that were

developing, and patterns and connections observed. These are the critical moments which steered the research. Also included are comments about the design of the study and my reflections as the inquiry progressed. Bogden and Biklen (1982, in Fraenkel and Wallen, 1990) state that the reflective aspect of field notes is the researcher's way of attempting to control for the danger of observer effect, and they remind us that if research is to be done well, it requires ongoing evaluation and judgement.

3.8 Developing trustworthiness

Every instrument, if it is to be of any value, must allow researchers to draw accurate conclusions about the capabilities or other characteristics of the people being studied. According to Fraenkel and Wallen (1990), research instruments are expected individually and/or collectively to provide :

- a) validity, which requires that that which is measured is what is supposed to be measured;
- b) reliability, which requires that the means of collection give consistent results;
- c) objectivity, which refers to the absence of subjective judgments.

The qualitative nature of the research conducted in this study is unlike quantitative (experimental) research which compares the effects of a particular treatment. It is easier to maintain objectivity in the latter form of research due to its empirical nature. However, in attempting to obtain a complete picture of a situation as in qualitative research, maintaining such objectivity becomes desirable although the possibility becomes

more difficult. I tried to be very controlled in not allowing my personal prejudices or biases to interfere with the research process. However, I am of the opinion that true objectivity can never be fully realised in any form of research. Biases inevitably creep in due to the research being conducted by a human being. I therefore hereby declare that a degree of subjectivity may have occurred because of the largely qualitative nature of the action research case studies reported in this dissertation.

According to Denzin and Lincoln (1994), trustworthiness is a more appropriate word to use in the context of qualitative (critical) research. It parallels internal validity - the extent to which a researcher's observations and measurements are purported to be true descriptions of a particular reality. The term transferability parallels external validity - the degree to which such descriptions can be accurately compared with other groups. Terms such as dependability and confirmability replace the usual positivist criteria of reliability and objectivity characteristic of the empiricist tradition in research. I used several methods of data collection referred to in 3.7 which played an important role in achieving trustworthiness and transferability through the process of triangulation.

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Cohen and Manion (1989) define triangulation as the use of two or more methods (multiple methods) of data collection in the study of some aspect of human behaviour. Triangular techniques help to map out, or explain more fully, the richness or

complexity of human behaviour by studying it from more than one standpoint and, in so doing, by making use of both quantitative data and qualitative data. I also attempted to achieve improved trustworthiness by minimising the amount of bias as much as possible. I did this by allowing a maximum freedom of expression from participants.

Observations in this case study took place over an extended period of time. As explained earlier in this dissertation, this enabled me to develop a more intimate and informal relationship with those I was interacting with and observing. I participated fully in the activities of the group being studied, but also made it clear that I was doing research. I made no pretence of being exactly the same kind of member of the group I was observing, as the other participants.

The entry into the situation was negotiated according to democratic principles. I aimed at engaging my participants in an equal partnership typical of a horizontal power relationship. The objective was to exclude any form of coercion typical of a hierarchical (vertical) power relationship in which most of the participants become subject to the authority of one or more individuals. This, I believe, was largely achieved with my students despite my position as a lecturer in the Science Education 3 course (see action research reports of students). I also tried my best to become aware of my biases and to try to control them. The reflective diaries of the student teachers served to identify some of these biases, which turned out to be

few in number. I admit that at times I tried to use my "authority" to move the project forward when the morale of the science student teachers ran low. This was due to the excessive demands on their other academic responsibilities, and sometimes to a lack of cooperation and interest shown by some staff members of the schools.

3.9 Conclusion

In the following four chapters, the methodology already presented is put into action in the form of descriptive analyses of the action research case studies. It is necessary to present the methodology in its given form so as to set the context for the implementation of the research. The research methodology used will be further elaborated upon in the next four chapters, especially in terms of how it evolved as the research progressed over six years in different school contexts.

CHAPTER FOUR

CASE STUDY ONE

4.1 Introduction

The process of curriculum development at the University of Durban-Westville for preservice science teacher education occurred in three stages. The first stage was confined to the university campus and involved student teachers developing curriculum materials for teaching science. During the second stage, the process of curriculum development occurred at the teacher education campus, and the materials were implemented/tested by the students in a school context without the involvement of the teachers. I was not employed as a teacher educator at the University of Durban-Westville during the first two stages of curriculum development.

I participated during the third stage as facilitator and researcher when the process of curriculum development was transferred to a school context. This stage represented a major case study involving four cases, each portraying an action research cycle which was sequentially linked to the next through involvement of the participants for improvement of an educational situation.

In this chapter I present the first case study. This includes a descriptive analysis of my colleagues' experiences with their students during the first two stages of curriculum development. The third stage consisted of four action research cycles which I facilitated as a researcher and participant. The outcomes of

the first action research cycle and how this influenced the case studies in the next three chapters/action research cycles are also presented and analysed to show how the interventions occurred. This analysis includes both the way in which the research instruments were developed to meet the needs of the next case study, and how the approach used was modified from one study to the next.

4.2 The first stage of curriculum development

The initial approach to curriculum development was introduced by my two colleagues who were science teacher educators in the Faculty of Education at the University of Durban-Westville. They personally communicated to me that, as a general plan, they engaged science student teachers in curriculum development as part of the science education course. The process of curriculum development was confined to the campus. The expectation was that when these students were employed as practising teachers they would implement the process of curriculum development for environmental education in their school context.

When my colleagues did an incidental evaluation of their former students' experiences as teachers by consulting with them, it was found that they were not able to engage in curriculum development with their new colleagues. Upon reflection they (our former students) advanced a reason for this failure. They claimed that they did not have an opportunity to test their curriculum materials in a school context during their preservice training as teachers. This was due to the process of curriculum

development being confined to the campus, an act which denied them the skill of implementing the materials which they had developed.

4.3 The second stage of curriculum development

My colleagues realised the need to amend the plan (first amendment) for curriculum development with future students by taking steps to select a school to implement curriculum materials developed at the teacher education campus. For the first time school pupils and teachers were taken to the mangrove swamps by my colleagues and their students. The purpose of this excursion was to implement an environmental education curriculum package which was planned and developed by the students. An evaluation of this approach showed that it was a very successful learning experience for the pupils. However, the process served to disempower the teachers who exhibited a dependency syndrome of watching passively while the teacher educator and the students implemented their curriculum package. It was also found through incidental contact with our students that, when they were employed as teachers, they reported that they could not develop curriculum materials with their new colleagues. The inference was that this occurred because their preservice teacher education programme did not enable them to develop these skills in a school through collaboration with teachers.

4.4 The third stage of curriculum development

The analysis above resulted in a need for a further amendment to the general plan for curriculum development for science teacher

education in environmental education. When I was employed as a science teacher educator in 1990, I was informed of the problems encountered by my colleagues in engaging students in curriculum development. One of my colleagues suggested that I should take the process further as an amendment to the previous approach to curriculum development.

With the support of my colleagues I then decided to conduct research into the area of curriculum development for science teacher education in environmental education. The amended plan (second amendment) agreed upon by all three colleagues was that the planning and development phases of curriculum development should occur through an intervention at the school involving our students and teachers. Science student teachers would now collaborate with practising teachers in a school context. This would involve action research. My research would represent a cycle in an action research spiral based on the second amended plan of action, viz., that the planning, development, and implementation of curriculum development would occur through close collaboration with students, teachers, and the teacher educator as the facilitator of the project. Such a view is endorsed by Halsey (1972, in Stenhouse, 1991:165) who stated that, "The emergence of a healthy tradition of curriculum research and development depends upon a partnership of teachers and curriculum research workers."

As indicated in the previous chapters the purpose of the school-based (reality site) intervention was to improve an educational

situation through involvement. In an attempt to achieve this, the case study was driven by an element of action research involving myself as teacher educator and facilitator and my students working with practising teachers. The model of action research used was that of Elliott's (1991) revised version of Kurt Lewin's model as illustrated in Figure 5 (Chapter Three). The students' level of action research has been described by Walker (1993) as first order and that of myself as second order. My action research strategy was focused on my students and was designed to improve my practice as a science teacher educator. The students' action research was focused on and occurred within the school context. The intention was to improve their role as future practitioners and at the same time influence the teachers to investigate their practice and improve it through collaboration among themselves (i.e, the students). Hence the reference to the science student teachers' level of action research as first order due to its attempt by practitioners to directly improve education in the school.

4.4.1 The decision to undertake a pilot study

Our new plan of action was to do a pilot study with a school and use this experience to plan for further interventions in other schools. My more experienced colleague and I, as science teacher educators, served as external facilitators for the curriculum development project and negotiated the entry into the school. Care was taken that the school atmosphere was conducive to an intervention involving interaction between our students and the teachers. I felt that, as a teacher educator, I owed this

responsibility to my students to avoid the project collapsing or failing in its early stages and wasting their valuable time which they needed to enable them to attend to other academic responsibilities as university students.

4.5 **THE FIRST ACTION RESEARCH CYCLE: The pilot study**

The pilot study for the research is presented as a descriptive analysis of the first action research cycle in this case study of the curriculum development process. Being a pilot study, the research instruments used were few and confined to my personal reflective diary and the minutes of meetings held during the planning and development phases.

4.5.1 **The school context and its resources:**

The school chosen for the pilot study for the sake of anonymity is referred to as School A - a primary school. The students who worked with teachers from School A in 1991 were the subjects of this pilot study. These students were studying for a second year science education course (Science Education 2). We visited School A for the first time on 15 May 1991. It was situated in a semi-rural (peri-urban) setting in a small town called Tongaat, 40 kilometres from our University campus. It was an old school. The surrounding Indian community appeared to belong to the lower socio-economic stratum. They lived in low cost homes and the children appeared to be under-privileged. Reading materials were limited and television sets rare.

There were a few, about 10, "Black African" pupils in the

predominantly "Indian" school. The principal was an older woman who was close to retirement. She welcomed us and was quite excited at the prospect of collaboration with her staff. She was most willing to "upset" the routine of the school to contest the curriculum through the process of curriculum development. She maintained that she had an open door policy for innovative approaches to education due to her short experience in curriculum development overseas. Her staff appeared to be happy and was bent on providing a good education for their charges. The eager faces of the pupils spelt it all out - that they enjoyed learning at this school.

The principal informed us that although the school was old it was reasonably resourced by the House of Delegates (a political tier at that time catering for "Indian" citizens). Among the items and other physical resources available at the school were the following:

- a) a television monitor
- b) a video machine
- c) a 16mm film projector
- d) a 35mm slide projector
- e) a film strip projector
- f) 3 overhead projectors
- g) 2 tape recorders
- h) a banda machine
- i) a duplicating machine
- j) a small library

4.5.2 **Our proposal to the school with a democratic principal:**

We explained to the principal the nature of the expected collaboration and the need for an environmental theme. She was informed that curriculum development for science student teachers constituted an essential aspect of their preservice training. Her support was needed to encourage her staff to participate with the students in developing an alternative curriculum for environmental education. This collaboration would enable a preservice/in-service link for curriculum development and teacher development, and her staff would benefit from the process for their professional growth. If she and her staff accepted this offer, this would mean "disrupting" the usual curriculum to accommodate an alternative curriculum developed by the students and her teachers. She would have to be prepared to make time available for the project which would be funded by the University of Durban-Westville, the students, and possibly an external funder (a local water board). Her staff would have to be available, prior to the implementation phase of the project, to plan and develop the curriculum with our students at the end of a school day, or during the school day.

The principal suggested that she would have to discuss this offer with her teachers and would later inform us of their decision to work together with our students. This, to my colleague and I, was an indication of her democratic approach to school administration. Additional evidence of her positive attitude could also be attributed to her full commitment and dedication to the local branch of the then Teachers' Association of South

Africa (TASA). TASA was in full support for teacher development and a change in the status quo with an in-coming new Government opposed to Apartheid. Her commitment to innovative curriculum development strategies were also the result of her experiences abroad, especially the UK and USA where she participated in such programmes. These experiences enabled her to respond favourably to a curriculum development project of this kind.

While driving back to the campus, my colleague and I reflected further on our first visit to the school. We agreed that not every school principal would even entertain the thought of collaboration with outside institutions. My colleague had met this principal at teacher association meetings. She was not a stranger to us. The rigid nature of the curriculum in South African schools made penetration difficult, especially since most principals adopted an autocratic attitude typical of an education system under bureaucratic control.

A culture of participation did not exist in such schools. In order to "break the mould", a policy change was necessary, or principals had to challenge the system by adopting a democratic approach to education. This principal appeared to satisfy our quest for such a person. She did not act slavishly on "red tape" bureaucratic decisions taken higher up in the education department's hierarchy. She made decisions for her school after consulting with her staff. This democratic approach to school administration and her positive attitude to curriculum development convinced us that she would be able to influence her

staff to meet with us and our student teachers.

4.5.3 **The staff's response and the planning and development phase:**

The principal informed us that the response of her staff was that they were keen to undertake the project. We planned a workshop with them and our students. My colleague during this pilot study played the role of facilitator while I decided to play the role of coordinator due to my lack of experience at this stage. A student was elected as the secretary. Records of the minutes of three meetings related to the initial project with School A are included in Appendix A. The purpose of using these records was to verify the process which the participants had to undergo during the planning and development phase of the project and which resulted in the implementation programme which was accepted and adopted by other schools as a model in future projects. This is supported by the field notes of my reflective diary (Appendix B) developed by myself as the researcher and video-recordings of the implementation phase. These data collection devices contributed to the triangulation process designed to ensure trustworthiness.

a) **The first meeting:** This meeting served to introduce all the participants involved in the project - the principal, students, teachers, my colleague and I. It also enabled the participants to briefly workshop ideas and issues pertaining to the project. After a lengthy deliberation with the teachers and students, it

was decided that a two week implementation phase would occur in September 1991. There would be three significant focus days for this phase of the project:

- 1) **The Awareness Day** would be the first day of the implementation phase. It would serve as a focusing experience because the students were expected to display all their curriculum materials (models, posters, charts, games, etc.) in the school's quadrangle. There would be work stations or teaching centres supervised by the students. The pupils would be called to an assembly and the principal, a student teacher, and I would explain the purpose of the project to them. The pupils would then be allowed to visit each work station in small groups where the students would discuss aspects of the project with them.
- 2) **The Excursion Day** would be a special day when the pupils were to be taken to a polluted river and exposed to a "hands on" water study. A low cost water quality monitoring kit would be used to determine the level of pollution of the river. The kit resembled a portable laboratory which enabled its users to do an "on the spot" investigation. This was expected to served as a demystifying experience in science. Usually a teacher may take a sample of river water to his classroom and inform the pupils that he/she would hand the sample over to a laboratory for a sophisticated test to be performed. Such an approach

may become a mystery to the child who is informed a few weeks later about the results. It was also hoped that the river study would lead to a community problem-solving strategy to reduce the pollution of water sources.

- 3) An **Open Day** was suggested as a final day for the implementation phase. A programme related to the water project at the school was planned between the teachers, pupils, and students. The parents, as representatives of the community at large, would be invited to the school on this day to provide further support for the curriculum development process. It was assumed that they would have contributed to the project when they assisted their children (pupils of the school) in preparing models and posters.

The Open Day programme was intended to be educational for the parents. They would also be exposed to a display of the curriculum materials used during the Awareness Day programme. The aim was to educate them about water problems in South Africa and to enhance a community problem-solving strategy related to these. During a refreshment break, the parents would meet with the staff to discuss such a strategy.

Teaching around water issues in all subjects would take place during the other school days. The role of the students in the river study and their duties were confirmed. The Awareness Day

and Open Day programmes were discussed and duties allocated to the participants.

b) **The second meeting:** During this meeting with our students, conducted in a lecture period at the University campus, my colleague and I discussed and shared ideas with them in preparation for the project. A time-schedule was developed and all the students agreed to abide by it.

c) **The third meeting** was convened by the students and concentrated on the planning for the first day of the project with the teachers - the Awareness Day. The development of curriculum materials across all school subject disciplines using the theme "water" was discussed and student responsibilities related to these were confirmed. The group decided to develop the curriculum using the theme "water". They wanted a cross-curricular approach with concepts related to water developed across all the subjects of the school.

d) **Contributions from some of the teachers:**

The **English** teacher was a strong driving force at the meeting. She was elected as the internal (school) coordinator for the project. She suggested that we should investigate the level of pollution of the local Hlawe River which appeared to be severely polluted. She was shocked at the observation she had made down stream when she saw people washing clothes in this river. She stated that her lessons would include drama related to rivers. Free writing related to pollution and other water issues would

also be included. Letters would be written by pupils to the local Town Board complaining about local water pollution. She also encouraged our students to keep a diary of their observations. My colleague and I suggested that the diary should not be totally descriptive, but should be reflective of the critical moments during the project. She promised to get her pupils to do the same.

The **Science** and **Geography** teachers were excited at the prospect of developing an alternative curriculum to the decontextualised one which they were forced to implement. This is in keeping with Elliott's (1991:49) statement that, "Teachers need to develop the ability to realise an alternative to the traditional pedagogy which has so long prevailed in the classrooms". The **Science** teacher stated that he would focus on water plants and animals and developing skills for problem solving in the environment. He would practically orientate his pupils towards rivers and work very closely with the geography teacher. The **History** teacher indicated his intention to develop lessons related to the history of Tongaat and its water supply. The **Art** teacher suggested a drawing competition based on water.

e) **Suggestions from students:** The students suggested that our lectures on campus should be focused on water issues and curriculum development. I suggested that they develop a file of resources to further improve their education on water. I had to consider changing my curriculum in the science education programme to equip the students for the project. The students

were very keen to participate in the project despite the loss of lecture time during visits to the school. The staff gave their commitment to the project and a procedure was worked out to plan and develop the project. Funding was an issue. My colleague stated that he would appeal to the Education Officer of the local Water Board, a bulk supplier with a very good water education service.

The students requested that they be allowed to group themselves into subject disciplines to plan further with the teachers. They appointed coordinators among them to attend to fund raising, resources, displays, posters, the Open Day display of pupil and student exhibits, the Awareness Day programme, and the River Day.

f) **The teachers adopt a changed approach to field trips:** The teachers admitted that previous field trips had been unstructured, with the main objective being to observe the environment. They realised that the next planned visit to the river should be structured to engage pupils in a meaningful way for meaningful learning. The field trip to the river would serve as a stimulus for environmental studies and the students agreed to plan a worksheet for a physical study of the river and to develop strategies for meaningful learning in the field.

g) **Negotiating an alternative curriculum for lectures:** My students and I worked out a new curriculum for our lectures on campus. They agreed that water-borne diseases, water testing, water animals and plants, river education, contesting the RDDA

model for curriculum development, and other water issues should form part of their course work. Lesson planning, development of work sheets, and a knowledge of learning theories were essential to the process. They requested that double practical periods be used for curriculum materials development. They wanted to work in groups. These became ethnically dominated. I suggested that groups should be racially integrated to break down language barriers arising from ethnic differences.

h) **Future arrangements:** An agreement was reached that the teachers would work on the project and would meet the students periodically. They would visit the river near the school to plan a curriculum. A workshop would be held on 21 June 1991 at the school with SHARE-NET environmental educators and the Education Officer of the local Water Board.

4.5.4 **The Implementation Phase:**

a) **The Awareness Day and pupil responses:** On the Awareness Day the students and their curriculum materials were transported to the school by bus. Here they displayed posters, models, books, and had a marine corner with fish, etc. (see Appendices C and I). Water testing was demonstrated at a water testing work-station by a few students. A wetlands model was used to demonstrate wetland importance. There was also a catchment area model. The pupils were allowed to study the posters and models. The students and teachers played an important role in discussing the curriculum materials with the pupils. The atmosphere of a real education (i.e., not decontextualised), which was contextualised

with all its richness to meet the needs of the pupils, prevailed. Some teachers did not expect the Awareness Day programme to be so appealing and expressed their feelings openly. I regretted that I did not have an audio-cassette recorder at hand. The Awareness Day process was recorded on videocassette.

A meeting was held with the staff to evaluate the programme. Teachers admitted that problem pupils were actively involved. These pupils were tired of responding to their regular teachers and were excited by the presence of the "new faces" of our students. The small groups were subjected to the individual attention provided by the students. This was very beneficial because under normal circumstances the teacher-pupil ratio was 1:30 compared to the current 1:4 situation. The teachers also observed that the quieter pupils responded in an unusually positive manner. They attributed the improved responses to the greater variety of curriculum materials and the non-traditional innovative educational experiences. The pupils' performance in homework tasks also improved significantly (Sham, 1991). Their exposure to diarising their experiences was new to them and it enabled them to see their role as involving their own initiative. This was a rare experience. The students admitted that their interaction with the pupils was a great experience and that the posters stimulated the pupils to take more interest in their learning.

b) **The River Day and comments by a few pupils:** On River Day, the local Water Board's Education Officer demonstrated the water

testing kit to the pupils, students and teachers. The pupils were divided into groups of 10 with each group allocated to three students. We walked to the Hlawe River. It appeared to be highly polluted. A few forms of life which survived such conditions were collected and identified by the pupils using a hands-on water information booklet. A coliform bacterial test was also conducted. The pupils openly declared that they thought that only crabs and fish lived in rivers. They were amazed at the diversity of fresh water life forms in rivers when they found animals such as leeches, rat-tailed maggots, and many others. It appeared to be an enjoyable and meaningful learning experience for them. Some comments by pupils:

"This is an experience which we will never get again."

"We saw creatures in a river for the first time."

"We can't see the real things in a class. We saw more in the river."

c) **Confirmation of pollution level:** The river was described as severely polluted after submitting it to the low cost water testing kit investigation. The presence of two local Water Board officials among us and several parents urged us to take some action to expose the industrial concern which contributed to the pollution of the river. The pupils were also annoyed. We returned to the school after conducting the water testing programme and decided to discuss our findings with the parents on Open Day.

d) **The Open Day and community problem solving:** This was the final day of the implementation phase - Open Day. The school used the hall which was part of the Hindu temple. A programme was developed by the students and teachers. There was a very good

turn out of parents. Items on the programme included a welcome by the principal, introductory speeches by a teacher, a student, and a pupil. The educational significance of the water project was explained to the parents and findings of the water testing experience at the river were presented to them. The student spoke about the role of his colleagues in the project. A pupil gave her views about the project. The pupils sang a song on water. There was a poetry recital on the theme water. Three sketches were presented related to the theme water. Competition winners were announced and prizes awarded. After the vote of thanks the parents were invited to view the displays and discuss some of the issues. They were clearly upset about the deliberate pollution of the river.

I visited the school a few weeks later and was informed that an offender was fined for polluting the water. This was a clear indication that our project was not in vain. This was a good example of community problem solving in the environment. Action competencies were developed during the project which empowered the community to take the appropriate action in exposing the offender. I am referring to the following competencies/skills:

1. The ability, during to the prolonged three weeks of exposure to a single theme ("water"), to develop and internalize the awareness that was necessary to commit oneself to take action in solving the problem of river pollution.
2. The ability to use the low cost water quality monitoring kit to confirm the level of pollution of

the river.

3. The ability to utilize the skills of writing to the local news media to expose the offender.

Such competencies may not be developed in a single lesson on "water" as is typical in existing classrooms. The development of these competencies has an empowering effect on the participants in enabling them, not only to show concern for the environment, but also to commit themselves to action. This is in keeping with Malone's (1993) view on environmental education and supported by Wals et al (1992). She stated that environmental education plays a critical role in enabling students, teachers, and the community to make a contribution to sustaining our fragile planet. The more specific field of environmental education should include the development of knowledge, skills, positive attitudes, and motivation to take action towards the prevention and resolution of environmental problems.

4.5.5 The post-implementation phase:

a) A case of support and resistance:

The teachers made a special request that the project be located in their school in 1992. When we returned to the campus, some students expressed their disgust at the lack of cooperation and interest which the Afrikaans teacher displayed regarding the project. I explained that we could not force her to participate. Fortunately it was only one teacher on the staff who resisted the project. It could have been more.

f) A poor turn of events: I visited the school in February 1992.

The principal had retired by then and a new principal was appointed. The school was unusually silent when I arrived at 9h00. I met the secretary who informed me about the change of office. I was introduced to the new principal who appeared to be quite uninterested in the project. He blatantly indicated that he would not allow the project to be implemented in his school. I realised that I was dealing with a bureaucrat. I thanked him for his time and requested his permission to meet some of the teachers who participated in the 1991 project. The teachers appeared to be withdrawn and despondent at the new appointment. I could not change the situation and left the school.

This principal represents an example of an autocrat who would not hesitate to stifle innovative approaches to education if these did not fall within the parameters of a rigid and prescriptive education system. Such a system embraces extreme central control which he had been employed to implement in subservience to his superiors. Reference is also made in Case Study Three (Chapter Six) to another principal who attempted to subvert the project. Marsh and Huberman (1984) refer to such principals as playing a superordinate role in implementing a system of education which is classified as a high-control or "authority model" employing a power coercive strategy.

The rejection of the project by the new autocratic principal coupled with the changed attitude of the teachers under his control indicated that the attitude of the principal in a school plays a key role in enabling curriculum development of the kind

used in this research.

4.6 Some reflections:

Reflections of the type referred to below enabled me to suggest improvements for future projects. These reflections helped to revise the project by informing the next action research cycle as part of the continuous evaluation of action research proposed by Elliott's (1991) revision of Lewin's (1980) model.

- a) I suspected that although the students supported the project, they experienced difficulty in conceptualising the rationale behind the curriculum development aspect of the project. I speculated that their participation was superficial. I realised that in motivating them to participate, I failed to expose them to the existing RDDA model for curriculum development, and its weaknesses, and the need to replace this with an action research model. The purpose of this project as a pilot study was indeed a learning experience for my colleague and me. I would include the RDDA model in their teacher education curriculum in the following year. Such an approach would provide an impetus for the students to gain a greater insight into the curriculum development project and to contribute appropriately. I would also expose the teachers to a similar process.

I also realised that if I allowed these second year students to repeat their participation as third year

students the following year, this might result in a more meaningful contribution from them. I would have to revise their teacher education curriculum to include other theoretical aspects which would support their collaboration with the practising teachers.

I would have to provide them with more resources to enable them to improve the quality of the curriculum materials which they developed and also assist them to improvise. This was necessary because during the project they were left to obtain their own resources for materials development. It was clear to me that most of the disadvantaged Black African students had been very handicapped by a lack of resources due to being poorer, financially, compared to some of the Indian students. The latter appeared to be more advantaged and evidence for this was clearly observed in the improved physical quality of their curriculum materials in which they invested their own funds. Some of the former were further disadvantaged by the lack of resources in the University residences. If they had travelled from their homes daily, resources may have been more easily acquired. Such a situation made it all the more necessary to obtain funding from outside sources for the project. I also needed to spend more time with the teachers during the planning and development phases and come to grips with resistance to the project by some teachers.

- b) In order to probe the thoughts of pupils, teachers, parents

and students, there would be a need for me to conduct interviews with them. The general support from most of the teachers, resistance from some teachers, the general enthusiasm of the pupils and some parents towards the project served as evidence that some very interesting data could be obtained through the interview process. These interviews would be captured on audio cassette, so that I would not lose the valuable details which might emerge if I had to record information in writing while the interview progressed.

- c) The cross-curricular approach developed during the pilot study made me realise that I should encourage lecturers (teacher educators) from other subject disciplines to participate in future projects and provide support for the students. This would serve to enhance a school-based curriculum development culture among lecturing staff. It appeared to be an ironical situation to several of my colleagues and me that, while we encouraged our student teachers to support and engage in cross-curricular approaches as future teachers, we failed to function in a similar manner in our personal teaching approaches in planning our lectures and school-based teaching practice approaches while on campus.

- d) There was also a need to engage students with the reality of the particular context of the school and its surrounding community. This would enable them to develop curriculum

materials to suit the context of the school. Cornbleth (1990) has made reference to the need to contextualise the curriculum. It also became clear to me, during the implementation phase, that a lack of some resources at the school could be overcome by student teachers engaging in improvisation. The process of improvisation becomes necessary in typically disadvantaged contexts in South African schools. Preservice education has a responsibility to prepare teachers for such a reality.

- e) The involvement of parents during the river study and the Open Day programme and their role in exposing the offender found guilty of polluting the river confirmed that community problem solving was possible through the school.
- f) Due to the distant location of the school (40 kilometers) from the university campus, the students did not engage in any formal classroom teaching. In the next project, I would have to find a school situated in close proximity to the university campus. There were logistical problems such as the need by the students to obtain transport if they wished to visit the school in their own time.
- g) I needed to change my role from that of coordinator to facilitator, researcher and participant observer since I agreed to research the project. School-based outreach programmes also became my responsibility and duty as a staff member of the Science Education Division.

- h) While the need for student teachers to keep diaries was suggested by the English teacher, I realised that, although my colleague and I thought of the idea, there was a real need for them to develop such documents. We would refer to such diaries in the next project as reflective diaries which would be partly reflective and more critical. The reflective diary would serve to capture the critical moments during the research and would be analysed to validate the research.
- i) In the next project I would draw upon the other subject combinations of the student teachers to develop a more deliberate attempt at a cross-curricular approach on campus. I would suggest to the student teachers that it would be compulsory for them to develop materials related to Science, and to collaborate with their colleagues who had similar combinations in other subject areas. Such a move would be in keeping with suggestions made by the Geography and Science teachers for purposes of integration.

4.7 Conclusion

The reflections of Case Study One presented above enabled me to realise that the pilot study provided me with appropriate guidelines to refine the research in a more focused direction with the next school. This would have to include, among others, providing students with more experience in curriculum development, interviewing students, teachers and parents during the implementation phase, and finding a school much closer to the University campus.

CHAPTER FIVE

CASE STUDY TWO: THE SECOND ACTION RESEARCH CYCLE

5.1 Introduction

This may be considered as the major case study reported in this dissertation. It was driven mainly by observations made during the pilot study represented by Stage Three of Case Study One representing Action Research Cycle One. One of its aims was to present the model of curriculum development generated during this action research cycle for adoption and adaptation by the next school. Another aim was to build on the strengths of this model and overcome some of its weaknesses, especially those which enabled the study to acquire more data to support the research. For example, structured interviews were conducted with pupils, staff, the principal, and student teachers for purposes of probing their thoughts and analysing selected recorded transcripts to obtain a clearer picture of the curriculum development process.

5.2 Selecting a school

I discussed the possibility of the Science Education 3 students participating in a curriculum development project with another school. These students had participated in the pilot study with School A. They agreed to participate with the next school in the study because they felt that they were more confident due to their previous experiences. They suggested that, apart from engaging in the outdoor experiences with the pupils during excursions and other awareness programmes for environmental education, they also preferred to teach in the classrooms. I

realised, as indicated previously, that I had to select a school which was within walking distance for the students from the university campus. I spoke to my colleague who indicated that he knew of a school principal at another school (School B) who might be very interested in his staff working with our students. He suggested that I should facilitate this project fully because his initial assistance as facilitator was to enable me to do the pilot study with the previous school as a learning experience to plan for the curriculum development project with the next school.

5.3 The principal of School B

I met with the acting principal of school B on 3 March 1992. The principal was on sick leave. I explained the significance of the project and its role in curriculum development. The deputy principal appeared to be very keen to support the project because he viewed it as a process of staff development which his Department of Education was beginning to encourage in schools. He appeared to be quite amenable to change and suggested that we could use the entire third term to plan, develop, and implement the project because this term was free of control tests which formed part of the formal system of school assessment. I informed the principal that since our students had to begin preparing for their university examinations during the third term, we could use three weeks of that term for the implementation phase of the project. Planning and development would have to begin with almost immediate effect for the next six months.

5.4 The planning and development phase

5.4.1 **Selecting an implementation period:**

I selected a three week period of implementation which terminated coincidentally with the last week of the university academic term. I could use the university Michaelmas vacation in September fruitfully for the research because schools remained open during this period. Post-implementation interviews pertinent to the research could be administered in the school with the teachers and pupils as part of the evaluation of the research. Other interviews would be conducted prior to and during the implementation phase of the project.

5.4.2 **My first meeting with the staff:**

I planned to meet with the teachers prior to arranging a meeting between them and our students. The acting principal was very friendly when I visited the school for the first meeting with his staff. He mentioned that his staff felt privileged at being chosen for the curriculum development project. Sixteen teachers attended the meeting. This included two heads of departments. The teachers appeared to feel hot and bothered as it was a particularly hot and humid afternoon. They made it quite clear that they were annoyed at being asked to meet after school for an hour and expressed the desire that future meetings be held during school time. I had to reduce the meeting by half an hour to appease the teachers. I recorded the proceedings of the meeting on an audiocassette. The following was discussed with the teachers:

a) I gave them a brief overview of the project with reference

to the experience with the previous school.

- b) I discussed with them the principles of action research.
- c) I compared the two models of curriculum development, viz., the action research model and the RDDA model. They preferred a cross-curricular thematic approach to curriculum development and were quite pleased to work with the theme "water". They requested that I provide them with an example of a cross-curricular thematic approach because they lacked experience in implementing such an approach. I used a transparency of an illustration of this approach taken from Lancaster's (1990) book based on reflections on art related to water (see Figure 7, page 134) which they willingly accepted. The request for an example of a cross-curricular approach made me realise the extent that the teachers were expected to function within the strict isolation of subject disciplines. Such isolation was disempowering and served only to restrict the creativity and innovation associated with cross-curricular thematic approaches to education.
- d) I also provided them with several research articles related to curriculum development and water education. I followed a similar approach with my students during lectures at the university campus. When I suggested that a horizontal power-relationship should prevail among us at all times, the two heads of departments walked out of the meeting. I surmised that they were not prepared to be equal partners in the project because they preferred to impose a coercive control upon the teachers which I felt was typical of the

bureaucratic hierarchical management which they were employed to preserve.

Towards the end of the meeting it appeared that most of the teachers present became more positive in their attitude to curriculum development and the project. They claimed that they regarded the project as a "great idea" and were willing to meet with our students. One teacher, the librarian, was adamant about not participating in the project because she claimed that she had attempted a similar integration project as an internal facilitator and failed to obtain the support of the staff. This, to me, was a critical moment in the research. It became obvious to me that an external facilitator was necessary to support curriculum development in schools which had never in the past expected to engage their staff in curriculum development practices. Some teachers on the staff also took advantage of my position as a university person who had access to human and physical resources not available at the school and made requests accordingly. I did not hesitate to assist them because I wanted them to realise that our role should be mutually supportive. At the conclusion of the meeting I arranged a date for the first meeting between the teachers and my students.

5.4.3 The first meeting between the students and the staff:

The meeting between the students and the teachers was an initially apprehensive one which kept both groups apart because they appeared to be afraid to communicate with each other. I tried to encourage an interactive dialogue between them and

finally succeeded. Once the "ice was broken" they agreed to adopt

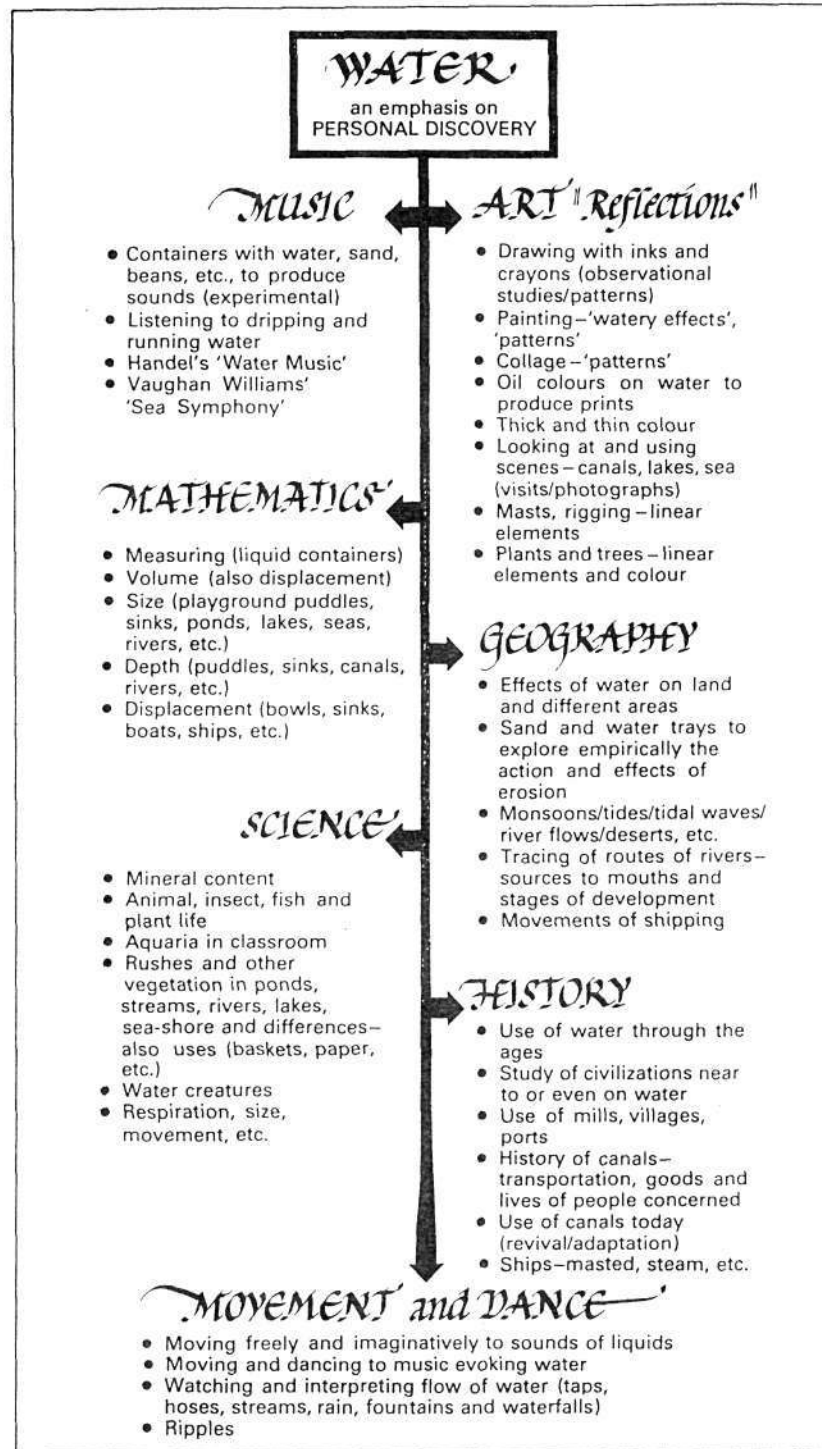


FIGURE 7: 'Water' - an integrated project topic.
Adapted from Lancaster (1990)

the model of the implementation plan of the previous project with some changes. There was a firm request from some of the students that they should be given the opportunity to do some classroom teaching during the project. The teachers agreed on condition that arrangements were made with them well in advance. Only one teacher, the English teacher, claimed to have had curriculum development experience as part of a voluntary inservice programme in the Western Cape. She was certainly a driving force in this project and was elected to serve as the internal coordinator for the project. Her main support came from a strong core of eight young teachers because there was an initial general resistance from a group of staff members, who, however, finally supported the project as they saw it unfolding. The students, however, gave the project their full support. The teachers and the students split into subject interest groups which agreed to work together in devising an alternative contextualised curriculum related to water. The subject interest groups were representative of both teachers and students and committed themselves to consultation with other groups. Once again I had to appeal for external funds for the project.

5.4.4 An offer of additional collaboration:

Planning and development for the project by the students occurred at the university campus during their lectures and practical periods. There were five official visits to the school by the students for consultation and collaboration with the teachers. A lecturer from the Integrated Arts Division of the Faculty of Education was most willing to participate in the curriculum

development project related to water. She suggested that her Drama students and my Science Education Three students collaborate in developing a drama package for practising teachers. She expressed the desire for her drama students to visit the local river with me as science educator. We agreed that there was a need for me to talk to her students during the drama period with the intention of setting the context for the curriculum development project.

5.4.5 **Exposing Drama students to a river study:**

I met with her students on 11 June 1992 and discussed the cross-curricular approach to environmental education which featured in the last school in 1991. They were excited about the water theme and I described the water problems of South Africa by focussing on drought, pollution, and the imbalance in the distribution of water in South Africa. They were willing to work with my science education students in producing a ten minute drama sketch related to water. The students insisted on me accompanying them on a study of the Palmiet River which runs through the campus. They suggested a movement and dance sequence in which they would move freely and imaginatively to the sounds of liquids. They were keen on watching and interpreting the flow of water from taps, streams, hoses, rain, fountains, and waterfalls.

5.4.6 **A drama sequence related to water:**

The Drama students finally produced a sketch called "Waterella" which portrayed a droplet of water called Waterella. Waterella was depicted as a water droplet which fell in a catchment area,

quite happy at being "born" there. Her happiness was soon turned to sorrow as the river passed through urbanised areas where she became a victim of pollution. Her sorrow soon turned to joy when she entered the open arms of mother ocean. The students were very keen on presenting this drama sketch to the pupils of School B during the Awareness Day programme.

5.4.7 A concern expressed for curriculum development:

The drama lecturer informed me that she did not feel comfortable with the thought that the teachers at School B were not directly involved with the planning and development of the sketch. This was not a democratic form of curriculum development since the school was not directly involved in its planning and development. I suggested that she ensured that in the next project the teachers be involved.

5.4.8 Curriculum materials developed by students:

Curriculum materials developed by the students were in the form of lesson plans, worksheets, posters, charts and models (see Appendix I). All these were related to water education in the different subject disciplines, but with an overall focus on developing science concepts. The planning and development for the project were finally completed and all of us looked forward to the implementation phase of the project.

5.5 The Implementation Phase

5.5.1 The Awareness Day programme and conducting of interviews:

As stated earlier, the implementation phase included an Awareness

Day programme, a river study, and an Open Day programme. Interviews were conducted with pupils, parents, teachers and students to evaluate the project and to triangulate information to determine research validity. Most of these interviews were structured in-depth interviews which were organised into predetermined questions (see Appendix D). Other interviews were unstructured (see Appendix E). Significant extracts from these interviews are presented and analysed as this report continues.

The Awareness Day programme commenced with pupils and staff being called to an assembly. There were talks by pupils, short drama sketches, and a presentation of a short play, "Waterella", developed by the drama students. These items were presented during the assembly and served to set the scene for the implementation phase of the project. On the same day groups of students and teachers set up work stations in the school's quadrangle where they displayed their curriculum materials related to water. The pupils were invited in groups to visit the stations where they were given a learning experience which was different from their regular classroom experience:

Researcher: So, what do you think about this programme?
Pupil 1 : I think that it is a very interesting programme. It makes people aware of how important water is not only to adults but also to children.
Pupil 2 : I think it's good. It is better than being in the classroom. Because here we can see it with our own eyes and can learn it. It's not like the teacher taking out a book and writing this and that about water on the board.

The pupils viewed this outdoor activity as being more significant to their education compared to their experiences within the confines of a classroom. Interacting with their peers and the

students was a unique experience enhanced by the models, posters, charts, science equipment, water quality monitoring kits, living specimens of aquatic life forms, and other activities related to water education. The curriculum development process was extended beyond the typical, standard, and traditional processes of classroom teaching. It enhanced their learning experiences by improving conceptualization.

While the Awareness Day programme set the scene for the project, the students made arrangements with the teachers to teach a few lessons in their classrooms during the two weeks of implementation. Lessons related to all the subject disciplines were taught and these were focused on water issues.

5.5.2 **The river study:**

The river study occurred on the third day of the implementation phase. The principal arranged for an assembly of the classes which participated. I did the preliminary demonstrations related to the water testing kits. I also divided the classes into smaller groups and assigned two students per group with water testing kits. We chartered a bus to the Umgebaan River where we were met by the education officer of the local Water Board, and his guest, a visiting professor in science education from Nigeria. The education officer assisted us with the water study. A teacher's response to a field trip indicated its role in contextualising and conceptualising science through the process of environmental education experienced as a hands on experience at the river.

Researcher: Do you find the information in the hands-on experience booklet useful?

Teacher: Very. It helps to conceptualise science. So many pupils have never seen these life forms before and did not even know that these exist. A study of this type will help them to enrich their knowledge. Now that they are doing it themselves, they seem to be enjoying this first hand experience which is so important.

An interesting point to note is that apart from one science teacher, we were also accompanied by teachers from most of the other subject disciplines offered at the school. These teachers were keen to study life forms in rivers and this was a great learning experience for them. They were especially enthused with the great diversity of life forms encountered in the river. They commented that they expected to find only crabs, fish, and frogs in the river. They promised to take their newly acquired experiences back to their classrooms and develop these further with their pupils. This observation served to further indicate that environmental education appears to appeal to all teachers, irrespective of their subject disciplines, and could be developed across the curriculum. Its role as a sensitising construct (O'Donoghue and McNaught, 1991) as described previously in this dissertation was hereby confirmed.

During the two weeks of implementation, the school also embarked on other excursions to the following places:

1. The Durban-Heights Water Purification Works.
2. The Wildlife GEC Expo.
3. Sea World.
4. NAPAC - for water related short plays.

The pupils were urged to watch television programmes related to the environment. They were also encouraged to involve their

parents in project work and assignments related to the curriculum development project.

5.5.3 **The Open Day programme:**

The Open Day programme was attended by 22 parents. The internal school coordinator liaised with me and the students in developing a programme of items related to water. Curriculum materials from the Awareness Day programme were displayed again so that these could serve as a learning experience for the pupils. Our students also contributed a few items to the programme. Prizes were awarded to pupils who excelled in art, drama, and model construction. These prizes were purchased by the students from the funds which they had raised for the project.

Pupils were encouraged to discuss the project with their parents and other relatives. Getting parents involved in the project through their children was an educational experience for them in acquainting themselves with South Africa's water problems such as abuse of piped water at homes, local water pollution and water-borne diseases:

- Researcher: Did you go home and tell your parents about your experiences?
Pupil 1: Yes. They learnt a lot from us.
Pupil 2: Yes, they like it. My mother is a teacher and she is in favour of it. They do think it is a very good programme and it makes it (learning?) easier and a lot more interesting.

A mother stated that there was a remarkable change in her daughter's attitude to water abuse at home. She claimed that the change could be attributed to the impact of the project as it had not occurred from regular class lessons. She declared that her

daughter had recently taken great care when using the tap at home following involvement in our project.

Researcher: Your teachers taught you about "water" in every subject. What do you think about this form of learning?

Pupil: Every thing is connected, sir, and it makes it very interesting.

A pupil's response (above) to the significance of cross-curricular thematic approaches to their learning shows that real education as opposed to the reproductive education of conventional curricula took place through the teaching approach of the project.

Researcher: Tell me, are you taking care at home to save water now?

Pupil 1: Yes, like before, I was not just worried about closing the tap properly, but now I am much more careful about saving water.

Pupil 3: Yes. And our parents are really shocked that we are saving water because when we used to brush our teeth and wash our faces we used to leave the taps running all the time. Now it's just a little.

These statements by the pupils endorse the significant impact of the project on their lives. It shows that the traditional approach to teaching by telling pupils in classrooms how to save water in a ten minute discussion made very little difference in solving the problems of water abuse. The project's three week sustained implementation in its apparently enriched and focused cross-curricular strategy has helped to do justice to environmental education as it is expected to be practiced.

5.6 Post-implementation interviews with students

While the students, practising teachers, and pupils appeared to

be pleased with the success of the implementation phase of the project, I decided to conduct further structured indepth interviews as a form of evaluation to validate the research. Set questions were used and the interviews recorded on audiocassettes and later transcribed. Transcripts of these post-implementation interviews are presented in Appendix D and some significant extracts from interviews with students are presented below and interpreted for their relevance to this study.

(note: ST = Student Teacher)

Researcher: Why did you think that some teachers did not cooperate with you?

ST 1 : One basic reason is that they were not exposed to this when they were at college (of teacher education). They don't know what to do. They simply come to school to earn a living and go home at the end of the school day.

ST 2 : I agree with my colleague. The teachers who resisted did not know what to do. They were confused. They only saw things towards the end. They agreed that if we come again next year, it will make more sense and they will participate more.

These responses from the students confirm the responses to the survey questionnaire sent to tertiary institutions (see Case Study Three) that most institutions of teacher education implement syllabi which exclude curriculum development. The second student's remarks imply that the teachers who resisted the project were too accustomed to prescription to the extent that they could only cope with certainty and not with any form of change. I recall the tendency of some resistant teachers to show more interest towards the end of the implementation of the project.

Researcher: Then, do you view them as curriculum developers or implementers of the curriculum?

ST 3 : They are more implementers. Change in South Africa must be accepted for them to shift away from being implementers.

This student has realised that teachers who function as implementers of curricula in South Africa may not be able to relate to the educational changes expected to accompany political change. They may be able to relate positively if they have acquired the skills of curriculum development which would enable them to become reflective. This observation about the reflective teacher has also been made by Brookes et al (1993).

5.7 Outcomes of post-implementation interviews conducted with school staff

Post-implementation interviews were conducted with five staff members of School B. The interviews were coded into categories for analysis and interpretation and are presented in Tables 1(a), 1(b), and 1(c) where responses are indicated with the symbol *. Each category is divided into sub-categories and a short report on the analysis is presented. The analysis is supported further by relevant extracts from transcripts of the interviews. The purpose of these interviews was, partly, to evaluate the project, to improve validity through triangulation, and to also answer some of the research questions posed in Chapter One of this dissertation. Abbreviations used in the tables are elaborated in the key below:

Key: CD = Curriculum development
EE = Environmental Education
SBTP = School-Based Teaching Practice
P = Principal
E = English Teacher
S = Science Teacher

a = Art Teacher
A = Afrikaans Teacher
T = Total number of respons

TABLE 1 (a): CATEGORISED RESPONSES OF 5 STAFF MEMBERS OF SCHOOL
B TO POST-IMPLEMENTATION INTERVIEWS : CURRICULUM

CATEGORIES	SUB-CATEGORIES	P	E	S	a	A	T	%
1. Staff's perception of curriculum	1.1 Slaves to prescription				*		1	20
	1.2 Change agents			*	*		2	40
	1.3 Implementers						0	0
	1.4 Curriculum developers	*	*	*	*	*	5	100
2. Curriculum development	2.1 Professional autonomy		*	*	*	*	4	80
	2.2 Contextualised education	*	*	*	*	*	5	100
	2.3 Inservice experience		*				1	20
	2.4 First inservice experience	*		*	*	*	4	80
	2.5 Educational transformation	*	*				2	40
	2.6 School culture constraint				*		1	20
	2.7 Conceptual dilemma		*		*		2	40
	2.8 Confidence development	*	*	*		*	4	80
	2.9 Supports innovation	*	*	*	*		4	80

The responses presented in the table above pertain to curriculum

issues related to the staff's perceptions of curriculum and curriculum development. Of the five staff members interviewed, the Art teacher indicated that she viewed herself as a slave of prescriptive curricula and was willing to serve as an agent of curriculum change. All of them indicated that they perceived their role as that of curriculum developers and not curriculum implementers.

Researcher: Do you feel that most teachers are slaves to a prescriptive curriculum?

Principal: In the present system I would say yes. But if you expose your teachers to a situation like this where you have children involved in field education where teachers also take an active part, then I think that will fall away. I think it depends entirely on the administration of a school.

The principal's statement supports the view that teachers in South Africa are, generally, implementers of curricula. He saw merit in the project's outdoor, child-centred approach to environmental education. However, his reference to the administration implies that change initiated at the grassroots level by teachers may not occur if its approval is not granted. His democratic approach to school administration is hereby endorsed through the positive nature of his leadership in fully supporting our curriculum development project because of its impact on staff development .

Researcher: Would you regard your teachers as implementers of curriculum or as curriculum developers?

Principal: Definitely. I think the approach has changed. At one time you had the principal and administrative staff telling teachers what's to be done. But now with this new concept in education, I think that they are more than implementers. They are now forming the curriculum.

This statement supports evidence that the participants in the project appeared to have succeeded in developing an alternative curriculum through a cross-curricular approach.

Researcher: Are there any questions that you would like to ask?

Principal: Mr Pillay, I am not going to ask you any questions, but I am going to tell you one thing. You have introduced something in education which is a new concept. I am not sure whether it exists in other official (education) systems but I do hope that you will visit other schools and introduce a thing of this nature. It is a new approach altogether and my staff, pupils, and myself will miss you. We are very grateful. The approach (to education) is now different.

The principal indicates that from his experience he has never come across such a project. He views it as an innovation in education which is worthy of implementation in other schools. He once more admits that the approach to education at his school has changed due to the impact of the project.

Researcher: Do you prefer to be an implementer of curriculum or a curriculum developer?

Teacher (E): What do you mean by implementer of curriculum?

I found it strange that even at the conclusion of the project some teachers were presented with a conceptual dilemma as indicated in the above response. They were prepared to view themselves as curriculum developers but failed to realise that they previously functioned as implementers of curricula. Perhaps the question posed by the researcher referred to language which was not familiar to the participants at grassroots level.

Researcher: Was the approach beneficial to your colleagues and your pupils?

Teacher (E): I cannot speak for the other teachers, but, for

my part it was my first experience in putting together a programme from the variety of feedback I got from the pupils. I mean from their writing they have thoroughly enjoyed it. Many of them said thanks to the lecturer from the University of Durban-Westville and the student teachers who took the time off to teach us. We have something we will never forget. It's so different from learning from this context than learning from a text book. That's the heartening thing because despite what colleagues had to say, a positive response like this from the pupils makes you feel that next year we have to go ahead and improve on this and make it a better experience.

The English teacher's statements reveal that she considered the project to be a great success and that the best judges ought to be the pupils. Moving away from a classroom-focused environmental education experience which was textbook based made a difference. The difference could be seen in the use of innovative curriculum materials and outdoor experiences for the pupils. She also alludes to the negative responses of some of her colleagues to the process. She concludes that if her pupils saw the implementation of the project as a success, then the resistant teachers must surely be wrong in their negative assessment of curriculum development.

Researcher: Do you as a professional feel that the curriculum should be imposed on you?

Teacher (S): Well, first of all, you need a guide. But, as to detail of content, I feel that we should be free to approach it the way we want to.

Researcher: Were you ever stifled in that respect?

Teacher (S): Yes. There is no time actually because of the physical restriction at times in school and one cannot do much that is out of the prescribed curriculum. This year we had a lot of interference.

These responses indicate that prescription by education authorities tends to stifle innovation by not leaving teachers with enough time. They appear to have no time to reflect and

change their practice.

TABLE 1 (b): CATEGORISED RESPONSES OF 5 STAFF MEMBERS OF SCHOOL

B TO POST-IMPLEMENTATION INTERVIEWS : RELATIONSHIPS

CATEGORIES	SUB-CATEGORIES	P	E	S	a	A	T	%
3. Collaboration	3.1 Enhance- ment of staff development	*		*		*	3	60
	3.2 CD enhancement	*	*	*	*	*	5	100
	3.3 Innovation promoted				*		1	20
	3.4 Culture of participation	*	*	*	*	*	5	100
	3.5 A preferred approach to SBTP	*	*	*	*	*	5	100
	3.6 Democratic principal	*		*		*	3	60
4. Researcher as facilitator	4.1 Personality important		*		*		2	40
	4.2 Poor coordinator					*	1	20
	4.3 Good coordinator	*	*	*	*		4	80
	4.4 Innovative	*	*		*		3	60
5. Resistance from other teachers	5.1 Ignorance of CD					*		
	5.2 Apathy			*	*		2	40
	5.3 Older teachers traditional		*			*	2	40
	5.4 Slaves to prescription	*	*	*			3	60

Table 1(b) presents an analysis of the relationships arising from the collaborative involvement of teachers during the process of curriculum development. It also presents an analysis of the views of teachers pertaining to the role of the researcher as facilitator, and reasons for teachers resisting the curriculum development project. All or most of the five staff members interviewed indicated that the process of collaboration with their colleagues enhanced staff development through curriculum development. All of them also agreed that a culture of participation was developed through their collaborative experiences, and they preferred such an approach to school-based teaching practice. Some of them preferred a democratic principal and an external facilitator to support such a process.

Researcher: You appeared to have a democratic approach to education during our interactions with you. Did you have any fears about deviating from the usual trend in schools?

Principal: I think there is a need for freedom in education as long as the pupils benefit. They should be the main benefactors. There was a lot of merit in what you have done and you have my full support.

This statement is evidence of the democratic approach to education by the principal. He appears not to be bound by prescription from his education department if his pupils do not benefit from it. He provided full support for the project despite its innovative and experimental nature.

Researcher: What are your comments about team work among teachers during the project?

Principal: I think it was generally good. Your students were positively motivated and they worked well with my teachers. If you did not come in from the University, we would have been still working in watertight compartments.

This statement by the principal indicates the impact that the curriculum development project had on his staff in engaging them in a cross-curricular approach. This means that the purpose of the action research strategy in this project was fulfilled to a large extent. It helped in enabling the improvement of a situation through collaboration between students and teachers.

Researcher: Do your subject advisors/inspectors collaborate with your staff members when a new syllabus is handed down to schools?

Principal: There is a need for communication between subject advisors and the school as a whole in order to work out a strategy to implement the new syllabus. They need to come to the school like you have done and collaborate with the teachers, rather than just giving us the syllabus. I think that a programme like this (project) should be introduced to every school.

Here the principal admits that the project has enabled him to see the need for a collaborative approach to pervade the education system to enable conceptualisation of curricula. He also indicates the extent to which the curriculum (syllabus) is currently handed down to teachers at the grassroots level without adequate support from subject advisors. Such a top-down approach may only serve to increase conceptual tensions which could result in implementation failure.

Researcher: Can you provide details of this resistance? Why did they (the teachers) behave this way?

Teacher (E): Basically many teachers are so set in their ways and are so established with promoting syllabuses handed down by the department (of education) that they don't focus on relevant education. They just simply go by the book irrespective of what they are teaching is relevant to education. Like, for example, the Maths teacher who will only do the Maths that is prescribed in the syllabus and nothing else out of that context. Even the Afrikaans teacher did not see it as very much as

an example for collaborative and participatory work.

Here the English teacher clearly explains the extent to which teachers become victims of a prescribed education. Their inability to function as reflective teachers due to such prescription prevents them from engaging in and contributing to educational change or transformation. They appear to have a natural tendency to resist anything new and it becomes difficult to break this mould. The teacher whom she referred to distanced himself from the project from its inception and even passed sarcastic remarks about the project to some members of staff.

Researcher: Are you aware of teachers who resisted the project?

Teacher (S): I am aware of one. She gave her views. She resisted because when she tried such a project in another school, she was not given the necessary help. So she did not want that to happen here. She wanted to remain neutral. But there are some teachers who had it easy without involvement. Teaching has to be a challenge.

This statement by the science teacher and by two other teachers in the school who experienced similar frustrations is an indication that the introduction of curriculum development in schools may require an external facilitator initially. In educational situations where a culture of participation is not the regular school culture, it appears to be a difficult task for a concerned and enthusiastic staff member from within the school to facilitate change. The negotiated entry of myself as researcher and external facilitator was welcomed by most staff members who viewed my intervention as a move in the direction of educational transformation. There were a few teachers who viewed the change sceptically due to the extra work associated with it.

Teachers need to realise that educational change cannot occur without a commitment to work hard at it.

Foucault (1980, in Elliott, 1991) states that there are no relations of power without resistance. I felt disappointed at the attitude of a few other teachers in the school who resisted the project despite the horizontal power-relationship which I attempted to encourage as facilitator and which appeared to influence the project positively.

Researcher: Can you and your colleagues now work together as a group without an external facilitator for future projects?

Teacher (S): Yes. As responsible people we should now be able to work together and improve the project further. It will not stop here. Our lessons will now become pupil-centred and not teacher-centred. Pupils are now asking us, "must we do this topic? - why are we doing it?", especially a prescribed topic. Now we as teachers can change and we need to change. We as teachers are there to change. And it does not take much work, just a little initiative. There are certain topics which I don't like. We need to bring in this creativeness.

The science teacher's response indicates that the curriculum development project has, to an extent, succeeded in instilling a culture of participation among some teachers in the school. This success could be attributed to its collaborative nature. The school-based action research intervention has helped to empower them to see the need to change and serve as change agents through reflection.

Researcher: Do you think that working with the English teacher and other subject teachers helped conceptualisation in science?

Teacher (S) Very much so because as we teach we come across

new concepts which overlap with other subjects. We contacted each other daily to share new ideas and concepts. And you know, as we are implementing the curriculum it works very well. There about twelve of us who are working closely and enjoying it (the cross-curricular approach) as we are sharing our ideas. More teachers are joining us.

These responses serve as evidence of teachers working together across all subjects to develop a common theme. The project in this school has realised its objective of stimulating collaboration among practising teachers through a preservice link enabling inservice education. It also shows that integration across the curriculum depends on the capacity of those involved to hold on to a particular open attitude to knowledge (Bernstein, 1989, in Stenhouse, 1991)

Researcher: What is your view of the collaboration between student teachers and practising teachers in developing the curriculum?

Teacher (a): It is a good idea. It encourages innovative thinking.

Researcher: Can the existing school system accommodate such a change in approach?

Teacher (a): No. The structure imposes a constraint to real education and its practical applications. The system is too prescriptive. It is not meaningful. The whole system needs to change to focus on real education.

Researcher: Were there any constraints in the implementation of this project with respect to things like time, planning, or development of materials.

Teacher (a): No. It depends entirely on the principal. This freedom does not occur in every school. I have served under a very firm principal in another school. This strips you of everything. - especially your individuality. You just become a part of the whole system.

The Art teacher was referring to the constraints of prescriptive systems as experienced in the other schools she served. She implied that collaboration between students and teachers may not be successful in such systems. I have indicated previously in

this dissertation that such an intervention can only be successful in schools which are democratic and willing to change. The case of School A, to which reference has been made in Case Study One, is a good example of a school which could not collaborate a second time due to a change in the principalship.

TABLE 1 (c): CATEGORISED RESPONSES OF 5 STAFF MEMBERS OF SCHOOL B TO POST-IMPLEMENTATION INTERVIEWS : EE ACROSS THE CURRICULUM

CATEGORIES	SUB-CATEGORIES	P	E	S	a	A	T	%
6. Cross-curricular thematic approach	6.1 Ideas shared	*	*	*	*	*	5	100
	6.2 Enhanced science concepts		*	*		*	3	60
	6.3 Enhanced language in science		*	*		*	3	60
	6.4 Supports EE		*	*		*	3	60
7. Environmental education	7.1 Field work preference	*	*			*	3	60
	7.2 Development of awareness		*	*	*		3	60
	7.3 Pupils' attitude to change	*	*	*			3	60
	7.4 Supported by parents	*	*	*	*		4	80

The table above presents an analysis of the views of teachers regarding the role of a cross-curricular, thematic approach and its development in a school context through environmental education. All or most of the staff members interviewed indicated

that the development of environmental education through a cross-curricular thematic approach enabled them to share ideas, and improve concepts and language related to science. They also preferred parents to play an active role in supporting the environmental education of their children.

Researcher: Do you think if they work in isolation they will be successful curriculum developers?

Principal: No. I do not think that we should have watertight compartments in schools. Subjects should not be watertight. I think that there should be integration. All subjects should be closely involved in such a way that teachers can play an active role.

This statement endorses the principal's recognition of the role that cross-curricular approaches have to play in curriculum development. He also implies that these approaches should be supported by the full participation of teachers.

5.8 Some reflections:

The need to confine the project to third year students: I took the second year students through the first project which served as the pilot study in the first school. I saw the need for the same students to participate again in this school as third year students because they claimed that they had conceptualised the project quite late as the project progressed towards the end of the implementation phase. I now realised that in the next case study with another school, I had to confine the curriculum development project to a new group of third year science education students. These students had already been exposed to an environmental education curriculum which focused on river education and other water related issues. They did not have any

curriculum development experiences in the programme. It would be more practical and logical to work with third year students due to their improved level of maturity compared to the second year students.

Curriculum materials: The curriculum materials produced by the students were of a reasonable standard and were capable of further improvement for a better quality. The quality of the posters, charts and models was good. I was not too pleased with the lesson plans, worksheets, and their general lack of creativity in developing materials of an innovative nature such as puzzles, games, puppetry and other materials. I had to think of some way of extending the students' experiences on the university campus by providing them with more human and physical resources.

The "Waterella" drama sequence developed by the drama students was useful in setting the scene during the Awareness Day programme. It was developed further when a script was written and it became a national publication for the Umgeni Water Education Service. However, the drama lecturer stated that there was a need to develop a water-related play which had an interactive drama sequence, i.e., involving the audience of pupils while they watched the play. I agreed that this was a good idea for our next case study, and she promised to pursue this idea with her students. She also indicated that our science student teachers should be involved with her drama student teachers in the planning of such a drama sequence, and that it was not good

curriculum development practice to exclude the teachers from the process.

The need to conduct a survey: The English teacher at the school claimed that she had participated in a curriculum development process during voluntary inservice in the Western Cape. This compelled me to engage with the need to conduct a survey to establish the status of curriculum development for science teacher education at institutions of teacher education in KwaZulu-Natal.

5.9 Conclusion

It became increasingly clear as the case study progressed that a democratic principal was needed to enable the process of curriculum development in the two schools studied thus far. Since only one teacher had an inservice experience in curriculum development in another province, it became necessary to conduct a survey in institutions of teacher education to establish the extent to which curriculum development was practised.

CHAPTER SIX

CASE STUDY THREE: THIRD ACTION RESEARCH CYCLE

6.1 Introduction

This case study occurred over two years (1993 and 1994). The implementation phase of the curriculum development project was subverted by strike action of a teachers' union in the first year after the planning and development was accomplished. The project ran smoothly during the second year, although staff tensions over the appointment of a new principal occurred.

In addition a survey which conducted during the case study is also included in this chapter. A questionnaire was administered provincially and partly nationally to assess the status of curriculum development for science teacher education in tertiary education institutions. The responses to this questionnaire are analysed. It has to be emphasised that although the survey may not form part of the action research cycle, it became necessary to conduct it at this stage of the case study. Observations of the student teachers and myself made during the previous two case studies showed that teachers generally were not exposed to collaborative curriculum development experiences during PRESET.

6.2 The school context and the principal's commitment

The Principal of School C had invited our Faculty of Education's staff to use his school for research purposes. I decided to seize this opportunity due to the school being about half a kilometre from our campus. It was a fully resourced school which was initially built to house "Indian" pupils. It soon became a "white

elephant" because it failed to attract enough pupils from the middle class community which surrounded it.

Fortunately at that time, Mr Nelson Mandela, a Black African political prisoner, was released after twenty seven years. He was incarcerated by the Nationalist Government for campaigning for the political freedom of the oppressed Black majority in South Africa. This signalled imminent political transition in South Africa. In response to this development, School B (and many others) adopted an open door policy for admission and, as a result, prevented its closure. Unfortunately, the principal was transferred to another school and was replaced by another.

In November 1992, I successfully negotiated with the new principal to plan and develop a curriculum development project with his staff. I visited his school in February 1993, only to discover that he had taken early retirement and had been temporarily replaced by his deputy principal until the appointment of a new principal. The deputy principal expressed her commitment to the project and was willing to work with my students. She also suggested, like the other principals, that she required the consent and approval of her staff and would meet with them to discuss the project before inviting me to address them.

6.3 The planning and development phase

I went back to her school in late February and was informed of her staff's decision to participate after consulting with me. I

arranged a meeting with the staff and explained the need for a collaborative approach to curriculum development and the role of my students therein. The staff was willing to participate in the curriculum development project. I sensed a tension between members of staff who welcomed the suggestion of a horizontal power-relationship, and one head of department who felt threatened by it. His initial resistance was defused by some of his staff members who convinced him of the need to co-create the curriculum.

Several meetings were arranged with the students and the school staff. The student profile comprised Science Education Three students who like previous groups were also registered for another major subject. The participants accepted the format of the implementation phase proposed by the previous two schools. The students prepared curriculum materials in their groups and were fully prepared for the implementation. The deputy principal played an instrumental role in ensuring that the project went off smoothly in preparation for its implementation in June 1993.

6.4 A subverted implementation phase

It was unfortunate that prior to the implementation, the newly established South African Democratic Teachers' Union (SADTU) decided to embark on strike action which resulted in a cancellation of the implementation phase of the project. The students were very disappointed at such a turn of events which prevented them from testing their curriculum materials. The staff suggested that the project be repeated the following year. I

preferred to accept the offer due to the good logistics associated with the close proximity of the school to the University Campus.

6.5 Reinstating the project with the same school

6.5.1 **Resistance from the newly appointed principal:**

I revisited School C quite early in 1994 and was informed by the deputy principal that a new principal had been appointed. I was introduced to her. She appeared to view the project negatively and attempted to subvert it by discouraging the collaboration. She indicated that she was a new principal who needed to get familiar with a new staff and this required time. She made it very clear that her role was to ensure that the curriculum (syllabus) of the education department was to be implemented at all costs, and that she agreed with its aims and objectives fully. It was quite clear that she was not prepared to listen to my view point. I informed her of her staff's commitment to the project as agreed upon during the previous year and suggested that she discuss the issue with them prior to making her own decision. The deputy principal also vouched for the previous year's promise and convinced her principal to consult with the staff.

6.5.2 **A very interesting staff response:**

The staff, who were by now quite used to my presence in the school and the merits of a collaborative curriculum development project, were not prepared to abandon the project. They took it

upon themselves to keep to their promise and continue with the project. It was quite obvious that they were influenced by SADTU's democratic position on teachers. A few teachers confided in me that they did not approve of the autocratic approach adopted by this principal and were determined to show her a point by cooperating with me and our students. Due to the sensitive nature of the situation at the school, I decided not to interview the staff or administer any questionnaires. I feared that, considering the principal's cold, bureaucratic approach, such an action would jeopardise the project if she decided to call in her superiors from the education department to intervene.

6.5.3 Implementation of the project:

The students and teachers met and planned the alternative curriculum together. The principal agreed to allow the project to resume but kept a low profile and allowed the deputy principal to be in charge of it. Again, I was able to enlist the support of the drama lecturer to develop a drama sequence for the project. She was careful to involve the support of a few practising teachers and produced an excellent interactive drama sequence related to water. During the implementation she was also able to produce a few puppet shows with the assistance of her Art students which were educational for the pupils. At no stage did the new principal show any interest in the process of development which her staff experienced during the intervention of the collaborative project with her school.

6.6 Some reflections:

6.6.1 **Changing to a Black school context:** By now I was beginning to see a clear pattern emerging which was common to the three schools which were of an "Indian" character typical of the Ex-House of Delegates schools which were better resourced than Black schools. I decided to discuss with my colleagues the possibility of working with a "Black" school which represented a disadvantaged context. Such schools were predominantly Black African due to the race policy of Separate Development of the previous Nationalist Government. Being disadvantaged, they lacked resources, had unqualified and under-qualified teachers, and were disempowered further by a serious second language problem among pupils and some staff members. The "Indian" science student teachers claimed that they required some experience in such schools because, unlike the previous Government policy, an individual irrespective of race could now teach in any school in the country.

I was also disturbed at the responses from the survey questionnaire in which 12 respondents from Ex-DEC Colleges of Education (Black Colleges) indicated that they refrained from instructing their students in curriculum development because their teacher education syllabus did not include training in this field. This had implications for such teachers who I suspected

would not be capable of functioning as curriculum developers.

6.6.2 **Writing an action research report:** Until now I had not expected my students to write an action research report. I realised that this was a demanding request for undergraduate students. I would have to offer them some support to develop their skills at reporting on action research as experienced in the project. Fortunately this group of students were the first to be exposed to action research in the Education course when it became an integral component of the teacher education curriculum that year. I decided that in the next project a booklet or file would have to be developed in three parts: a reflective diary, an action research report, and a presentation of curriculum materials developed during the project. This could be a group effort. I also decided that second year students would have to develop skills at materials development by engaging in curriculum development which would be campus-based and related to environmental education. This experience would enable them to feel more confident to develop curriculum materials when they engaged with teachers in the third year.

6.6.3 **Additional participant observers:** To enhance triangulation of data and hence the trustworthiness

("validity") of the research, I decided that there was a need for additional participant observers to be included in the project.

6.6.4 **Including students in preliminary visits:** In the case studies discussed thus far, my students did not accompany me during my initial negotiations with the principal and during the first meeting with the staff. I felt that in future projects I would include at least four students as representatives of the class during preliminary visits. Such an action would serve to improve the horizontal power-relationship which I believed was necessary for curriculum development. The Integrated Arts (drama and arts) students would also have to be part of all the visits to the school together with their lecturers.

6.6.5 **Interviewing fourth year students:** I questioned the assumption that if our students had school-based curriculum development experiences, they would develop skills to continue the process as teachers. I therefore decided that in the next case study (1995) I would conduct an interview with this group of students. They would then be in their fourth year of study and would engage in a compulsory six week school-based teaching practice programme.

6.7 A survey questionnaire for tertiary institutions

6.7.1 **The need for the questionnaire:**

During the planning and development of the above project I developed a survey questionnaire aimed at establishing the status of curriculum development for science teacher education at colleges of education and faculties/schools of education at universities in the Province of KwaZulu-Natal in South Africa. The purpose of this questionnaire was to compare the process of curriculum development as practised at the University of Durban-Westville in the Science Education Division with what occurred in other teacher education institutions. This would serve to validate the need for the research because by this stage I was convinced that curriculum development was hardly ever practised at most of the institutions of teacher education in the Province of KwaZulu-Natal. A copy of this questionnaire is included as Appendix F in this dissertation. Some supply type items were subdivided into further items. Provision was also made for the respondents to answer questions applicable to their institutions only, according to their practices relating to curriculum development.

6.7.2 **Coding the questionnaire:**

The supervisor of this dissertation advised me to consult with a senior lecturer in the Department of Curriculum Studies at the University of Durban-Westville. The purpose of the consultation was to establish whether the questionnaire was structured appropriately to answer one of the research questions. The senior lecturer advised me to code the questionnaire into categories to

facilitate analysis and interpretation of data to enhance validity due to the qualitative nature of the study. Another colleague, a science education lecturer, suggested that coding was not necessary due to the descriptive analytic nature of the case study. However, due to the open-ended nature of the questionnaire, I decided to post-code the responses after receiving returns from the institutions. My supervisor also suggested that the questionnaire be subjected to a pilot study by testing responses to it in science teacher education institutions in parts of South Africa outside KwaZulu-Natal.

6.7.3 Piloting the questionnaire in another province:

As a pilot study, 12 questionnaires were sent to institutions of teacher education outside the province of KwaZulu Natal (KZN) to test the validity of responses to the items. Fraenkel and Wallen (1990) suggest that researchers should carefully prepare their questionnaires ahead of time and then try out the instrument by administering it to a group of individuals similar to the population they intended to sample in their study. Problems with administration can thus be identified early and corrected before it is too late.

Eight of these questionnaires were returned (return rate: 67%). Upon scrutiny the responses were found to be valid and this did not warrant any further changes to the items in the questionnaire. Of these questionnaires five respondents indicated that they practised curriculum development with their teachers in some form while three did not practise curriculum

development at all.

6.7.4 Administering the questionnaire within the Province of KwaZulu-Natal:

As a follow-up, 40 questionnaires were sent to institutions of tertiary education in KwaZulu Natal. Twenty questionnaires were returned (response rate: 50%) representing 14 institutions of science education. Respondents from two institutions indicated that they did not provide initial preparation (preservice) for science teachers.

6.7.5 Questionnaire analysis:

Responses to the items were coded into categories for analysis. The responses are reflected in Table Two (see page 170). The categories were not pre-coded and evolved out of the responses to items in the questionnaire. The categories reflecting "thematic and participatory approaches" show responses from institutions which did not implement curriculum development but which preferred these approaches. The "innovative and standardised materials" category refer to the materials development process which occurred in institutions which practiced curriculum development. The "collaboration with teachers" category refers to institutions which involve teachers in curriculum development. The "cross-curricular approach" category is a general response by all respondents whether they practised curriculum development or not. The results of the pilot study are also indicated as a matter of interest.

a) Institutions practising curriculum development:

Six respondents from KwaZulu-Natal indicated that some form of curriculum development exposure/instruction occurred at their institutions of teacher education. Three of these were from colleges of education not under the control of the Ex-Department of Education and Culture (DEC) and the other three were from universities. These colleges of education are semi-autonomous institutions which have a degree of flexibility in planning their teacher education curriculum. The universities are autonomous institutions and have a greater curriculum flexibility.

b) Institutions which do not include curriculum development in their preservice programme:

Twelve respondents from Ex-DEC colleges of education indicated that they refrained from instructing their students in curriculum development because their teacher education syllabus did not include training in curriculum development. The Ex-DEC institutions had been denied the freedom to alter the prescribed curriculum which emanated from Pretoria. This loaded curriculum only served to disempower the respondents from any attempt at curriculum development by imposing a severe time constraint.

c) Development of innovative materials development practices:

Innovative materials development practices through collaboration appears to be the prerogative of universities due to their autonomous state. However it appeared that most of the innovative and collaborative practices were confined to the campus and lacked school-based intervention similar to the research project

reported in this dissertation.

TABLE 2 : RESPONSES TO A SURVEY QUESTIONNAIRE ADMINISTERED IN KZN AND NON-KZN (PILOT STUDY) INSTITUTIONS PROVIDING SCIENCE TEACHER EDUCATION

CATEGORIES	KZN COL. OF ED. (15)	KZN UNIV. (5)	NON-KZN COL. OF ED. (4)	NON-KZN UNIV. (4)
1. Syllabus constraint to cur. dev.	12		1	1
2. Thematic approach to cur. dev.	3			
3. A participatory approach preferred.	2			
4. Innovative materials developed		2		2
5. Standardised materials developed	3	1		
6. Collaboration with teachers		3		
7. Cross-curricular approach favoured	10	4	2	3
8. Practise curriculum development	3	3		2

d) Views of cross-curricular, thematic approaches:

A very promising aspect of this survey was the recognition by the majority of respondents that cross-curricular thematic approaches to curriculum development have an important role to play in enhancing the conceptualization of science through developing a holistic view to knowledge. One respondent from a college of education acknowledged the role of such an approach to making

science relevant, but, with certain reservations. He believed that cross-curricular thematic approaches could breed misconceptions due to the simplistic nature of the concepts associated with it from other subject areas.

Some statements made by respondents favouring cross-curricular thematic approaches were as follows:

- (1) "It helps to develop a holistic, non-fragmented view of knowledge. It contextualises science."
- (2) "It proves that a holistic approach to environmental education is necessary."
- (3) "It allows the child to internalise concepts in environmental education more easily".
- (4) "It will help to demystify science and help pupils to develop a more positive attitude to it."
- (5) "It will help pupils to engage with the reality that knowledge cannot be compartmentalised and that concepts are inextricably linked."
- (6) "It will help to break down the boundaries separating knowledge and enable meaningful learning in science."

6.7.6 Additional significant responses:

Additional significant responses which were not categorised in Table 2 are the following:

- (a) A respondent from a Non-Governmental Organisation (NGO) offering a Further Diploma in Education (FDE) as an inservice programme indicated that her science teachers resisted or disliked anything new and out of the traditional mode of operation such as

collaboration with teachers for curriculum development.

- (b) A very promising response from a non-KZN university lecturer was the reference to a fourth year project in which the science student teachers did a critique of an element of the science curriculum of a given school standard. This was followed with a submission of a resource pack of materials, some of which had been trialled and proposed alternatives and innovative ideas. A major aspect of this approach was to show cross-curricular links to other subjects such as English, Geography, History and Guidance.
- (c) Another non-KZN lecturer indicated that a group of interested teachers had begun to develop some alternative curriculum materials for standards six, seven, and eight. However, research funds were needed to support the process.

6.8 Conclusion

The responses to the survey questionnaire pertaining to the exclusion of curriculum development in the syllabus of Black colleges of education, the request from some of the students to work in a different context, and the limited amount of change experienced during the case study prompted me to reconsider the use of predominantly "Indian" schools as future sites for curriculum development. I therefore decided to consider a totally Black school context for the next case study of curriculum development in the action research spiral. This also came as a

request from both the African and Indian students who preferred the project to be conducted in a poorly resourced school.

CHAPTER SEVEN

CASE STUDY FOUR: THE FOURTH ACTION RESEARCH CYCLE

7.1 Introduction

This case study was conducted in a Black African context. It presents a descriptive analysis of the process of curriculum development which occurred over a period of two years (1995 and 1996) in the same school and with two different groups of third year students. Also analysed are three questionnaires, two reflective diaries, and one action research report.

7.2 The school context and the principal

In February 1995 I approached two of our ex-students who had been appointed as teachers at School D in KwaDabeka (Clermont). This is a "Black" African township situated next to New Germany and 15 Km from the campus of the University of Durban-Westville. The two teachers were very keen to serve as internal coordinators for the project. Their previous experience as science student teachers involved in Case Studies One and Two of this research would serve to encourage their colleagues in the school context to collaborate with our students. I was pleased with their support and decided to visit the school for the first time early in March 1995.

The principal was on the verge of retirement. The deputy principal was a dynamic gentleman who was concerned about improving the education of his pupils in a school which was classified as being in a disadvantaged context and typically under-resourced. With the advent of a political democracy in

South Africa and a new Government, changes were taking place in disadvantaged schools which were becoming visible. For the first time the school was fenced and a new block of classrooms had been built and fully furnished. This block was in marked contrast to the existing drab classrooms.

School D had 21 teachers and 1300 pupils. The classes ranged from Class One to Standard Five. There were three graduates on the staff which appeared to be generally friendly. The school was clean and kept this way by the pupils who were given the menial tasks of cleaning toilets and sweeping the classrooms and the school yard. It had a duplicator and an overhead projector. A photocopier was donated to the school by the Anglo American Corporation. A nutrition scheme was in progress at the school and the pupils appeared to be a happy lot with bright faces.

Instruction up to Standard Two was in the medium of the mother tongue, viz., Zulu. Science was offered for the first time when pupils entered Standard Three with a sudden change in the medium of instruction. The principal's office had a telephone and posters on its walls. A very interesting sight was the presence of a mission statement which clearly outlined that their intention was to, "provide an innovative and purposeful education suitable and relevant to the child's world." This encouraged me greatly and I knew that I had chosen the right school. The deputy principal's office was even more appealing with wall charts and posters related to History, English, and Art. The staff room had a large table and a few desks which did not appear to be adequate

to cater for the needs of the staff.

I was made to feel welcome by both the principal and the deputy principal. I discussed the role of the project from a staff development position. They informed me that despite half the staff being generally away at inservice day programmes/workshops, they would accept our curriculum development project. They appeared to be willing to expose their staff to as much experience of teacher development as possible. I assumed that this was due to the stifling effect which the former system of Bantu Education imposed on the professional development of teachers. My offer was renewed hope for further attempts at staff development, and they felt duty bound to seek such avenues.

I was not pleased at the thought that the principal and the deputy principal took decisions for their staff without consultation. I therefore explained the need to consult with the staff and to obtain their endorsement for the project. The deputy principal stated that he would prefer to be the internal coordinator for the project. I suggested that it was necessary for me to explain the nature of the project to the staff. He agreed to inform me in due course as to whether the staff would be prepared to meet with me to discuss the project.

The principal at the end of our meeting stated, "We hope, Mr Pillay, that with your coming here we will have more improvements. We are tired of waiting. We are waiters". This statement saddened me and indicated the state of official neglect

which the school's administrative staff was compelled to endure.

7.3 My first meeting with the staff

I met with the staff during the last hour of the school day. The deputy principal did not invite the junior primary teachers who had already left for home. I presented the project to the teachers as I had done previously. I indicated that the theme "water" could not be changed because our key funders were interested in promoting water education at schools and that funding was otherwise difficult to obtain.

I discussed the need for teachers to engage in reflective teaching by moving away from inflexible, rigid, and restrictive traditional teaching methods. They needed to move away from practising in isolation and had to learn to plan, develop, and implement their teaching by collaboration with their colleagues. The teachers were keen on adopting the procedure which other schools had accepted. They also agreed to collaborate with our students and I arranged a date for the two groups to meet.

7.4 The planning phase

7.4.1 **The first meeting of the students and staff:**

3 April 1995

I arranged for the transport of 70 science student teachers to the school on 3 April 1995. I suggested that the deputy principal chair the meeting.

Some observations/critical moments:

- a) The students and teachers sat in the staff-room in their own groups and a cold silence separated them. The deputy principal suggested an ice breaking session to get the two groups talking. He finally succeeded in integrating the two groups (students and teachers) and proceeded with the discussion.

- b) The principal suggested that a few pupils also be involved in the planning and development of the project and called them in.

- c) The students were busy making notes of the proceedings. They were keen on reporting on the action research as part of their year mark. They had to compile a file in three parts: A reflective diary, an action research report, and a record of curriculum materials.

- d) It was difficult to get the teachers directly involved in the action research process. They were willing to assist the students in developing materials as per subject, but indicated that they lacked the time to do research. I had the impression that they did not understand the process, despite the presence of my ex-students among them. The latter claimed that they could not assist the teachers because were busy studying for a part-time higher degree and had been occupied with their own school-based research.

- e) A student suggested that since the "Indian" students were

not familiar with the culture of a "Black" African school, they wished to observe a few lessons before developing curriculum materials. They were keen on observing how the teachers handled second language learners in a disadvantaged context.

- f) The deputy principal noticed that most of his teachers were not fully committed to the project and informed them that a sum of R6000.00 was at stake and that they should be considerate. He assured me that he would talk to them to motivate them further for their full cooperation. (Note the use of funding to encourage the school to participate. Some funds were to be used for refreshments for pupils, teachers, and parents). He also stated that his teachers would produce curriculum materials with their pupils for the implementation phase.

- g) It appeared that the teachers were part of an authoritarian regime. Although the senior management appeared to be democratic, the teaching culture of subservience prevailed. Why? Is it that Black African teachers respect authority, especially that of older principals?

- h) The teachers were reminded that their school's mission statement related perfectly to our contextualised project.

- i) The two ex-student teachers had kept a low profile. I waited to see when they would feature. After all, one of

them introduced us to the school.

- j) The deputy principal stated that it was difficult for teachers to change from the old school of thought. They were accustomed to teaching in English and in Zulu and now must change to the medium of English only. This made teaching their pupils more difficult because all their pupils come from homes where the mother tongue language was Zulu. I suspected that even some of the teachers had a second language problem.

**7.4.2 A pre-project questionnaire on curriculum development:
addressed to the practising teachers at School D:**

I decided to administer an open-ended questionnaire directed at the teachers of School D who participated in the curriculum development project. Additional background information was also provided as an introduction to the questionnaire (see copy of questionnaire in Appendix J). The purpose of administering such a questionnaire as a pre-project data collection device was to establish the perceptions of teachers pertaining to the curriculum development project. The questionnaire aimed at obtaining the teachers' views on curriculum, environmental education, cross-curricular approaches, collaboration, and their commitment to a curriculum development project. Such views were necessary to enable me as facilitator to plan the intervention at the school site with my students. This questionnaire was expected to enhance triangulation by complementing the results of the survey questionnaire aimed at establishing the status of

curriculum development at teacher education institutions in KwaZulu-Natal and in other parts of South Africa.

7.4.3 The response rate and analysis of the questionnaire:

The response rate to this questionnaire was poor. Seventeen teachers received questionnaires and only three responded. This questionnaire was presented to the teachers immediately after my first meeting with them. They requested a week to complete the questionnaires. The responses have been categorised and are indicated in Table 3 below.

Table 3: Responses of practising teachers at School D to a pre-project questionnaire

CATEGORIES	NO. OF RESPONSES	PERCENTAGE
1. Curriculum is the syllabus	1	33%
2. Curriculum is a group of subjects	2	66%
3. Previous experience in curriculum development	1	33%
4. Purification of river water at home	3	100%
5. Water education- a cross-curricular approach	3	100%
6. Full commitment to the project	2	66%
7. No experience of collaboration with other subject teachers	2	66%
8. EE should be a separate subject	1	33%
9. EE should be integrated	2	66%
10. Time constraint for project	2	66%

Key: EE = Environmental Education

Despite the low response rate from teachers, the picture created confirmed the perceptions of the students about them (see later). Most of the teachers lacked experience in curriculum development and it is understandable that, consequently, they would not see the need to collaborate with their colleagues in the other subjects. The narrow view of curriculum as being a subject may also contribute to their activities being confined to a subject discipline and hence to work in isolation. The time constraint due to a demanding work-load may also serve to diminish the prospect of functioning as curriculum developers. An encouraging response was the tendency for teachers to view the implementation of environmental education as an integrated approach across all the subjects in the school.

7.5 The development phase

7.5.1 **Discussions with science student teachers during lectures:**

First discussion:

The students were introduced to the curriculum development project. Reference was made to previous projects. This project enabled them to collaborate with school teachers in producing an alternative curriculum and implementing this in the school context (reality site). The students were excited at this prospect and were willing to accept the project as a challenge. Some of them were worried about losing lecture time in other subject areas. I assured them that I would make time available during their science education lectures and practical periods to enable them to develop materials. Student group leaders were identified. Subject groups were formed to facilitate a cross-

curricular approach. I insisted that each group should also produce science materials related to water education.

Second discussion:

The students were introduced to the RDDA model and the action research model for curriculum development. They realised that the latter model was useful in challenging the status quo in science education and wanted to apply it in the school context and among themselves. I explained to them the need to keep a reflective diary and to plan their action research strategies in their groups. The need to interview teachers and pupils was made quite clear.

Third discussion:

The students wanted to know what to expect at the school. I informed them that most of them (i.e, the "Indian" students) had never been to a disadvantaged school or experienced its context and that they should reflect on their reading experiences of newspaper articles and also discuss issues with those students who had been educated in these schools. They already realised that second language problems would exist, but had no idea of the reality. They were looking forward to the first visit to the school.

Fourth Discussion:

This meeting involved a review of the students' first visit to the school for a meeting with the teachers. Discussions typical of previous projects occurred. They requested a tour of the

school to visit classrooms. I encouraged three Integrated Arts lecturers to also accompany us with a few of their students. This group planned a useful materials development process with two teachers.

Some students were not too pleased with their interaction with some of the teachers who appeared to be disinterested. Other students found their interaction with some of the teachers to be most encouraging. The students generally sensed that a lot of the effort would be theirs, with the teachers serving as mentors in the process. They realised the need to plan materials with a Zulu language background to enhance concepts. They requested a day to implement classroom teaching and the "Indian" students realised that this would not be possible without a "Black African" colleague's assistance with Zulu. The students suggested the need to raise additional funds to provide resources for the school because they appeared to sympathise with its plight. They also requested a letter from me addressed to their lecturers in other subject fields so that they could be excused from lectures during future visits. They made a further request that the next four double period practicals and a few lectures be devoted to materials development because they found it difficult to meet with their colleagues after hours.

7.5.2 An assessment of materials prior to implementation:

The groups displayed their materials in the science laboratory. These included posters, charts, models, experiments, puppet shows, games, etc. These materials were assessed by me and

comments were made about their usefulness or relevance to the context of the pupils. I felt that their materials were prepared well, with a lot of effort, and suggested that the students develop strategies for their implementation during the Awareness Day programme which was scheduled to take place in two days time.

7.6 The implementation phase

7.6.1 **The Awareness Day Programme:**

The Awareness Day programme commenced with an assembly of the pupils addressed by the principal, myself, a student, and a representative of Durban Waste Water Management who spoke to the pupils about abuse of sewage and storm water systems. The programme was eagerly received by the pupils because the curriculum materials developed by the students were displayed on the walls of the school's quadrangle and represented an enriched educational environment which the pupils were not exposed to previously. After the assembly, groups of pupils visited the work stations set up by the students who had interesting discussions and interactions with them. The context was now set for the next two weeks of teaching around the concept water.

7.6.2 **The Excursion Day Programme:**

The Excursion Day programme included a visit to a sewage works, waterworks, and a river. We were fortunate to have with us a professor from the African Forum for Childrens' Literacy in Science and Technology (AFCLIST). He presented us with a reflective account of the river study (Appendix N). Such an account by a science educator from the outside served to enhance

the trustworthiness of the research. He found that the teachers left most of the actual river study to the students and the principal. They appeared to be disempowered. The pupils, however, enjoyed the educational outing.

The professor's comments were valid because they were based on a fair observation on his part. His visit coincided with our first curriculum development project within a new context, viz., a Black African school. It confirmed the students' observations about the teachers of this school. Second language problems were observed not only with the pupils but also with some of the teachers. The principal whom he referred to as the head teacher was quite enthusiastic and supportive due to his own positive beliefs about curriculum development. The students were left to do most of the work. It seemed that the teachers had taken a long time to conceptualise the significance of the project for their practice as teachers. It may have been that the project was imposed upon them by the principal and this was not made known to me due to the teachers' fear of victimization or respect for authority. However many of the teachers were very helpful to the students in assisting them to understand the culture of the school and the second language reality.

At the river the principal and the two teachers (our ex-students) did not play the role of spectators, rather involving themselves with the students. As facilitator, I did not conduct a workshop with the staff to empower them to use the water testing kit to do a hands-on experiment at the river. I handed a kit to the two

ex-students on the staff and expected them to conduct the workshop -an act which I took for granted, but which did not occur.

7.6.3 The Open Day Programme:

This programme had an excellent response from the parents who were exposed to water problems related to our rivers, diseases, sewage abuse, etc. The students interviewed some parents and teachers to assess the impact of the project on education at the school and for the community. This was an appropriate community problem-solving strategy in environmental education. The problems of waste water abuse were discussed with the parents by an education officer from Durban Waste Water Management using a model. Refreshments were served to all the participants at the end of the programme.

7.7 The administration and analysis of post-implementation questionnaires

Two post-implementation questionnaires were administered. One was administered to the Science Education Three students who participated in the project in 1995 at School D. The other was administered to fourth year B.Paed students who had participated in the project in their third year of study (1994) as Science Education Three students.

7.7.1 Post-implementation questionnaire administered to Science Education Three students:

An open-ended questionnaire was directed at students who

participated in the curriculum development project with School D. This questionnaire was administered to the students after the implementation of the project. They were given the option of answering the questionnaire as individuals or in small groups of four or five students. See copy of questionnaire in Appendix G. The purpose of this questionnaire was to provide me with a picture of curriculum development as perceived by the students. It would also serve to inform the descriptive analysis of the case study by enhancing triangulation.

Twenty nine questionnaires were returned. Twenty three were group responses and the size of groups ranged from two to six students. Six were individual responses. Apart from Science Education Three, the second major subject of the students is indicated in Table 4 below:

Table 4: The second major subject and the number of student teachers per subject

SUBJECT	NUMBER OF STUDENT TEACHERS
1. English 3	15
2. Zulu 3	10
3. Geography 3	10
4. Mathematics Education 3	28
5. Afrikaans 3	1
6. Integrated Arts 2	4
7. History 3	1
8. Psychology 2	1
TOTAL	70

The responses to the questionnaire were coded into categories. Due to the large number of categories identified, it was decided

to create sub-categories to facilitate analysis and interpretation of the tabulated form in which the data are presented (see Tables 5 a, b, and c). The number indicated next to each sub-category represents the number of the questionnaire item (Appendix G) which generated the response from the students. Each table is followed by a brief description of the analysis. The key below pertains to the three tables.

Key: PT = Practising Teacher
 ST = Student Teacher
 CD = Curriculum Development
 IND= Individual

Table 5 (a): Categorised responses of student teachers to a post-implementation questionnaire : Problems of Curriculum Development and the role of the Facilitator

CATEGORIES	SUB-CATEGORIES	IND.- 6 MAX	GROUPS 23 MAX
a) Problems of CD	3.1 Lack of resources	5=83%	19=83%
	3.2 Time constraints	1=16%	5=22%
	3.3 Second language communication	1=16%	6=26%
	3.4 Lacked experience		1=4%
b) Facilitator/ Coordinator	5.1 Positive role of facilitator	6= 100%	23= 100%
	5.2 Negative role of facilitator		1=4%
	6.1 Positive role of coordinator	6= 100%	23= 100%
	6.2 Negative role of coordinator		1=4%

The **lack of resources** (Category (a), sub-category 3.1) mainly pertained to physical resources such as modelling clay,

chartpaper, paints, etc., which were available in a limited supply in the Resource Centre of the Faculty of Education. The Resource Centre is located in the Faculty of Education. It made available to students resources which enabled them to complete assignments and research projects. It housed a collection of books, periodicals, and magazines to support students to prepare seminars and to engage in curriculum development projects.

I also obtained limited funds from external sources to purchase materials. However, students claimed that a lack of resources impacted negatively on the physical quality of curriculum materials developed during the project. The problem was partly overcome by some students improvising materials - a process which assisted them to teach in a disadvantaged context.

My role as external facilitator (Category b) was perceived by some students as being necessary in conceptualising the students' and teachers' role in the project. They claimed that I was able to do this by bridging the gap between the preservice and inservice teachers. Some also claimed that I was a neutral partner who acted as a mediator between the teachers and the students (reduction of the participant observer effect). However, one student claimed that my role as external facilitator was a good one, except that the actual interaction should have been entirely between the students and the teachers. He claimed that many students regarded me as an authoritarian who influenced the involvement. One student counter-claimed this view. He stated that on one occasion I, as facilitator, was not available to

accompany the students to the school. Such an absence resulted in a communication breakdown at the school and that visit was a loss to the project.

Table 5(b): Categorised responses of student teachers to a post-implementation questionnaire : Collaboration and Teacher Responses.

CATEGORIES	SUB-CATEGORIES	IND.- 6 MAX	GROUPS 23 MAX
c) Collaboration/ participation	4.1 Improved context related materials	3=50%	9=39%
	9.1 With PT - an advantage	4=67%	16=70%
	9.2 With PT - a disadvantage	2=33%	7=30%
	10.1 PT - poor collaborators initially	6= 100%	15=65%
	13. Commitment of St as future PT	6= 100%	23= 100%
d) Responses of PT to CD	16.1 Traditional	4=67%	9=39%
	16.2 Lacked CD skills	6= 100%	15=65%
	16.3 Innovative and creative		2=9%
	16.4 Willing to learn skills of CD	3=50%	3=13%

Students' perceptions of the participatory role of teachers (category c): During their collaboration with teachers, some students indicated that some teachers did not contribute much to the curriculum development process. They were able to assist the students to understand the context of the school for enhancing

the materials development process and class teaching. Some students indicated that the production of materials for the project became their responsibility with the teachers' supervision.

Another group claimed that the teachers did not really work with them in developing materials except for some casual "chats" with them during their visits to the school. This group added that the practising teachers were potentially good teachers and hoped that there would be more consultation and exchange of ideas on materials development in the next project. Some groups and individuals stated that they were disappointed at the apparent lack of interest shown by teachers in the project. Others claimed that the teachers felt threatened by the presence of university students in their school. It is my assumption that this could be due to most of the teachers in School D being underqualified and without a university teacher education experience.

However about 70% of the students made positive comments about their collaboration with the teachers. All the students agreed that when they completed their initial training as teachers, they would be committed to collaborating with their colleagues. Some stated a willingness to collaborate on condition that the education department did not impose bureaucratic restrictions to the culture of participation.

Responses of practising teachers to curriculum development

(Category d): Some students observed that the teachers lacked curriculum development skills. They claimed that the teachers were very traditional and were dependent on text books and taught in a "talk and chalk" fashion. Being progressive and innovative was a new experience to them. The deputy principal of the school had attended workshops on curriculum development and tried to impose his ideas upon the teachers, e.g., the use of charts, drama, and song to teach primary school pupils. The students also claimed that the absence of charts and other teaching aids in classes showed that the teachers lacked the experience to develop curriculum materials. One group of students stated that the teachers congratulated them for having better skills at curriculum development. Nevertheless, one group of students stated that the two teachers who were ex-students of UDW and who had participated in a similar project were very supportive.

Students' views of cross-curricular, thematic approaches

(Category e): All the individual respondents and half of the group respondents agreed that cross-curricular thematic approaches connected subjects meaningfully through environmental education and in the process made science relevant. This further confirms the role of environmental education as a sensitising construct (O'Donoghue and McNaught, 1991). A strange observation was that the individual respondents were more in favour of cross-curricular thematic approaches than the group respondents. Perhaps in groups the students were compelled to reflect more precisely on their observations and experiences.

Table 5 (c) : Categorised responses of student teachers to a post-implementation questionnaire : Views on a Cross-curricular Approach, Action Research, and Curriculum Development

CATEGORIES	SUB-CATEGORIES	IND.- 6 MAX	GROUPS 23 MAX
e) Cross-curricular thematic approach	11.1 ST innovative	3=50%	5=22%
	11.2 Context related materials	3=50%	8=35%
	14.2 Enhanced teaching and learning	2=33%	9=39%
	20.2 Connects (links) subjects	6=100%	12=52%
	20.3 Made science relevant	3=50%	5=22%
f) Action research	21.1 Improved materials development	6=100%	9=39%
	21.3 Helped contextualise curriculum		8=35%
	21.4 Active involvement		8=35%
g) Curriculum development project	12.1 Project successful	5=83%	16=70%
	12.2 Project - a failure	1=16%	7=30%
	22. A social process	3=50%	12=52%
	10.2 PT felt threatened	1=16%	4=17%
	10.3 PT uninterested		7=30%

The role of action research (Category f): The students generally viewed action research as playing a positive role in improving the materials development process. Several groups viewed their active involvement during action research as having enhanced the process of contextualising the materials developed so that these related to the life world of the child.

The curriculum development project (Category g): The majority of students regarded the curriculum development project as a success. This implied that the collaboration with their colleagues and the teachers was a valuable experience. It also showed that despite the problems experienced by both groups of participants, that they were capable of developing an alternative curriculum in environmental education through a cross-curricular thematic approach.

7.7.2 Responses of fourth year B.Paed students:

An open-ended questionnaire was directed at fourth year (1995) science student teachers who participated in the curriculum development project as third year (1994) Science Education students. The purpose of this questionnaire was to assess the extent to which these students were able to apply curriculum development skills acquired in the previous year to their school-based teaching practice experience (see copy of questionnaire in Appendix H). The questionnaire was administered during the week that they had returned to the campus. Questionnaires were handed to ten volunteers and four were returned to me upon completion.

The findings of this questionnaire were expected to confirm the need for curriculum development to be included in the curriculum of science teacher education in tertiary institutions. The students' successful application of skills (developed during the project) to their school-based teaching practice in their fourth year would serve as a final evaluation of the project experienced during their third year as science education students. The responses to this questionnaire were expected to enhance triangulation of information obtained from the survey questionnaire sent to science teacher educators at other institutions. The responses are presented in Table Six below:

Table 6: Responses of fourth year B.Paed students

CATEGORIES	NO. OF RESPONSES	PERCENTAGE
1. Developed an innovative approach to lesson prep.	3	75%
2. Successful application of collaborative skills	4	100%
3. More tolerant of ideas/opinions of others	3	75%
4. PT resist change	3	75%
5. Some PT support change	2	50%
6. PT negative to CD	3	75%
7. PT support innovation	1	25%
8. CD project enhanced reflection	2	50%
9. Previous AR experience useful during SBTP	2	50%

Key: PT = Practising Teachers
 CD = Curriculum Development
 AR = Action Research
 SBTP = School-Based Teaching Practice

This group of students were exposed to a collaborative approach to school-based teaching practice in their fourth year after participating in the third year project. This was the Faculty's first attempt at implementing an innovative approach to school-based teaching practice. The collaborative approach to teaching practice has limited international implementation as indicated in Chapter 2 (page 67) by Goodlad (1990, in Fensham and Northfield, 1993) in this dissertation. It is almost non-existent in South Africa because it is not part of the school-based teaching practice culture. A significant aspect of this research is that these students had developed skills of collaboration during the project which were effectively used during their school-based teaching practice experience the following year. This is supported by responses in Table 6 to categories 1, 2, 3, 8, and 9. It is also appropriate to mention that the project served as a stimulus to the Faculty of Education at the University of Durban-Westville to change its approach to school-based teaching practice so that it reflected a learning partnership between the student teachers, resident (practising) teachers, and teacher educators (lecturers).

The tendency of teachers to generally resist change is supported by categories 4 and 6 of Table 6. The students had no difficulty in recognising this trend due to their experience in the project. The fact that some teachers are willing to change is also indicated in categories 5 and 7 of Table 6.

7.8 The 1996 project

7.8.1 **A request to repeat the project**

The principal of School D and some members of his staff made a special request for the project to be repeated with their school in 1996. I grasped the opportunity again because early in the year I was approached by an official of Durban Waste Water Management to propose a school-based curriculum development project which would serve to reduce the abuse of storm water and sewage systems. Such abuse was a major problem especially in the Black African and "Indian" townships which usually have a high population density. A group called Community Life Projects had already developed posters, models, and pamphlets which were aimed at developing general awareness of the problems related to storm water and sewage abuse. This was a project which was implemented in schools and communities at large during 1995.

The official was looking for an approach which would now help to sustain the project further through schools. When I explained the potential of a community problem-solving strategy using schools and quoted evidence from my curriculum development projects in environmental education, he immediately invited me to develop a proposal for curriculum development for waste water management related to schools. I suggested that a pilot study be conducted during 1996 using four schools, and if the findings were feasible, that more schools may be involved in 1997. My proposal was accepted and I included School D as part of the study involving a preservice/in-service link. The remaining three schools did not have a preservice link and I served as an

external facilitator and involved the staff in the planning, development, and implementation of a smaller project compared with that of School D. The Durban Waste Water Management offer included funding which was desperately needed to support the projects.

7.8.2 The planning, development, and implementation phases:

The planning, development, and implementation phases ran smoothly. I included students in every visit to the school, especially the preliminary visits from which they were usually excluded during previous visits. They consulted with the students from the 1995 project and were given first hand information about the second language reality in schools which were historically Black African. They insisted on making more frequent visits to the school's classrooms during the planning stages. These visits involved consultations with teachers which informed them about the approach they should use in developing curriculum materials for meaningful teaching and learning at such schools. They made a concerted effort to develop materials which addressed second language problems by overcoming language barriers. They presented the Awareness Day and Open Day programmes with a bilingual (Zulu/English) slant. Sewage and storm water abuse featured for the first time on the implementation agenda especially during the Awareness Day and Open Day. Pupils and staff were also taken on an excursion to a local sewage treatment-works.

7.8.3 Obtaining additional spontaneous data:

I also took the opportunity during the research to gain some

additional spontaneous data. Such data provided further validity to the research by allowing me to check if my participant observations were supported by these additional participant observers. One of these is in the form of a copy of the reflections of post-graduate HDE Biology Special Methods students who were invited to attend the Awareness and Open Day programmes (Appendix O). These science student teachers were not subjected to a curriculum development exercise of the scale experienced by the third year students. I felt that their views would be significant to the project and its evaluation. Their reflections and observations would serve to verify the need for curriculum development in science teacher education.

These students were exposed to science teacher education only in the fourth year as post-graduate diploma students after completing a three year Bachelor of Science degree. This degree does not have any education courses due to its focus on pure science. The students were not part of the project and were invited to attend the Open Day programme during the implementation of the project in School D in 1996 for the second time. The following paragraph is an extract from their written comments:

"We think that an activity like this should definitely be part of our final year programme because we are able to put into practice all that we learn and it is also practice for us as future teachers. It will most definitely help us to deal with the problem of English as a second language. We

will be given practice in the role of teachers being facilitators. We learn how to create an atmosphere of socialization and interaction with not only pupils but also the other teachers. We saw that the entire process was process orientated and we were fortunate enough to see it in action. We are at a disadvantage in that because of our pure science background we have not been given the opportunity to develop as teachers. This would have been the perfect opportunity for us to gain experience as teachers".

The above comments show that the students involved in the project in 1996 had made a significant improvement over the problems encountered by the previous group of students with the same school in 1995. These comments also demonstrate the significance of a school-based curriculum development project to the initial preparation of teachers as reflective practitioners.

I also presented a paper related to this case study at the 8th Symposium of the International Organisation for Science and Technology Education (IOSTE) in August 1996 at Edmonton, Canada. The title of the paper was "Case studies of science and technology education programmes in South Africa designed for community problem solving in the environment." This paper and another presented at the 7th IOSTE Symposium in 1994 are included in the dissertation as Appendix K. The purpose of these reports was to test the validity of the research in an international forum of science and technology educators. Delegates at the

Symposia were pleased to note the emergence of curriculum responses in South Africa designed for community problem solving in the environment.

7.8.4 Analysis of the reflective diaries and Action Research

Reports of a group of science student teachers:

The reflective diaries (Appendix L) and action research reports (Appendix M) of the students revealed impressions of their participation in the curriculum development project in School D. These also served to complement and support my reflective diary and field notes and thus enhanced triangulation. The students claimed that they did not share the same views about the project. Some did not have any hope for the the success of the project whilst others saw this as an opportunity to implement curriculum materials and viewed it as a challenge. The Indian students stated that since School D was an ex-DET school, it provided them with the opportunity to visit such a school for the first time and hence served as a unique learning experience. They were compelled to find a way of addressing the English second language problems of the Zulu speaking pupils.

The students were perturbed at the lack of enthusiasm and interest from some of the teachers. It seemed that the teachers did not understand what was expected of them. The students claimed that they struggled with the task of actively involving the teachers in the project. This confirmed the AFCLIST professor's observations regarding the teachers.

The lack of experience of undergraduate students in writing a research report was clearly evident. These reports, however, were invaluable in providing useful information pertinent to this dissertation - some of which are listed below:

- a) The teachers did not collaborate with the students due to the disempowering nature of Apartheid education.
- b) Collaboration between the students and the teachers improved as the planning and development phases of the project progressed. The greatest participation occurred during the implementation phase.
- c) Pages 6,7,8, and 9 of the report includes the students' analysis of their research and their recommendations.

Case Study Four involving School D in Action Research Cycle 4 may be considered as a significant development for the action research process. It served to expose the oppressive effect of Apartheid education upon School D and its disadvantaged community. It also presented a challenge to the process of curriculum development which ran more smoothly in the more advantaged contexts represented by Schools A, B, and C, despite the existence on occasion of intransigent head teachers and staff strike action.

7.9 Analysis of my reflective diary

Before proceeding to a full synthesis, an overview of the case studies is presented through the "eyes" of my reflective diary. The development which occurred over six years and recorded as four case studies, each involving a sequentially linked action

research cycle, needed more than one school to sample the varied contexts in which the teacher educator and student teachers normally worked. The field work was, therefore, conducted in several schools, each representing a case study involving a new context. This approach enabled some generalizations to be made regarding the nature of school-based curriculum development involving the participation of students and teachers.

My reflective diary is incorporated into this research report. It presents a descriptive account of the school contexts and the nature of the intervention for curriculum development from 1991 to 1996. Its partly reflective character included the identification of critical moments which guided and drove the action research strategy of the intervention. It provides the reader with an insight into how the rationale for the research was developed with my colleagues. It also shows the practical steps which were taken to realise this, most of which have been presented in the case studies and will not be repeated here.

I have presented a tabulated summary of the four case studies in Table 7 (Page 206). A diagrammatic representation of the three stages of curriculum development entailing four sequentially linked action research cycles is also shown in Figure 8. The development of Table 7 and Figure 8 have emerged from records kept in my reflective diary.

The interventions in a Black context appeared to be different from the previous case studies conducted in predominantly "Indian" schools. The pupils and staff were all Black African and

Table 7: A summary of the four case studies

	Case Study	1	2	3	4
	School	A	B	C	D
	Action Res. Cycle	1	2	3	4
	Year	1991	1992	1993/4	1995/6
a	Race of pupils	Mainly Indian Few Black	Mainly Indian Few Black	Mainly Indian More Black	Only Black
b	Race of school staff	Indian	Indian	Indian	Black
c	Race of students	Mixed	Mixed	Mixed	Mixed
d	School staff:PRESET	Col.Ed	Col.Ed	Col.Ed 4 UDW	Col.Ed 4 UDW
e	Courses taken by ST	ScEd 2 Others	ScEd 3 Others	ScEd 3 Drama Others	ScEd 3 Drama IA Others
f	Resources: School	Good	Good	Very Good	Poor
g	Distance of school from the Campus	40 Km	3 Km	0,5 Km	15 Km
h	Funding for the project	UDW ST	UDW UmgWa ST	UDW UmgWa ST	UDW UmgWa ST DWWM
i	Principal's support	V.Good	Excellent	Satisfactory	V.Good
j	Teachers' support	V.Good	V.Good	Good	Satis.
k	ST collaboration	V.Good	V.Good	V.Good	V.Good
l	Degree of resistance from teachers	5%	20%	20%	50%
m	Research instruments used	Res. Diary	Intv. Diary	Ref.dia Quest	Quest AR Re Diary
n	Participant observers	2 ScEd Lects.	1 ScEd Lect. Drama Lect.	1 ScEd Lect. Drama Lect.	2 ScEd Lect. IA ST HDE ST Prof.
o	Community problem solving achieved	Yes	Yes partly	Yes partly	Yes partly

Key:

CS	= Case Studies	DWWM	= Durban Waste Water Management
SCH	= School	Res	= Research
ARC	= Action Research Cycle	Intv.	= Interview
YR	= Year	Ref.dia	= Reflective diary
ScEd	= Science Education	Quest	= Questionnaire
IA	= Integrated Arts	AR Re	= Action Research Report
ST	= Student Teachers		
UmgWa	= Umgeni Water		
Lect	= Lecturer		

the availability of physical resources was poor. The action research reports of the students revealed that the support from the principal for the project was very good. The students viewed the support from the teachers as satisfactory and claimed that approximately 50% of them resisted the project.

These reports also provided evidence which I had overlooked. It became apparent that the staff at this Black school, possibly like most of the others, was disempowered by the oppressive Bantu Education system. Such a system discouraged a culture of participation and enforced a system of subservience to the *status quo*. It is therefore most likely the reason why the educational change which this project attempted to encourage was met with general resistance from the teachers. One cannot rule out the possibility of a second language problem among some teachers which hindered conceptualization of the curriculum development project. However, the implementation of the project in the same school twice (1995 and 1996) appeared to have made a difference to the process of curriculum development. For example, the group of students who participated in 1995 found the intervention in a Black school context to be a challenging experience. They were able to share these experiences with the new group of students

who followed them in 1996, an act which resulted in the development of curriculum materials which were much improved and more appropriate to the context of such a school.

7.10 A concluding overview of the four action research cycles:

My research diary is used as a basis for a concluding overview of the four action research cycles. Figure 8 (page 208) shows the sequentially linked action research cycles derived from Elliot's (1991) model of action research presented in Chapter Three (Figure 5). The action research cycles present a summary of linked events which occurred during the curriculum development projects and are subject to a further analysis to build an overall picture.

The emerging picture:

Teacher empowerment: The analysis shows that while teachers may be considered to be non-reflective, that such reflection does occur, but is constrained by the school culture and its bureaucratic and prescriptive control. Such control may also result in resistance to educational change by teachers who have been conditioned to accept such control. The situation was ironical - the inexperienced student teachers were more enthusiastic and concerned about the need for educational change than the experienced teachers who preferred to cling on to traditional practices of teaching. The teachers were generally prepared to become active only after external facilitation and outside entry by student teachers in all the case studies presented. They were generally excited by this new strategy. I

became convinced, during the research, that an external facilitator's role and a horizontal power relationship were advantageous to support and promote curriculum change/transformation in South African schools. This also depended upon the principals' approach to education as to whether they were democratic or not and why they functioned this way.

The need for an "ice-breaker" was apparent in all the case studies, and especially more so in School D. When students and teachers met for the first time, they remained apart, silent, and failed to communicate with each other until the facilitator engaged them in a lively ice breaking experience. This could be attributed to a lack of a culture of participation which keeps people isolated.

The need to change the context: The location of the schools, the nature of their population, and their available resources served as essential factors for the success of curriculum development of this kind. The students could not test their curriculum materials by classroom teaching if the school was remotely located from the campus. Schools distantly located from the campus would have the opportunity of experiencing such an innovation if teachers who had trained at our University were employed in such schools, or if other institutions of teacher education exposed their teachers to such a process. The multicultural nature of the new South African education system based on racial integration made it imperative that the curriculum development process occurred in contexts which varied

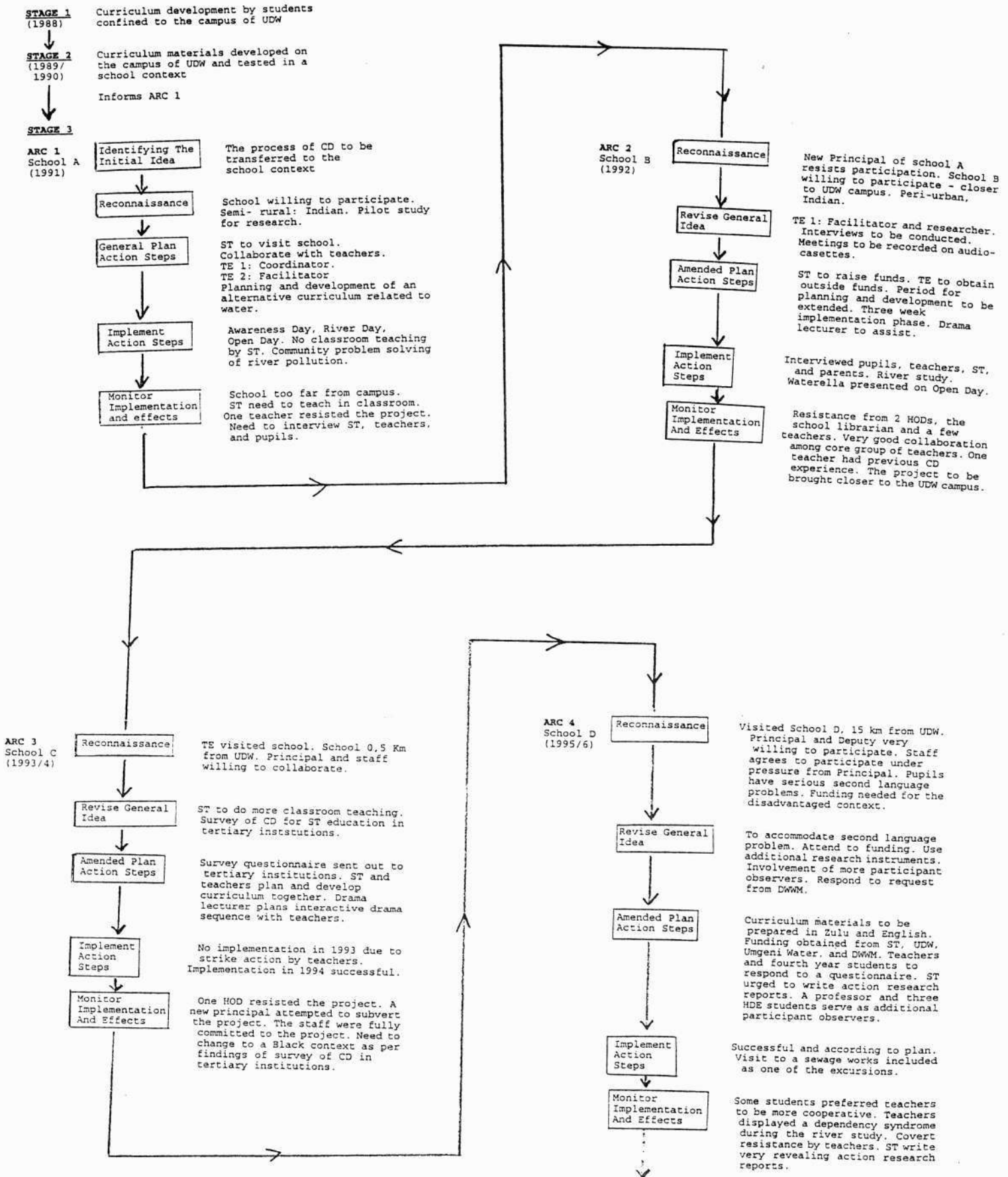


Figure 8: A summary of the linked action research cycles

greatly in terms of race and resources (see Figure 8).

The change to a new (disadvantaged) context resulted in some students becoming frustrated in coping with such a context. These students could not accept the fact that some staff were simply uninterested in the project possibly because they could not conceptualise it or had no previous experience in curriculum development. In such a context the principal took decisions for the staff without consultation. This pertains to school D (the Black school) which, like most similar schools, were under the coercive control of an education department which ensured that the principal was the super-ordinate authority in implementing its will.

Curriculum development and community problem solving: The cross-curricular nature of the project compelled the teachers to engage their reflective capacities in contextualising their subject discipline to suit the theme. Teachers' perceptions of the environment and their concerns were shown not only in Science subjects but also in other subject areas. For example, the History teacher at School A decided to teach his pupils about the history of Tongaat and its water supply. This topic was not part of the syllabus. Of the four schools which participated in the project, School A (Case Study One) presented the best problem solving strategy due to its close proximity to a river. This school used the curriculum development project to actually solve the pollution problem of a local river. This shows the nature of the environmental education programmes of the teachers and

their desire to do something for the environment. The other three schools were unfortunately distantly located from the closest river. This reduced the feasibility of implementing a community problem solving process.

The commitment to the project by the key teachers: This is especially true in Case Study Two. Here the English teacher was able to sustain the project by internally coordinating it with the core support of the Art, Science, and Afrikaans teachers. In Case Study One, the principal and the English teacher were instrumental in driving the process of curriculum development internally. In Case Study Three, the Science teacher played a significant role in supporting the project. The success of the curriculum development project reported in Case Study Four can be attributed mainly to the vibrant and insightful deputy principal. The need for the teacher educator to change his formal science teacher education curriculum to include lectures related to the project enabled greater cooperation from the student teachers and a more meaningful implementation of an innovative project.

Racial tensions: Racial tensions occurred among some students due to a lack of resources experienced by a disadvantaged group. These tensions were experienced when an advantaged group ("Indian") became frustrated when their disadvantaged ("African") colleagues failed to develop materials of a good physical quality due to a lack of resources. It appeared that the latter, due to their poverty, lacked the funds to purchase resources.

Resistance: The resistance from some members of staff in the schools was generally confirmed through triangulation of information obtained from the questionnaires, interviews, and action research reports of the students and my own observations. The reasons for resistance were various:

- a) Two heads of department from School B regarded a horizontal power-relationship as a threat to their position of power. As a result, they distanced themselves from the project and their leadership was lost.
- b) A teacher may have had a bad experience as facilitator of an integrated approach in another school, e.g., the experience of the librarian in Case Study Two.
- c) Teachers had difficulty in adapting to change or they failed to conceptualise the nature of the curriculum development project. The latter became evident when some teachers showed limited cooperation during the planning and development phases. Their interest became more evident during the implementation phase when they were able to see the process unfolding (see Appendix D).

The extent to which the field work and emerging picture presented above served to help me to answer the research questions posed in Chapter One will be attempted in the synthesis chapter which follows.

CHAPTER 8

SYNTHESIS

8.1 Introduction

The purpose of this chapter is to interpret further the analysis made in Chapter 4 in terms of its significance for the study. The research problem and the research questions are posed again for convenience of reference. An attempt will be made to relate the analysed data to the research questions in an attempt to confirm the extent to which these have been answered. Analysed data already presented will not be repeated during the synthesis although constant reference will be made to these.

8.1.1 **The research problem :**

Can the process of curriculum development for student science teacher education be transferred to the reality site of the school to enable the student science teachers to collaborate with practising teachers in developing an alternative curriculum? Would such collaboration promote the transfer of curriculum development skills to the practising teachers in a developmental process? Can this process be viewed as a school focused inservice strategy to compensate for the lack of curriculum development training in the practising teachers' preservice education obtained from institutions of tertiary education in South Africa?

8.1.2 The research questions :

1. Are student science teachers and practising teachers capable of developing an alternative curriculum in environmental education through a cross-curricular approach?
2. How do student science teachers view themselves in relation to such joint curriculum development?
3. How do practising teachers view themselves in relation to such joint curriculum development?
4. What is the nature of the collaboration between student science teachers and practising teachers?
5. What role does action research play in the implementation of participatory collaboration strategies and the illumination of the curriculum development process?
6. What is the current status of curriculum development in institutions of teacher education in South Africa?

8.2 Research Question 1 :

Are student science teachers and practising teachers capable of developing an alternative curriculum in environmental education through a cross-curricular approach?

Evidence from curriculum materials: Evidence obtained from the case studies indicated that the answer to this question was

positive. The curriculum materials produced and developed by the students who were advised and assisted by the teachers served as exemplars of a cross-curricular thematic approach. They also served as evidence that an alternative curriculum in environmental education was achieved through the collaboration of both groups. Appendix I presents a sample of curriculum materials produced by the students after consultation with the teachers, and represents a general collection from all the case studies/schools involved in the research.

A variety of curriculum materials was produced which pertained to the theme water. These included posters, charts, lesson plans, worksheets, models, games, puzzles, word searches, puppetry and cartoons (see Appendix I). Some of these materials are also presented in a photographic form in Appendix C as photographs 3, 4, 14, and 18, and are available as video footage upon request by the reader of this dissertation. An analysis of these materials showed that they reflected learning and teaching in a variety of subject disciplines (Mathematics, Science, English, etc.), and all pertained to the theme "water". The context of the school where the project was located was carefully considered, especially in Case Study 4 (the Black school). Here the materials were developed in Zulu and in English to enhance meaningful learning related to the theme "water" for English second language learners.

Collaboration and cross-curricular development: The teachers at School B, especially the Art, English, Afrikaans and Science

teachers, worked very closely with each other to link concepts in their subjects to the theme "water" (see Appendix I). Further support for this claim is provided as evidence in Table 1(c) on page 155 which reflects an analysis of post-implementation interviews conducted with the staff of school B. There was consensus among the five staff members interviewed about sharing ideas to enable a cross-curricular thematic approach. The English, Science and Afrikaans teachers agreed that such an approach supported environmental education and enhanced the development of language in science and science concepts.

My research diary (Appendix B, page 3), part of which has been incorporated in the four case studies showed that in School A the Science, Geography, and History teachers had committed themselves to developing materials related to the theme "water" during our first meeting with them. The teachers in Schools C and D did not produce curriculum materials (see Appendix B, page 25 and Chapter Six, page 185). They, however, provided the students with support in the development of these materials. The variation in subject combination of the students' major subjects, as indicated in Table 2 (page 171) of Case Study 4 with School D, served to further enhance the development of materials across the curriculum to support the common theme.

Contextualising the alternative curriculum: The process of integration conducted in a cross-curricular manner was also important because it allowed the teachers freedom in contextualising the alternative curriculum which they attempted

to develop. A good example of evidence supporting my claim occurred, apart from the other case studies, in Case Study 1 (School A). Here, the English teacher suggested that the local Hlawe River which flowed close to the school and appeared to be severely polluted should be the focus of our investigations. She encouraged the pupils to write letters to the local Town Board complaining about the pollution which they (the pupils) confirmed with the use of the water testing kits. The History teacher agreed to plan lessons related to the history of the town and its water supply. My reflective diary (Appendix B, page 3) provides further evidence of this claim. The prescribed curriculum did not refer to such a river, nor did it encourage a study of any local river.

The concerted effort of contextualising the curriculum materials to reflect the reality of the school and its community by both science students and teachers indicated that their collaboration across all subjects was necessary. Since most of the participants lacked experience in collaborating across the curriculum, my role as an external facilitator became very significant. Evidence for this observation is supported by the interview conducted with five staff members of school B and analysed in Table 1(b), Category 4 (page 149 of Chapter 5) in which four of them agreed that I was a good coordinator and three indicated that I supported innovation. Further support is provided in Case Study 2 (Chapter 5, page 152) by the science teacher who referred to a project at a school which failed due to a lack of support for the internal facilitator from the staff. My role as external

facilitator helped the teachers of the different subject disciplines to relate to the theme more easily than they would have if they had worked on their own. The resistance from the Afrikaans teacher from school A and the History and Mathematics teachers from schools B and D may also have been due to narrow views of their subject and the theme. It may also have been due to their lack of imagination, creativity, and reflection. The students who did the course Mathematics Education were better able to put their creative talents into action in order to produce curriculum materials in mathematics related to the theme "water". This may have been possibly due to to my consistent efforts at encouraging reflection during the project. They also had the added advantage of being younger, more enthusiastic, and with more time as university students compared to the teachers.

Cross-curricular efforts by their very nature are driven by a culture of participation in any institution. Teachers who are accustomed to working in isolation due to prescriptive, easy-to-interpret non-reflective syllabi, have a tendency to resist change, especially if the changes impose greater expectations and demands on them. If syllabi of colleges of education and other institutions of teacher education do not encourage such an approach, it is understandable that it will present difficulties to teachers who encounter it for the first time as in this project. The curriculum contestation characteristic of this project has, instead, served to encourage the interested teachers' needs to experiment even further with education.

Evidence from a survey: An interesting development in the project was the tendency of all the respondents to the survey questionnaire from teacher education institutions to generally favour cross-curricular thematic approaches to education (see Category 7 of Table 2, page 171). One respondent indicated that her fourth year science student teachers were encouraged to show cross-curricular links to other subjects in a major school project aimed at critiquing science curricula (syllabi). However, none of the respondents indicated that their curriculum engaged science student teachers in formulating an alternative curriculum.

A visiting science educator's view: Professor Warren Beasley attended my presentation on this project at the National Science and Mathematics Teachers' Conference held in Bloemfontein, South Africa, in 1993. He was invited as one of the guest speakers for the Conference. His work with the Science Teachers' Association of Queensland, Australia, spanned a period of 20 years, during which he also served as its president. He also worked extensively with local education authorities in Australia to develop innovative approaches to curriculum design and staff development. He indicated during the synopsis of the South African Conference, with reference to my presentation, that he was impressed that in a developing country like South Africa at least someone had thought of the possibility of developing an alternative curriculum with teachers. He was not aware of the role of NGOs in South Africa and their attempts to develop alternative curricula (see Chapter 2).

An attempt to overcome prescription: South African tertiary institutions, especially colleges of education, which offer science teacher education, may experience problems at attempting to develop alternative curricula due to serious time constraints and overloaded curricula. This position is supported by Salmon and Woods (1991:73) who, using data from lecturers and students, reported that:

"One of the main problems of curricula in the Colleges of Education of the Ex-Department of Education and Culture in KwaZulu-Natal was that of overload. The existing 3 year course was so full with a large number of unrelated courses that students felt unable to do any justice to any of them. The courses were seen as unwieldy, bursting at the seams with unintegrated subjects which merely had to be ticked off, one by one, enroute to graduation. The overload was due to policy determined by the oppressive Nationalist Government for the teacher education process in South Africa. It crammed both professional and academic content into an intensive three year period at the outset of a teacher's career. Repetition and fragmentation of the syllabus also contributed to the overload. Lecturers were forced in their lectures to supplement an inadequate basic education rather than build on the existing knowledge base of students".

The curriculum development project reported in this dissertation attempted to overcome some of these problems in the following ways:

- a) It provided flexibility in our preservice teacher education programme for myself as teacher educator to consult with the students and teachers in deciding the content of the the campus-based curriculum (see Second discussion with students during lectures in Case Study 4, Chapter 7, page 183).
- b) It encouraged a contextualised approach to the curriculum as became evident in the four case studies described in this thesis.

- c) It encouraged curriculum development with other lecturers in the teacher education programme, for example, the Drama lecturer as reported in the case studies.
- d) It attempted to build the existing knowledge base of students by encouraging reflection.

OBE and the project: Policy development towards an outcomes-based approach to education and training in South Africa (NCDC, 1996) has proposed integration as a curriculum strategy. One of the ways which has been suggested to effect integration is to combine two or more traditional subjects or areas of learning into one. Another is to combine various subject perspectives into a particular topic, such as was used for "water education" in this curriculum development project. This allowed separate points of view and processes to be combined to achieve a particular goal. The process which the students and teachers experienced during the curriculum development project enabled them to achieve such a goal. The interviews and questionnaires administered as the research progressed during the four case studies served through their analysis to validate such a development.

8.3 Research Question 2

How do student science teachers view themselves in relation to such joint curriculum development?

Sharing ideas: The joint curriculum development experience between students and teachers provided the students with an opportunity to share ideas and to develop a better understanding

of the context of the school for developing curriculum materials related to the theme "water". The students felt that as university undergraduates they had a better understanding of curriculum issues and curriculum development than the teachers in School D (see Table 5(b), Category d, 16.2, page 192). They viewed the teachers as being initially uninterested, generally traditional, lacking in curriculum development skills, and not very creative and innovative due to a lack of experience. Some students felt constrained by the lack of physical resources and that this impacted negatively on the quality of curriculum materials produced.

Resistance: The situation at Schools A,B and C was slightly different. Here the commitment of most of the teachers to the process of curriculum development was encouraging to the students. They were, however, perturbed by the resistance of some of the teachers to participating in a cross-curricular approach. Evidence of resistance from teachers presented itself several times during the research, e.g., the Afrikaans teacher from school A (Appendix B, page 8), the two heads of department of School B (Appendix B, page 17), and the librarian of the same school whose previous attempt to facilitate an integration project failed due to a lack of staff support.

The five teachers who were interviewed from school B attributed the reasons for the resistance from their colleagues to the following of which Category 5 of Table 1(b), page 149 refers:

- a) The Afrikaans teacher attributed resistance to ignorance of curriculum development by her colleagues.
- b) The Science and Art teachers claimed that their colleagues were apathetic about curriculum change.
- c) The English teacher attributed resistance as a characteristic of older teachers who preferred traditional prescriptive curricula and practices.
- d) The principal described resistant teachers as slaves of prescription.

A group of students who wrote an action research report based on school D (Appendix M, page 16) confirmed that 40% of the teachers did not involve themselves in the project because they had other work to do, were fundamentally lazy, and were not prepared to do more than the bare minimum. In a collaborative paper entitled "Reflections on the cooperative development of an environmental plan for teachers", Keogh et al (1995) noted that some teachers may not completely understand why they should incorporate environmental education into their classes, especially non-science teachers. They also claimed that teachers may come into conflict with their colleagues who feel their instructional methods are threatened. This is further supported by Za'rour (1987, in Hansen and Olson, 1996) who has identified a variety of common forces that hinder the introduction and broad dissemination of STS in schools. These include the conservative nature of the education system, the high esteem attached to pure science, and teacher fear of losing control over subject matter in classrooms. These factors all help to explain why an

integrated approach frequently fails.

An exploitative process: The students from all the projects seemed to view the process of curriculum development as exploitative because they were left to do most of the work. For example, a group of student teachers reported in an action research report (Appendix M, page 12) that the teachers in school D were reluctant to commence with the development of materials during the negotiation phase of the project. In a reflective diary (Appendix L, page 9) a student remarked towards the end of the project that, "The 'dependency syndrome' was still prevalent as most of the teachers relied on the students for the development of curriculum materials". The students preferred that the teachers should cooperate more with students during future projects. They appreciated the general assistance and guidance provided by the practising teachers but were not happy about being left with most of the the responsibility of materials development.

Some teachers, however, like the few at School B, were dedicated and committed to the project because one of their colleagues had previous formal inservice experience in curriculum development which she shared with both the students and teachers (see Table 1(a), page 145, Category 2, sub-category 2.3). The disillusionment experienced by the students was lessened by such a development in School B and the realisation that teachers were constrained severely by time due to a packed syllabus which they were compelled to implement. They were therefore, to a larger

extent, dependent upon students to do most of the materials development related to the curriculum development project.

The external facilitator: The students acknowledged during interviews and written comments in questionnaires that I, as the external facilitator, had a crucial role to play in promoting the curriculum development project. They considered my role as "an important liaison officer between the practising teachers and science student teachers" in supporting and promoting the joint curriculum development process. A student referred to me in her reflective diary (Appendix L, individual report, page 3) as "the external facilitator and the vigorous catalyst in the project".

8.4 Research Question 3

How do practising teachers view themselves in relation to such joint curriculum development?

An extension of staff development: The teachers viewed the joint curriculum development process with student teachers as an extension of staff development activities. This view was endorsed by the principal of school B (Appendix B, page 10) who stated that, "The school welcomed the project as serving the needs of a staff development programme suggested by the Department of Education". In Case Study Two (Chapter Five, page 150) he claimed that our students were positively motivated and worked well with his teachers. He indicated that if our project had not been introduced to his school, then his teachers would have continued working within the isolation of subject disciplines which he

referred to as "water tight compartments". The principal was also indirectly referring to inservice education occurring through the joint process of curriculum development and implying that it enabled his teachers (who participated) to acquire skills of curriculum development.

In the same Case Study (page 151) the principal acknowledged that the example of collaboration experienced between his staff and our students in implementing curriculum development should be followed by subject advisors of the Department of Education. He suggested that they needed to spend more time with his teachers to develop curriculum, especially when a new syllabus had been introduced. This suggestion is supported by Sparks and Loucks-Horsley (1990, in Gabel, 1993:35) who concluded, in a review of inservice education, that, "In the USA, district administrators who work with teaching staff to clarify goals and expectations, also actively commit themselves to and support teachers' efforts to change their practice".

The principal also openly recognised that our students' intervention in his school had transformed some of his staff from functioning as implementers to that of curriculum developers. In Case Study 2 (page 146) he stated, "I think that they are more than implementers. They are now forming the curriculum."

Scope for professional autonomy: The comments above are in keeping with Keiny's (1993) views on school-based curriculum development, that it is an endeavour to diminish dependency on

central or national curricula and therefore to increase school autonomy. She also confirms the ability of school-based curriculum development to enhance teachers' professional development and implies that it has the potential to transfer the responsibility of ownership of the innovations to teachers. She maintains that teachers who indulge in group activity with the aim of improving their practice or revising their curriculum, undergo a process of professional growth.

The need to function as curriculum developers: The practising teachers who responded positively to the joint process of curriculum development as participants indicated at the conclusion of the project their preference now to function as curriculum developers as opposed to curriculum implementers. For example, all five of the staff members interviewed in School B indicated their perception of their role in curriculum as that of a curriculum developer (Table 1 (a), page 145, Sub-category 1,4). Such a development is supported by Gurney (1989) who maintained that teachers needed to be encouraged to move out of their submissive position and to take on a much more innovatory, as opposed to implementary, role in curriculum development.

Human resources support for students: The teachers viewed the students as human resources for the development of curriculum materials in the joint process of curriculum development of this kind. They claimed that they lacked the time, due to a loaded syllabus, to develop materials for the project. They preferred to support the development of materials undertaken by the

students by assisting with contextualising these for teaching. Evidence in the research which supports such a view was obtained from a student's reflective diary (Appendix L, individual report, page 2):

"..... the need for collaborative participation between student teachers and practising teachers was realised in order to take the responsibility to use their innovation and creativity in developing a curriculum that moved away from tradition and oppressive styles of teaching. However, after creating such an atmosphere, it was discovered that practising teachers were not accepting the new challenge but rather depended exclusively on the student teachers for developing materials and activities using a cross-curricular approach that linked with all the subjects".

In School D, a disadvantaged context, the same student claimed (Appendix L, page 5) that:

"Teachers felt that it would be difficult for them to develop curriculum materials as they had no resources available. This school did not have a library and they were further used to following a syllabus package that they adopted".

This is supported further by an action research report of a group of students (Appendix M, page 8) who claimed that one of the problems during action research was that:

"Using of the supplied syllabus has been so closely adopted that difficulty arose in using other resources in trying a new approach".

However, the majority of teachers were trained at ex-DET colleges of education, which, according to my survey (Table 2, page 171) showed that curriculum development was not part of the college curriculum. It is, therefore, doubtful whether they were capable of developing materials without further training.

Some teachers who lacked the time or who had problems related to the above views, however, encouraged their pupils to develop

models, posters, charts, and short drama scripts related to the theme "water".

Initial anxiety: It became very clear to me that with each case study, the introduction of the joint project to staff was viewed initially with anxiety by teachers. I reported in my reflective diary (Appendix B, page 17) that a teacher, during my first meeting with the staff commented:

"We are unclear about the project. We can't see our way through."

It was very evident with each school which participated that the staff showed more interest as the project gained momentum, and especially during the implementation phase. A response from an action research report (Appendix M, page 16) written by a group of students attributed the improved response of many teachers to the project in school D to:

"...the school realising the effort we were putting into the project by raising funds to aid the project so that pupils could be taken on field trips to the river and water-works, and prizes were to be awarded to pupils who performed well in the competitions held"

Externally facilitated: As explained in other parts of this dissertation, the teachers realised the need for an external facilitator to support the joint process of curriculum development. In the interview conducted with five staff members of School B (Table 1(b), Category 4, page 149) four of them rated my role as external facilitator as being "good".

The need for an external facilitator is further supported by the following statement (Appendix B, page 17) from a teacher in

School B towards the end of my first meeting with the staff:

"Will we see you again until the implementation in September? Will you as facilitator come often? You must be here to coordinate! We cannot coordinate".

Such a statement was convincing evidence to me that a joint curriculum development project involving teachers and students may not succeed without an external facilitator.

Considered seriously by a few: Although teachers from the four schools participated generally in the project, very few viewed the joint process of curriculum development as having great potential for school teachers to contest existing curricula for educational transformation and establishing a culture of participation. Those who saw the potential clearly were the principals and English teachers of schools A and B, and the Deputy Principal of school D. Evidence for this claim has been presented elsewhere in this dissertation.

Most teachers regarded the joint process as involving extra work in a busy school day which was already constrained by prescription and other aspects of bureaucratic control. Some students were frustrated by the lack of support from teachers, and finally conceded, as indicated previously, that this was due to a demanding work load for teachers.

8.5 Research Question 4

What is the nature of the collaboration between student science teachers and practising teachers?

Participatory: My research has shown that the collaboration

between teachers and students was of a participatory nature driven by contesting the existing curriculum (syllabus) through environmental education. It was a negotiated collaboration which worked only in democratic school contexts free of excessive bureaucratic control. For example, reference has been made in Case Study 1 to a change in headship from a democratic principal to an autocratic appointment who blatantly refused to allow the project to be continued in school A.

Horizontal power relationship: The collaboration thrived where there was a horizontal power relationship between the students and teachers and it required external facilitation by a teacher educator, whose role included the support of its participants and the drawing in of teachers who resisted the process. Marsh and Huberman (1984:54) state that, "In a low control situation, power is distributed among the involved parties so as to reduce the assymetry of one group's influence over another". Evidence for this claim in my research has already been presented in this and other chapters of this dissertation.

Driven by environmental education: The collaboration among the students and teachers across all the subject disciplines offered at the schools which participated in the project required a suitable and appropriate theme. Such a theme would serve to relate to and attract the interest of all the teachers from the different subject disciplines offered at the school so as to enlist their support and cooperation. I concede that the successful implementation of the curriculum development project

through a cross-curricular approach was largely due to the choice of the theme "water". The teachers (from different subject disciplines) were excited and promised to take their newly acquired "outdoor classroom" experiences from the river study back to their formal classrooms at school and develop these further with their pupils.

Brody (1994) provided empirical evidence to show that there exists in the field of water education a body of knowledge that is distinct from that embodied in traditional education programmes. He claimed that among the most important characteristics were, interdisciplinarity, relevance, and integration of concepts, skills and effect. He stated that, "Although water is integral to all life processes and thus central to the study of Biology, it is powerful in its ability to relate all disciplines in interesting ways".

A PRESET/INSET link: As a reality site intervention, the collaboration between teachers and students facilitated a preservice/inservice link which served the interests of both groups. Such a strategy provided support for students by teachers and stimulated, in the process, the professional development of the latter to the point where they would question the effects of bureaucratic prescription and challenge it through their involvement in curriculum contestation. This was especially evident in Case Study 3 (Chapter 6, page 163, 6.6.1) when staff tension developed due to the appointment of a new principal.

Some positive and negative aspects: The students' acceptance of their role in materials development and the teachers' support for the process may be regarded as positive aspects of the collaboration between the two groups. While many other positive aspects of collaboration between students and teachers also prevailed, it must be stated that the level of success of implementation of the project at School D was due largely to the efforts of the students, the deputy-principal, and partly to two of our ex-science students employed as teachers at that school. The teachers' general apathy, lack of interest, and conceptual dilemmas (see Table 3, page 182) regarding the project posed serious constraints to collaboration, much to the disappointment and disillusionment of most of the students.

Covert resistance: It would have been difficult and unprofessional of me to have questioned the principal of School D about his teachers' poor collaboration during the project. I feel that despite his democratic approach to education, the coercive control characterised by the ex-DET schools was probably present but was masked by the principal's assurance that the project must and would succeed. Being concerned about staff development, he realised that the school had much to lose by non-participation. He was also not prepared to abandon the funding that was available to support the project in such a disadvantaged context. Brown et al (1976, in Macdonald and Gilmore, 1980) concluded, after a series of interviews conducted with teachers from a random sample of 50 Scottish schools, that innovations are acceptable to teachers (in this case the principal) if the

problem of resources is eased. The concerned principal was able to convince his staff to support the project, but the general covert resistance remained and was sensed by the students and myself.

Calls to repeat the project: In the above context, there was a greater expectation by the school staff for the students to do most of the work associated with the project, much to the students' dismay. The highly prescriptive nature of the school curriculum resulted in a one-sided relationship, the students being the knowledgeable group while many teachers were the learners. Under such circumstances, a longer period of planning and development was necessary in order to overcome some relevant conceptual dilemmas among teachers. The request by the teachers to repeat the project the following year is evidence of this success because they claimed to have developed a better understanding of curriculum development towards the end of the project. However, when the project was repeated the following year, there was little significant change in the teachers' contribution. It is important to note at this stage that with the second attempt a senior teacher had developed a very significant working relationship with respect to materials development with an Integrated Arts lecturer from our Faculty of Education. This can be regarded as one of the most significant achievements that the project realised at School D.

Time constraints: The time constraint which most teachers and some students mentioned during responses to interviews was a real

one. I had to encourage students not to attend some of their lectures so that they could make several visits to the school. The teachers were also inundated with demands imposed upon them by a heavy workload. It was only a highly motivated teacher committed to change who would be willing to make sacrifices to experiment with alternative approaches to education. The teacher referred to in the previous paragraph and the English teachers from Schools A and B are some examples of such teachers. It was therefore understandable that resistance by some teachers would occur under such circumstances.

Contrasting school contexts: The difference in the degree of collaboration which occurred in the context of School D as opposed to the other schools which were predominantly "Indian" in character could be attributed to a greater degree of flexibility in the latter. It is my personal view that changes came about in these schools through severe protest by teachers against a very oppressive inspectorate which was eventually prevented from gaining access to classrooms. This development provided staff, who were willing to collaborate, with the opportunity to challenge the inspectorate about an outdated teacher appraisal instrument designed to support a prescriptive curriculum. It is my belief that they, therefore, chose to participate in the curriculum development project because it provided them with a greater freedom to experiment with education and illustrate their professionalism as teachers.

8.6 Research Question 5

What role does action research play in the implementation of participatory collaboration strategies and the illumination of the curriculum development process?

Linked action research cycles: Cohen and Manion (1989) define action research as reality site intervention. The reality site intervention in this research was of a collaborative nature between students and teachers in a school context. The intervention developed into action research cycles during the third stage of the process of curriculum development practised in the Science Education Division at the University of Durban-Westville. These linked action research cycles (Figure 5, Chapter 3) were informed and driven by problems and refinements as they progressed. The collaboration between students and teachers during the cycles of action research was continuously evaluated to bring about improvements to the curriculum development process: hence the need to compare schools by changing the context with each successive year to ascertain the effect of previous interventions, or to repeat the process in the same school the following year to enhance further improvements. This was also done to confirm the extent to which teachers had changed their roles from that of implementers to one of curriculum developers.

First and second order action research: Action research is grounded in the principles of involvement and improvement (Walker, 1993). The collaborative strategies for curriculum

development used in this research were driven and improved by an action research strategy. As explained in Chapter 3, the curriculum development process was dependent on first and second order action research (Walker, 1993) to improve the quality of curriculum materials in the different school contexts. First order action research is a form of research performed by school-based practitioners. Second order action research is that form of action research performed by "outsiders" in a school context. Elements or limited forms of first order action research were performed by the teachers and the students. My action research approach as a teacher educator was the dominant form of action research (second order) in this study because it was planned to improve my practice and, indirectly, that of the teachers and students.

Support for claims: All the claims mentioned above are supported in the tables of analysed data from questionnaires and interviews and the summary of improvements shown in Figure 8 (Chapter 7). The students generally agreed that the action research which they embarked on was based on the active involvement of teachers and themselves. The action research intervention at the reality site of the school helped to contextualise the curriculum and consequently improved the materials development process.

Action research and curriculum development: The following observations were made as my action research progressed and served to illuminate the nature of the curriculum development process:

1. It was a contextualised social process which occurred through a participatory collaboration between science student teachers and practising teachers at the reality site of a school (see Case Studies 1, 2, 3, and 4).
2. Essential critical moments were identified which helped to guide the process of curriculum development through action research (see my reflective diary in Appendix B, an action research report of a group of student teachers in Appendix M, and reflective diaries of students in Appendix L).
3. Continuous self-monitoring by participants served to evaluate the process as it progressed. There was, therefore, no need for one summative evaluation.
4. My action research as teacher educator was enhanced by a democratic school context or education system. The process could be seriously obstructed by bureaucrats from the education department who sought uniform control of schools.
5. In the current development of the South African education system, it is necessary to have an external facilitator to drive the process of curriculum development through action research involving the collaborative participation of teachers.

8.7 Research Question 6

What is the current status of curriculum development in institutions of teacher education in South Africa?

A limited scale in DET Colleges: Curriculum development occurs on a very limited scale or may be almost non-existent in colleges of education under the control of the Ex-Department of Education and Training (DET) in South Africa (see Table 2, Category 1, page 171). This is due to a highly prescriptive curriculum which is centrally controlled. Salmon and Woods (1991) reported that, "The existing curriculum in these colleges of education is a highly contentious one. Originating from the Department of Education and Training in Pretoria, it is essentially a highly prescriptive package of course structures, compulsory subjects, and period allocations. All subjects have to conform to the core syllabi, from which nothing may be removed and little can be added. The current curriculum is so full that there is little space for anything else".

Salmon and Woods (1991) view the way in which syllabi are implemented in such colleges as a "tyrannical imposition". They claim that, "The terms syllabus and curriculum are frequently used interchangeably. Despite the syllabus's potential to be a process, it tends to be delivered as prescribed sets of separate subject-related knowledge which have to be covered within a given period of time. It is regarded by many colleges as a quantifiable, reified product which plays a pivotal role in the broader college curriculum". They also claim that "the tyranny

of the syllabus is evident in schools and is not a unique college phenomenon". Under such conditions it is highly unlikely that innovative curriculum development could occur. If it does occur, it usually presents itself in the form of standardised materials such as lesson plans, worksheets, or charts.

Interventions by non-governmental organisations (NGOs) such as Fulcrum have succeeded in breaking the "mould" in at least one college of education under the control of the Ex-DET in KwaZulu-Natal. This NGO successfully facilitated a curriculum development process with lecturers at the Appelsbosch College of Education.

Semi-autonomous and autonomous institutions: Colleges of education under the Ex-Houses of Representatives, Delegates, and Assembly have included curriculum development exercises in their teacher education curriculum due to their semi-autonomous nature and links with universities. The autonomous nature of teacher education within universities in South Africa has allowed them the freedom to innovate in curriculum development. My survey indicates that innovations in curriculum development at these institutions have not been characterised by collaboration between students and teachers, except in the realm of school-based teaching practice. Reality site intervention at schools through action research, as is characteristic of the research reported in this dissertation and practised in the Faculty of Education at the University of Durban-Westville, appears to be a development which does not occur elsewhere. A search on the internet revealed that it is not common practice to take a whole

class of students to a school to collaborate with teachers through action research. Interventions between students and teachers do, however, occur on a limited scale, especially during school-based teaching practice.

Action research and the formal curriculum: A colleague of mine, Mr Michael Samuel, conducted a survey of the extent to which action research is practised in institutions of teacher education in KwaZulu-Natal. He reported at a national conference in 1994 (Pers. Com.) that UDW was the only institution in the Province, if not nationally, which conducts its PRESET programme with action research as an integral part of its teacher education curriculum.

8.8 Conclusion

The emerging picture of curriculum development for science teacher education shows that it appears to be a process which has the potential to be accomplished in a school context through action research and facilitation from the outside. The transfer of the process of curriculum development from the campus of teacher education to the school requires a democratic school administration and committed teachers. Its success also depends on the existence of a culture of participation in schools. Naidoo (1992) suggests that the culture of non-participation in South African Schools needs to be challenged and replaced by a culture of participation through curriculum development.

A PRESET/INSET link was made possible through such an

intervention which benefits both student teachers and practising teachers. The inclusion of such an approach in the curriculum of teacher education institutions would be beneficial to teacher development for a reflective practice. It seems that the student teachers would always have the task of developing materials, while the teachers would play a supportive role due to a demanding workload. Also, advantaged schools have less difficulty in accommodating such a process compared to disadvantaged schools which may, therefore, resist the process more.

CHAPTER 9

CONCLUSION

The final chapter serves as a conclusion of the research report by determining what was learned. It presents the role of the key participants, the key elements of the programme, the key processes and tensions involved, and the implications arising from the planning, development, and implementation of the curriculum development project peculiar to this research project. Since the case studies presented in Chapters Four, Five, Six, and Seven, and the synthesis chapter (Chapter 8) have presented analyses significant to the research, brief references to these are made in what follows.

9.1 The Key Participants: The planning, development and implementation of the curriculum development project was dependent upon the support/backing and collaboration of its key participants:

9.1.1 **An External Facilitator**: The process of curriculum development required an external facilitator such as a teacher educator to initiate a negotiated entry into the participating schools. This was to gauge the extent to which a democratic climate, conducive to educational change, prevailed in these schools. Thereafter the external facilitator was instrumental in driving the process of curriculum development in the preservice institution and the schools. He had to facilitate the transfer of the curriculum development process from the preservice institution to the school context as an intervention aimed at

developing an alternative curriculum through a cross-curricular approach for environmental education. The external facilitator's personality was significant in the process. He had to promote a horizontal power relationship without threatening the professional autonomy of the teachers who were willing to participate. He also had to attract the support of teachers who resisted the project.

9.1.2 A Democratic Principal: A principal open to change with the support of an outside intervention in his/her school served as an important prerequisite for the initiation and sustainability of the process of curriculum development. Teachers generally appeared to take their cue from such a principal who usually served as a manager in charge of a large staff complement. An undemocratic principal had a profoundly negative influence on his staff by stifling the process of curriculum development in its early stages when approached by the external facilitator. It was the principal with a democratic approach to education who collaborated with the external facilitator in enabling the transfer of curriculum development to the school context and its subsequent planning, development, and implementation.

9.1.3 A Core of Willing and Able Teachers: It helped to have some teachers with appropriate experiences in curriculum development to support the project. They were few and served as useful internal facilitators among their colleagues. Their presence impacted positively upon our students and the project as a whole. The role of the other teachers in the joint curriculum

development process varied greatly. Not all of them were willing to participate to acquire the skills of curriculum development. This presented the project with an added challenge of overcoming teacher resistance. Those teachers who were keen to try contributed to challenging the status quo at schools by contesting the existing curriculum and sharing their ideas with the students. They expressed gratitude for being given the opportunity to develop their skills through participatory curriculum development.

9.1.4 An Extended Planning and Development Period: The planning and development period for the curriculum development process was vital to success and varied according to need. A long period of up to three months of planning and development served to enable a sustained interest in the project. The maximum period of a three week implementation served to provide the process with a greater meaning in its implications for teaching and learning. Despite resisting the changes in the school related to the project, some teachers were silent observers. The long period of planning, development, and implementation gave them the scope to reflect and re-examine their views about participation.

9.1.5 The Freshness of the Student Teachers: Students generally appear to be more enthusiastic than teachers in developing curriculum. Their vigour may be attributed to their "freshness" as energetic under-graduates which contributed to their willingness to experiment with educational change. Such a positive attitude of the students served as an invaluable asset

in the curriculum development process.

The students, however, had indicated their frustrations of working with teachers who agreed to collaborate initially but did not cooperate fully with them. In a study of the effect on student teachers of the teaching behaviours of cooperating teachers, Osunde (1996) claimed that cooperating teachers play a significant role in the professional development and preparation of student teachers. One of the qualities which the student teachers perceived as essential in cooperating teachers was a "warm and positive relationship with students". The student teachers in my research also were perturbed at the lack of commitment by teachers to also develop curriculum materials during the project in School D, a disadvantaged context. Jennings-Wray (1984) states that one of the reasons Jamaican teachers gave for not producing any curriculum materials was their lack of confidence in their competence in curriculum development. It seems that teachers in the disadvantaged context of school D may have experienced a similar problem.

It may also be that teachers are generally over-burdened with a demanding work-load related to a large teacher-pupil ratio which does not provide them with sufficient time to attempt new approaches to education - hence the existence of a negative attitude. Those who are not over-burdened would be available to participate in curriculum development initiatives. Students would generally have the flexibility to handle the extra work associated with curriculum development. The question therefore

should be: "Can we blame some of the teachers for their apparent lack of commitment to curriculum development?". Perhaps an intervention by students into schools may be necessary to encourage teachers to develop a positive attitude to contribute to curriculum change. Or, should teachers be given more time to come to a realization that curriculum change is a necessity which depends upon their integrity as teachers without the need for an outside intervention?

9.2 The Key Elements of the Programme: The success of the curriculum development process was dependent upon several key elements. Among these were its cross-curricular aspects, a suitable theme, the development of awareness, and a community problem-solving strategy.

Students and teachers who participated in the four case studies appeared to have accepted a cross-curricular approach to curriculum development without reservation. They were willing to attempt an approach which was not generally a culture in the schools. There was also a preference for cross-curricular thematic approaches to environmental education by science teacher educators. This was expressed in the survey questionnaire addressed to tertiary institutions.

Further support for a cross-curricular approach to environmental education was offered by Loubser (1993). He stated that, "Environmental education has at last been recognised by educational authorities as of sufficient importance for inclusion

as a cross-curricular theme in the broader curriculum of the South African education system. This important decision was announced in the discussion document: A National Curriculum Model for Education in South Africa (Department of National Education 1991:31). Integrating environmental education into all school subjects is an approach which could, in itself, cause a stir in the education system. Although many researchers, individuals and institutions have fought for this moment, one will have to admit that our education system is not at present prepared for this important step. The teacher training system will, for instance, be challenged enormously, because all teachers will have to be prepared for this new approach".

The curriculum development approach reported in this dissertation can be considered as being an appropriate practical response to the above claim. Its community problem solving strategy related to the theme "water" extends the process beyond the development of awareness only, and gives environmental education a more holistic approach. The use of the theme "water" attracted pupils, students, and teachers due to its limited availability, especially in times of drought, in South Africa. The theme, therefore, worked well with the participants in the curriculum development project. It could be replaced by other themes of environmental significance.

9.3 The Key Processes: Several key processes which contributed to the success of the curriculum development project were identified as the research progressed:

9.3.1 **The need to work across the curriculum:** Confining environmental education to Science as a subject makes it the sole responsibility of the Science teacher. In order to develop a more holistic approach to environmental education so that wider participation in solving environmental problems occurs, it becomes necessary to engage the teachers from all the subject disciplines offered at the school. Collaboration across disciplines in this project was a challenge which further indicated the need for an outside participant as an external facilitator since such a culture does not usually prevail in schools.

9.3.2 **Working on a context related theme:** The choice of the theme "water" was appropriate to the research. Its flexibility as a topic enabled the participants from all the subject disciplines offered at the schools to relate to it without difficulty. It helped to enhance the process of collaboration among the participants which was needed to develop an alternative curriculum for environmental education.

9.3.3 **Reflecting on process through action research:** The choice of action research as a strategy in illuminating the process of curriculum development served as a necessary approach to the research. Such a strategy was dependent upon a reflective process to drive the curriculum development project. Each of the four action research cycles, which were sequentially linked, were continuously monitored, reviewed, and evaluated by the key participants to ensure improvement through involvement.

9.3.4 **Collaboration among the participants:** The process of collaboration among the participants appeared to be fundamental to the success of the curriculum development project. The collaboration which occurred between students and myself as interventions in the four school contexts encouraged the involvement of participant teachers to improve their role as curriculum developers, as opposed to curriculum implementers. My role as an external facilitator, the role of an internal coordinator within the school, and the supportive role of a democratic principal served to impact positively on the success of the project. One cannot exclude the constructive role played by an available core of teachers in each school which made the curriculum development process work.

9.3.5 **Working in a school:** Transferring the process of curriculum development from the teacher education institution to a school was an important move. It enabled the students to reflect on the context of the school prior to producing relevant curriculum materials for environmental education. It also gave them the opportunity to develop collaborative skills, not only with their familiar colleagues, but also with a new group of teachers. Such an opportunity was necessary for the role of the students as future teachers and change agents in developing a culture of participation in schools. Working within a school context also helped the students to develop direct links with the community through the parents of pupils - an act which enhanced the process of community problem-solving for the environment.

9.4 Some Tensions: The process of curriculum development was not without its tensions. One of the biggest tensions was related to resistance by teachers, some of whom were heads of departments in the school. Other lesser tensions pertained to race, a lack of physical resources, unfair work distribution which favoured the teachers and not the students, and conflict situations involving school staff and newly appointed principals. The existence of such tensions, however, presented the external facilitator with more challenges, and are matters which would need to be taken into account in projects of this nature.

9.5 Implications and Limitations of the Research:

9.5.1 **Implications**:

Curriculum development and PRESET curricula: The analysis of the survey questionnaire responses from tertiary institutions offering science teacher education indicated that a limited or almost non-existent form of curriculum development existed in the curriculum of the majority of these institutions. The findings of this research indicate that curriculum development should form an essential part of the science teacher education programme in teacher education institutions for the preservice education of teachers and at schools as inservice education for practising teachers.

I also recommend that the approach to school-based curriculum development involving a participatory collaboration between science student teachers and practising teachers should be included in the curriculum of teacher education programmes as a

policy development. A reference to this research project in a report by the National Education Policy Investigation (NEPI) (1992) quoted from Levy (1992) (see Chapter 2) is an indication that the approach to curriculum development is worth noting for future teacher educational policy development. Such an approach serves to also indicate the need to establish a PRESET/INSET link for curriculum development for science teacher education.

A PRESET/INSET model: Curriculum development strategies for existing teachers who did not have this experience in their PRESET years could be overcome by their collaboration with students in a PRESET/INSET mode of the type reported in this dissertation. This would enable a transfer of skills from students to teachers, especially, and vice-versa. INSET curriculum development through action research should also be offered on a voluntary basis to interested teachers. This could stimulate a climate of reflection among teachers.

Unifying effect of curriculum: The national and provincial curriculum development centres proposed by the White Paper on Education and Training (1994) could serve as vital centres of support for curriculum development through action research. Schools, teacher education institutions, and the proposed curriculum development centres could liaise with education departments to enable a PRESET/INSET model for curriculum development and teacher development. The unifying effect of curriculum may, in this relationship, result in a school or a cluster of schools producing curriculum packages which could be

shared and developed further by other schools. A limiting factor in a PRESET/INSET curriculum development model in environmental education may be a lack of funds needed to support the transport of student teachers to schools, and pupils to places of environmental interest.

9.5.2 **Limitations:**

More research needed: I also wish to emphasise that the preservice/in-service strategy of the kind referred to in this research bears no reference in any literature studied. Participatory approaches involving action research have occurred among practising teachers at schools, but there has been no report in the literature of a whole class of science student teachers working with practising teachers on a scale such as this to create an alternative curriculum in environmental education. Such an approach ought to contribute to educational research as a new body of knowledge for teacher education which is worthy of reporting. I make this claim because, apart from an intensive literature survey, I also interacted with researchers internationally on the internet and could not come across any collaboration of the scale presented in this dissertation. Further confirmation was obtained during my presentation of this research in progress at two international conferences: the 7th Symposium of the International Organisation for Science and Technology Education (IOSTE) in 1994 in the Netherlands and the 8th IOSTE Symposium in Edmonton, Canada in 1996. Such an observation shows that the area of PRESET/INSET as a model for curriculum development for science teacher education through

action research needs greater attention.

A culture of action research: A culture of action research among teachers as a form of practitioners' research needs to be developed at schools. My research showed that teachers appear to lack the time and possibly skills to document their action research strategies as formal research. In a Conference Report on Commissions (1995) in South Africa, the Commission on Teacher Research indicated that teacher education curricula do not prepare teachers to undertake research. It was mentioned in the previous chapter that UDW may be the only institution in South Africa which includes action research as an integral part of its teacher education curriculum since 1994. In view of the Commission's report, INSET could assist teachers to function as action researchers.

It is interesting to note that it was only by the fourth action research cycle that I succeeded in encouraging my students to write an action research report because by then the PRESET programme at UDW included action research as an integral part of our teacher education curriculum. It proved impossible to engage any of the teachers in the process of writing a report because they came from a PRESET situation which excluded curriculum development and action research from the curriculum.

9.6 The reflective teacher: Finally, I wish to endorse the sentiments of Brookes et al (1993) who have indicated that in a political transition which enables the establishment of a

democratic system of education, it will be the reflective teacher who will be able to adapt more easily to change. Non-reflective traditional teachers who have not been exposed to curriculum development exercises may take a longer period to relate to new developments in education and may resist change. The reflective teacher of the type which this curriculum development project has attempted to develop should be able to relate to the challenges of the new outcomes-based approach to education and training which has become education policy in South Africa. The new outcomes-based approach to education and training proposed as a policy development for South Africa (NCDC, 1996) also needs to be cognisant of the potential of this curriculum development project in enhancing the aims of such a policy, viz., that of developing alternate curricula relevant to the life-world (context) of the child. I have to refer to a teacher's remarks when I visited school B four years after its participation in the project. She said, "Oh, Mr Pillay, we are most grateful for your project. It was a good example of OBE. We did not realise it at that time, but now we do not have difficulty in relating to OBE. Thanks to you."

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APPENDICES

**A Action Planning Meetings between science student teachers
and practising teachers**

ACTION PLANNING MEETINGS

DATE: 4 June 1991
TIME: Afternoon
VENUE: SCHOOL A - Tongaat

MEMBERS: Science II students, two science lecturers, Mr Naidoo and Mr Pillay, and four teachers at the school.

Mr Naidoo opened the meeting by introducing the students to the school principal and teachers. He briefly outlined the purpose of the meeting.

We had discussions with the teachers about developing a curriculum package. The teachers came up with ideas on how to prepare our lessons for a field trip. The purpose of the field trip would be to teach science in relation to other subjects. So each student was advised to teach a minimum of two subjects during the field trip.

The school as a whole consists of 80 pupils and has Standard II, III and IV. It was confirmed that each standard would be supervised by seven students. Students and teachers will first go and observe the river before taking the pupils in September.

ACTIVITIES FOR THE STUDENT TEACHERS BEFORE THE FIELD TRIP

1. To collect and develop resources for pupils to use as references.
2. To display the resources such as an exhibition for pupils to look at and to capture their interests.
3. Raise funds.
4. Do experiments for the pupils.

CO-ORDINATORS FOR THE ABOVE-MENTIONED ACTIVITIES

1. Collection of resources: Siphso Msezane and Adam Mahlare.
2. Displaying of posters and resources: Leonard Bhendane and Joseph Nkabinde.
3. Performing experiments: Lucy Naguran, Frashoka Maharaj, Neresh Bharath.
4. Competition for the pupils: Nozipho Mavuso and Victor Cele
5. Raising funds: Frashoka Maharaj and Joyce Miya.

CO-ORDINATORS FOR SUBJECTS

English: Kingboy Dlamini
Science: P. Koobal
History: Siphso Msezane
Maths: Sarah Mpangane
Geography: Frashoka Maharaj

Lastly, there will be an open day exhibition where pupils will display their posters and essays. Prizes will be given to pupils who have done excellent work.

The next meeting will be on 11 June where students and teachers will visit the river.

Joyce Miya
Secretary



DATE: 29 July 1991
TIME: Afternoon
VENUE: Lecture room

CHAIRPERSON: Mr Naidoo
MEMBERS: Mr Naidoo, Mr Pillay, and Science in Education II students.

ACTION

Mr Naidoo gave students ideas on how to prepare for the project. It was agreed to use the first three weeks of August as preparation for the project.

REQUIREMENTS FOR THE PREPARATION

Worksheets, charts, lesson planning for teachers or students, and the collection of resources for teachers to use as references.

PREPARATION FOR FIRST THREE WEEKS OF AUGUST ON CAMPUS

FIRST WEEK

The first week will be used to clarify the task. The subjects committee will designate duties to students.

SECOND WEEK

The subjects committee will meet to plan the procedure of the three weeks programme at Vishwraap School.

THIRD WEEK

The third week will be used for a discussion of the open day exhibition.

During these three weeks the following activities are compulsory for students:

1. Planning of lessons for teachers and students.
2. Collection of resources for teachers to use as references for their teaching during the project.
3. Submission of copies of the time table.

PLAN FOR THE THREE WEEKS PROGRAMME AT SCHOOL A

FIRST WEEK

The first week will be used as an awareness campaign. There will be:

1. An assembly talk.
2. A display of charts.
3. Introductory talks by teachers or students. Students should provide the teachers with resources.

SECOND WEEK

This week will be used as preparation for the field trip. Both teachers and student will be involved in the preparation.

THIRD WEEK

During this week students, teachers and pupils will be involved in the preparation for the competition.

COMPULSORY DATES ON WHICH STUDENTS MUST BE PRESENT AT SCHOOL A

1. First day of the first week.
2. Day of the field trip.
3. Open day exhibition - it should be on a Friday.

CO-ORDINATORS OF THE STANDARDS AND THE FIELD TRIP

1. Standard II: Joseph Nkabinde and Florence Mveli.
2. Standard III: Sipho Msezane.
3. Standard IV: Lucy Naguaran.

These students will be co-ordinating the preparation for the field trip, and controlling the field trip as well.

Joyce Miya
Secretary



DATE: 30 July 1991
TIME: Morning
VENUE: Lecture room

CHAIRPERSON: Prasheka Maharaj
MEMBERS: Science in Education II students.

ACTION

Preparation of the first week at School^A, particularly the first day.

ACTIVITIES

Students will make a model of the water run-off. Newspapers, plaster, paint and starch.

COLLECTION OF RESOURCES

Students will collect material on water that is relevant to our study and give them to Adam and Siphon.

DISPLAYING OF POSTERS

Students should collect pictures and photocopies on water, or draw a chart, and give these to Leonard and Joseph Nkabinde. Press stick and staples are required for the posters.

PERFORMING OF EXPERIMENTS

Students should collect information on experiments and give them to Lucy, Niresh and P. Koobal.

Nalin will prepare a speech as she will be the speaker for the Assembly talk.

LIST OF THE NAMES OF STUDENTS, STANDARDS AND THE SUBJECTS THEY WILL BE TEACHING

Precious: Maths and Science, Standard III
Sarah: Maths and Science, Standard IV
Joyce: Maths and Science, Standard II
Robert: English and Science, Standard IV, and Afrikaans, Standard II
Nalin: English and Science, Standard II
Bongani: English and Science, Standard III
Adam: Science, Standard II
Robert A: Science, English and Afrikaans, Standard III
Kingboy: Science, Standard IV, English and Maths, Standard III
Victor: Maths and Science, Standard IV
Florence: Maths and Science, Standard II
Joseph N: English and Science, Standard II
Siphon: History and Science, Standard III
Leonard: English and Science, Standard II
Prasheka: Geography, Standard II, III, IV, and Science, Standard IV
C Pillay: Geography, Standard II, III, IV, and Science, Standard IV
Niresh: History, Standard II, III, IV, and Science, Standard IV
Noziphon: History and Science Standard II

Joyce Miya
Secretary *Joyce*

B The Researcher's Reflective Diary

Reflective Diary for Curriculum Development Project with School A

2 April 1991

My colleague and I discussed a curriculum development project which will be planned and developed partly at the reality site of a school with student teachers and practising teachers. He indicated that he discussed such a project with the Principal of School A. The Principal was very keen on implementing such a project because of her overseas experiences. Prem informed me that we should grab the opportunity. He also questioned the validity of campus based initiatives in curriculum development by our science student teachers which did not involve planning and development by practising teachers. Their school was only used for implementation of the project. Practising teachers felt that they were incapable of developing curriculum materials for an alternative curriculum. We decided that we would visit the school and discuss the possibility of a collaborative curriculum development project in environmental education with the principal.

My colleague suggested that our science education team of three should engage in a division of labour: One will develop links within the University for science education. The other will develop links with outside institutions. My role would be to develop the curriculum with schools as part of an outreach programme.

15 May 1991

We visited the school for the first time. It is situated in a semi-rural (peri-urban) setting in a small town called Tongaat, 40 kilometres from our University campus. It is an old school, about more than 60 years, and located next to a Hindu temple which had a nice hall. The surrounding community is "Indian" and appeared to be of the lower socio-economic stratum. They live in low cost homes and the children appear to be under privileged. Reading materials are limited and television sets are rare. Library access is possible - not far from the school.

There were a few, about 10, "Black African" pupils in the predominantly "Indian" school. The principal was an older woman who appeared to be close to retirement. She welcomed us and was quite excited at the prospect of collaboration. She was most willing to "upset" the routine of the school to contest the curriculum through the process of curriculum development. She maintained that she had an open door policy for innovative approaches to education due to her short experience overseas. Her staff appeared to be a happy one which was bent on providing a good education for their charges. The eager faces of the pupils spelt it all out - that they enjoyed learning at this school. We the nature of the expected collaboration and the environmental theme. She suggested that she would have to discuss the offer with her teachers and will inform us of their decision to work together with our student teachers. This, to my colleague and I, was an indication of her democratic approach to school

administration.

The principal informed us that although the school was old it was reasonably resourced by the House of Delegates (a political tier catering for "Indian" citizens). Among the items available at the school were the following:

- a) television monitor
- b) video machine
- c) 16mm film projector
- d) 35mm slide projector
- e) film strip projector
- f) 3 overhead projectors
- g) 2 tape recorders
- h) a banda machine
- i) a duplicating machine
- j) a small library

The school did not have a science laboratory. It had a science cabinet with some basic science equipment. This was an eye-opener to my "Black" African student teachers whose primary schools lacked all or most of the above named resources. This was a sore point to me: to pacify the historically under-privileged "Black" students.

While driving back to the campus, my colleague and I reflected further on our first visit to the school. We agreed that not every school principal would even entertain the thought of collaboration with outside institutions. He had met this principal at Teacher Association meetings. She was not a stranger to us. The rigid nature of the curriculum in South African schools made penetration difficult, especially since most principals adopted an autocratic attitude typical of an education system under bureaucratic control. A culture of participation did not exist in such schools. In order to "break the mould", a policy change was necessary, or principals had to adopt a democratic approach to education. This principal appeared to satisfy our quest for such a person. She did not act on "red tape" bureaucratic decisions taken higher up in the education department's hierarchy. She made her own decisions for her school after consulting with her staff. It was now our hope that her staff would agree to meet with us and our student teachers.

We discussed the need to conduct research into our practice as teacher educators and my colleague suggested that I adopt the process as a research project towards a Masters Degree in Education. This was a great challenge to me and I accepted the offer. He suggested that should negotiations with the school be successful, that I consider the experience as a pilot study for curriculum development.

11 June 1991

The staff of the school were keen on the project. We planned a workshop with them and our student teachers. Prem and I decided to play the role of facilitators. A student was elected as the secretary. The group decided to develop the curriculum using the theme "water". They wanted a cross-curricular approach with

concepts related to water developed across all the subjects of the school.

The English teacher, was a strong driving force at the meeting. She suggested that we should investigate the level of pollution of the local Hlawe River which appeared to be severely polluted. She was shocked at the observation she had made down stream when she saw people washing clothes in this river. She would include drama related to rivers. Free writing related to pollution and other water issues will also be included. Letters will be written by pupils to the local Town Board complaining about local water pollution. She also encouraged our student teachers to keep a diary of their observations. She promised to get her pupils to do the same.

The science and geography teachers were very excited at the prospect of developing an alternative curriculum to the decontextualised one which they are forced to implement. The science teacher will focus on water plants and animals and developing skills for problem solving in the environment. He will practically orientate his pupils towards rivers and work very closely with the geography teacher. The History teacher will develop lessons related to the history of Tongaat and its water supply. The art teacher suggested a drawing competition based on water.

The science student teachers suggested that our lectures be focused on water issues and curriculum development. I suggested that they develop a file of resources to further improve their education on water. I had to consider changing my curriculum in the science education programme to equip the students for the project. The student teachers were very keen to participate in the project despite the loss of lecture time during visits to the school. The staff gave their commitment to the project and a procedure was worked out to plan and develop the project. Funding was an issue. My colleague stated that he would speak to the education officer of Umgeni Water, a bulk supplier with a very good water education service.

After lengthy deliberation with the practising teachers and science student teachers, it was decided that a two week implementation phase would occur in September 1991. There will be three important days: an Awareness Day, an Excursion Day, a

River Day, and an Open Day to which parents would be invited. Teaching around water issues in all subjects will take place on the other school days.

The student teachers requested that they wished to group themselves into subject disciplines to plan further with the practising teachers. They appointed coordinators among them to attend to fund raising, resources, displays, posters, the Open Day Exhibition of pupil and student teacher exhibits, the Awareness Day programme, and the River Day.

The practising teachers admitted that previous field trips were unstructured with the main objective being to observe the environment. They realised that the next planned visit to the

river should be structured to engage pupils in a meaningful way for meaningful learning. The field trip to the river will serve as a stimulus for environmental studies and the student teachers agreed to plan a work sheet for a physical study of the river and to develop strategies for meaningful learning in the field.

A very interesting debate occurred when a practising teacher questioned the validity of the existing curriculum's role in environmental education. My colleague and I made it quite clear to the teachers that the existing curriculum was not environmentally relevant, and that the purpose of the curriculum development project was to challenge this deficiency or weakness. We had to clarify the concept of environmental education as not being only focused on the biophysical aspect of the environment, but also includes political, social, and economic impact. This was new to the practising teachers. We indicated that teachers have been implementers of the curriculum for years and that this project could engage us in a paradigm shift to being teachers as curriculum developers. Developing the curriculum as a contextualised social process was what the project aimed at realising.

I explained to the teachers that the cross-curricular thematic approach to teaching and learning prevents teachers from operating in isolation for each school period. Here was a chance to relate each period in the time table in a meaningful way to establish continuity in the child's mind.

Prem stated that a curriculum package could be developed by the school which could be studied by teachers in other schools in the vicinity and ideas could be shared for development of improved packages.

Planning and Development Phase : Mid June to Mid September

I worked out a new curriculum for our lectures on campus after consulting with the student teachers. They agreed that water-borne diseases, water testing, water animals and plants, river education, contesting the RDDA model for curriculum development and other water issues should form part of their course work. Lesson planning, development of work sheets, and learning theories were essential to the process. They requested double practical periods to be used for materials development. They wanted to work in groups. These became ethnically dominated. I suggested that groups should be integrated to breakdown language barriers.

We invited experts in the field of water engineering, such as Dr John Kilani. At the end of his lecture, the student teachers agreed to develop a portable model of a filtration unit. An education officer from the Municipal Health Department, Mr H.C.Pillay, conducted talks on waterborne diseases which plague KwaZulu-Natal. Household cleansing of water also formed part of the health education programme for the student teachers. Mr Pillay provided the student teachers with pamphlets on water-borne diseases and household cleaning of water. Our student teachers were also taken on an educational tour of the Durban Heights Water-works. They indicated that this was their first

visit to such a plant and suggested that the pupils also be taken to the water-works.

Future arrangements: An agreement was reached that the practising teachers would work on the project and will meet the science student teachers periodically. They will visit the river near the school to plan a curriculum. A workshop will be held on 21 June 1991 at the school with Rob O' Donoghue and Jim Taylor of SHARENET and the education officer of the Umgeni Water Board.

There was a degree of racial tension between an "Indian" female student teacher and a "Black" male student teacher. The latter felt that he was marginalised due to his race and not given a responsible duty. I realised that to defuse any tension within groups I had to be very observant and down play the outspoken "Indian" students and offer more duties and support to "Black" students to build their confidence. The latter respected me for this attitude, the former despised me. I had to be democratic in a sensitive situation of political transition and transformation in our country.

The Implementation Phase

27 August 1991: This was the Awareness Day Programme. The science student teachers and their curriculum materials were transported to the school by bus. They displayed posters, models, books, and had a marine corner with fish, etc. Water testing was demonstrated at a water testing station by a few student teachers. A wetlands model was used to demonstrate wetland importance. There was also a catchment area model. The pupils were allowed to study the posters and models. The student teachers and practising teachers played an important role in discussing the curriculum materials with the pupils. The atmosphere of a real education which was contextualised with all its richness to meet the needs of the pupils prevailed. Some practising teachers did not expect the awareness day programme to be so appealing and expressed their feelings openly. I regretted that I did not have an audio-cassette recorder at hand. The awareness day process was recorded on videocassette.

A meeting was held with the staff to evaluate the programme. Teachers admitted that problem pupils were actively involved. They were tired of responding to their regular practising teachers and were excited by the presence of new faces (science student teachers). The small groups were subjected to the individual attention provided by the student teachers. This was very beneficial because under normal circumstances the teacher-pupil ratio was 1:30 compared to the current 1:4 situation. The practising teachers also observed that the quieter pupils responded in an unusually positive manner. They attributed the improved responses to the greater variety of curriculum materials and non-traditional innovative educational experiences. The pupils performance in homework tasks also improved significantly. Their exposure to diarising their experiences was new to them and it enabled them to see their role as their own initiative. This was a rare experience. The student teachers admitted that their interaction with the pupils was a great experience and that the posters stimulated the pupils to take more interest in their

learning.

3 September 1996: This was the River Day. The education officer of the Umgeni Water Board demonstrated the water testing kit to the pupils and the student teachers. The pupils were divided into groups of 10 with each group allocated to three student teachers. We walked to the Hlawe River. It appeared to be highly polluted. A few forms of life which survived such conditions were collected and identified by the pupils using a hands-on water booklet. A coliform bacterial test was also conducted. The pupils openly declared that they thought that only crabs and fish lived in rivers. They were amazed to find leeches, rat-tailed maggots, and other forms of life. It appeared to be an enjoyable experience.

Some comments by pupils: "This is an experience which we will never get again."
"We saw creatures in a river for the first time."
"We can't see the real things in a class. We saw more in the river."

The presence of Umgeni Water Board officials among us and a few parents urged us to take some action to expose the industrial concern which contributed to the pollution of the river which was described as severely polluted after submitting it to the low cost water testing kit investigation. The pupils were equally annoyed. We returned to the school after conducting the water testing programme and decided to discuss our findings with the parents on Open Day.

10 September 1991: This was the final day of the implementation phase, Open Day. The school used the hall which was part of the Hindu temple. A programme was developed by the student teachers and practising teachers. There was a very good turn out of parents. Items on the programme included a welcome by the principal, introductory speeches by a practising teacher, student teacher, and a pupil. The educational significance of the water project was explained to the parents and findings of the water testing experience at the river were presented to them. The student teacher spoke about the role of his colleagues in the project. The pupil gave her views about the project. The pupils sang a song on water. There was a poetry recital on the theme water. Three sketches were presented on the theme water. Competition winners were announced and prizes awarded. After the vote of thanks the parents were invited to view the displays and discuss some of the issues. They were clearly upset about the deliberate pollution of the river. I visited the school a few weeks later and was informed that an offender was fined for polluting the water. This was a clear indication that our project was not in vain. This was a good example of community problem solving in the environment. Action competencies were developed during the project which empowered the community to take the appropriate action in exposing the offender.

The teachers made a special request that the project be located in their school in 1992. When we returned to the campus, some

student teachers expressed their disgust at the lack of cooperation and interest which the Afrikaans teacher displayed regarding the project. I explained that we could not force her to participate. Fortunately it was only one teacher on the staff who resisted the project. It could have been more.

I visited the school in February 1992. The principal had retired and a new principal was appointed. The school was unusually silent when I arrived at 9h00. I met the secretary who informed me about the change of office. I met the principal who appeared to be quite disinterested in the project. He blatantly indicated that he will not allow the project to be implemented in his school. He reminded me of being a real authoritarian head who would do anything to bow down to his departmental superiors in carrying out their orders (of educational oppression). I thanked him for his time and requested his permission to meet some of the teachers who participated in the 1991 project. The teachers appeared to be withdrawn and despondent at the new appointment. I could not change the situation and left the school.

Some reflections for improvements in the project with the next school

1. I did not conduct any interviews as this was a pilot study. Observations were made to improve the project in the following year.
2. A school would have to be found which had a democratic principal.
3. Audiocassette recordings will be made of meetings or interviews.
4. A survey would be conducted of the status of curriculum development in the province of KwaZulu-Natal.
5. Research funds would have to be obtained from the University to conduct the research.
6. The school selected would have to be situated in close proximity to the University. Vishwaroop Primary was 40 kilometres away from our campus. There were logistical problems.
7. An attempt will be made to encourage lecturers from other subject disciplines to also participate in the project to enhance a curriculum development culture among lecturing staff.
8. I need to change my role from that of coordinator to facilitator and participant.
9. Due to distant location of school from campus, the student teachers did not engage in any formal classroom teaching.
10. The science student teachers were second year students. They claimed that they conceptualised the project too late in the year. I feel tempted to involve the same students with a new school in 1992.

RESEARCH DIARYTUESDAY : 3 MARCH 1992 8H30FIRST VISIT TO SCHOOL B

Met Principal on sick leave, and the Acting Principal. Explained the project. They welcomed the project as serving the needs of a staff development programme suggested by the Department of Education. The Principal suggested that the implementation of the project occur during the entire third term of 1992 since this term was the free of control tests. I informed the principal that since our student teachers have to begin preparing for examinations we could use only 3 weeks for the implementation and that planning and development and development will begin immediately. The most appropriate time for implementation would be 24.08.1992 to 11.09.1992. Our teaching practice second session ends about this time and we close for Michaelmas at the end of the suggested implementation phase. The University Michaelmas will be useful to me as facilitator and participant since the school will remain open during this period and interviews and questionnaires pertinent to the research could be conducted with the practising teachers (QT) and the pupils.

The Principal stated that the school had a total of about 240 pupils in standards 3,4, and 5 who were taught by 11 teachers.

Std.3 = 83 pupils

Std.4 = 72 pupils

Std.5 = 89 pupils

Telephone number of school =

Home telephone number of the Principal =

Home telephone number of Acting-Principal =

Address of school = Reservoir Hills.

The action research study, thematic approach (water), cross-curricular (integrative) approach, and contextualized nature (Palmiet River) of the research was emphasized.

I informed the Principal that I will be addressing his teachers in two weeks time. This will be followed up with a meeting between the the practising teachers and the student teachers.

SECOND VISIT TO SCHOOL B

THURSDAY 12.03.1992 10H45

The Acting Principal was not available as he had to attend an orientation programme for principals. The Acting Deputy Principal spoke to me. Despite my first visit to the school, by now it seems that neither she, nor the teachers were informed of the project.

I explained the nature of the project to her and she welcomed it as a good suggestion. She felt that the teachers needed the stimulation of such a curriculum development project. She had tried a cross-curricular approach with her junior primary pupils.

I requested that the first meeting with the teachers occur on Tuesday 17.03.1992. She felt that that was not a good day as it was the last day of the South African White referendum and suggested Thursday 19.03.1992 - 14h00 to 15h00.

11 MARCH 1992

14H15

MEETING WITH MR.D.W.BROOKES (PROMOTER)

1.The purpose of the research diary:

a)To influence records of the nature and the focus of the research.

b)To illustrate findings -eg.comments on the behaviour of students, comments on the level of maturity of the student teachers.

c)To evaluate curriculum change.

d)Audio recordings to be used on appropriate occasions.

2. ST to teach 2 lessons per week or 6 times.

3. What does one hope to achieve in addressing the QT in the second visit to the school?

Overview of the project.Critical reflection and action research.ST,QT,TE-roles in CD.Resources - own and outside.-physical and human.Planning,development, and implementation phases.Mr.Brookes made me aware of the possibility of interference which may be positive and negative and for which I should be prepared.There may be fears on the part pf the QT.Need to compensate or adapt to changes.The advantages of the project to the teachers may be great in terms of their own development.

The implementation phase should be scheduled in the third term after practice teaching.Our Michaelmas holiday follows immediately-school will still be open and the holidays will be useful for interviews and evaluation.

4. Curriculum change - has it occurred?/will it occur?

The approach is different from previous work - teachers were implementers - had no say in the plannning and development - experts prepared package which was handed down to teachers - no ownership - poor adoption (conceptual tensions at grass roots level) - hence poor implementation.

If QT involved in CD as in my intervention (UDW) - there will be a willingness to do CD themselves thereafter.

*****a comparative evaluation will be necessary - existing curriculum(syllabus) versus new approach.*****

*****need for another Questionnaire to evaluate curriculum change - comparative evaluation.*****

5. READ : DEVELOPMENTS IN SCIENCE EDUCATION - WHITE,R.H. - in main library

6. READ : WHAT CHILDREN BRING TO USE IN THE CLASS ROOM - SHAPIRO

7. Since my research is qualitative, there is no statistical analysis - data is to emerge as the action research progresses.

8. EVALUATION OF WHETHER CURRICULUM CHANGE HAS OCCURRED

Obtain reports from teachers.

Have the objectives of the research been achieved?

How to decide what happens

Meet with Prem and David

Can I handle this?

Use my research diary to evaluate whether curriculum change has occurred!Select what needs to be evaluated.

For QUALITATIVE EVALUATION see Carolina and Anand Naicker.

9. STRUCTURE OF DISERTATION

Preliminary chapters to be to be structured by practice.

9.1 Problem/hypothesis

9.2 Literature review

9.3 Methodology

Reporting research/data

9.4 Analysis/implications

*** Use 1991 experience to decide on appropriate chapters***

10. WHAT TO LOOK FOR DURING THE ACTION RESEARCH

10.1 Critical issues which make things happen:

- why do they happen?

- reference to the literature

(Theory informs practice)

10.2 Things which make the teachers change:

- why did they do this?

- "turning points"

possible use of questionnaires to establish above

11. NEXT MEETING WITH MR.D.W.BROOKES - POINTS TO BE RAISED

11.1 Questionnaire to Colleges and Universities

11.2 Chapters for research

11.3 Report on meeting with teachers

11.4 Evaluation of

CD

11.5 Comparative evaluation :
existing curriculum versus new approach to CD

11.6 Questionnaire for QT/ST to evaluate curriculum change

11.6 Duties for ST

11.7 Duties for QT

THIRD VISIT TO SCHOOL B

THURSDAY 19.03.1992

14H00

FIRST MEETING WITH TEACHERS AT SCHOOL B

1. I arrived at the school at 13h45. The acting principal was very friendly and once more expressed that his school felt privileged at being chosen for the curriculum development exercise. One of the HOD's was overheard to remark sarcastically, "Oh! I think that Professor Pillay has arrived."

2. I finally addressed 16 teachers in a classroom. Included among them were 2 HODs (males) and the acting deputy principal. The teachers appeared to feel hot and bothered as it was a particularly hot and humid afternoon. They made it quite clear that they were annoyed at being asked to meet after school for an hour and expressed the desire that future meetings be held during school time. I carried an audio-recorder. Some teachers felt intimidated by it - reason - evidence from the audiocassette may be used against them. I had to reduce my meeting from one hour to half an hour to appease the teachers.

3. The following points were discussed with the teachers:

3.1 A brief overview of the project with reference to the V School A experience (Tonga).

3.2 The action research (AR) framework of the project.

AR grounded in 2 principles:

- (a) involvement - collaborative participation
 - a democratic research process
 - emancipatory
 - teachers have the power to control all aspects of the research process
- (b) improvement - of the social conditions of one's existence. e.g. the theme water - helps man to solve problems related to water.
 - of one's practice as a teaching practitioner.
 - the improvement occurs during the research, not after the research as in conventional research
 - critical reflection / action (doing) / reading.

3.3 The existing syllabus and the RDDA model were explained - problems related to these. The importance of curriculum development at grass-roots level. The use of a cross-curricular integrative, thematic approach based on water.

3.4 The use of an action research framework necessitates a horizontal power relationship between us since ideas and resources will be shared. As a teacher educator (TE), my role will be that of researcher, facilitator and participant. The relationship will not be vertical (top-down) - democratic/empowering.

3.5 The first order and second order action research was explained. First order AR - occurs between TE and qualified (practising) teacher (QT). Second order AR - occurs between TE and student teachers (ST). Our AR is a combination of first order AR and second order AR - a model proposed for curriculum development in science teacher education.

3.6 A copy of an example from John Lancaster's, "Art in the Primary School", showing a cross-curricular approach to water studies in art was given to each of the teachers to clarify the meaning of such an approach. Science education of the topic "water" could also follow such an approach.

3.7 I supplied the teachers with a resource box containing a number of articles illustrating the purpose of my visit:

3.7.1 Interview with Sharon Levy,

3.7.2 Part of my research proposal,

3.7.3 Some articles on action research and curriculum development,

3.7.4 Teacher participation in the general science curriculum,

3.7.5 John Lancaster's article on "Art in the Primary School" - a cross-curricular approach.

3.7.6 Article on water purification at Durban Heights.

4. Having explained the above, it appeared that most of the teachers became more positive in their support for such a study. A few teachers regarded it as a "great" idea. They were not accustomed to a collaborative approach. This is expected since there has been an erosion of the culture of participation in the apartheid education system. They expressed a willingness to work with the student teachers whom they preferred, however, to meet during school time and not after school.

An analysis of the audio-cassette recording gives further expression of some of the views, problems, and fears of the teachers.

4.1 One teacher said, "Can we worry you for information on Science and Geography." I made it quite clear that by participating in such a university based project they would be guaranteed of access to human and physical resources most of the time.

4.2 "Where can we find resources for the 3 week implementation phase?" I stated that these would have to be developed as the year progresses in collaboration with the ST and TE.

"The facilitator will have to look for resources. Teachers lack the time."

4.3 "You need our help? We get involved. How do we obtain resources?" I explained that I could provide a limited supply of resources and that the onus was on the teachers to attempt to access these from the school, or as a sign of their commitment to even raise funds for this purpose.

4.4 "Will you see us again until the implementation in September? Will you as facilitator come often? You must be here to coordinate. We cannot coordinate."

4.5 "We are unclear about the project at the moment. We can't see our way through."

I explained that as time goes on, the project will become clear.

4.5 "How can we meet during school time? We have large classes which need to be supervised at all times. Perhaps we should meet after school."

4.6 "The librarian at NPS Primary school attempted an integration project which did not work due to poor coordination and lack of support. There was no conclusion to the project"

4.7 Miss Dorasamy, English teacher: "The use of videos will be a good experience. We forget that reading is for learning. Reading is for information. Science is not given a chance in English."

4.8 I explained that a horizontal power relationship should prevail at all times. The heads of department walked out soon after my statement. The embarrassed Deputy Principal remarked, "Where do we take the lead? This is sad and reflects apathy."

(Same problem with Afrikaans teacher at Vishwaroop Primary School, our pilot study)

OUTLINE OF PROGRAMME FOR CURRICULUM DEVELOPMENT PROJECT 1992 -
SCHOOL B AND UNIVERSITY OF DURBAN-WESTVILLE (FACULTY OF EDUCATION
- SCIENCE EDUCATION)

1. School : School B - Standards 3, 4, and 5.
2. Approach used : Cross-curricular thematic approach
Water theme
Development of the concept " water" across the curriculum (using as many subjects as possible)

NOTE :

A working definition of curriculum development : "Curriculum development is viewed as a process or exercise which transcends or goes beyond the existing prescriptive curriculum (syllabus) by being innovative, creative, evolutionary (changing), and participatory.

3. Main objective : To develop the curriculum by collaborative participation of qualified teachers, parents, student teachers, and teacher educators using an action research framework.
(to develop a culture of participation)
** See resource box with Secretary for further details.

4. Planning and development of curriculum materials:

- 4.1 Five official visits from April to August, apart from unofficial visits by student teachers for consultation with qualified teachers.
- 4.2 Qualified teachers to prepare curriculum materials such as lesson plans, posters, excursions related to water, e.g. Durban Heights water purification works
Wild life GEC Expo
Sea World
NAPAC water related plays
Make pupils aware of TV programmes related to water.
- 4.3 Student teachers to develop materials- lesson plans, posters, models, etc.

5. Implementation Phase:

3 weeks : 24 August 1992 to 10 September 1992

Will involve :

- 5.1 Teaching in class by qualified teachers and student teachers.
- 5.2 Talks on water-borne diseases by Health Educators from the City Health Department.
- 5.3 Water awareness day - Monday 24.08.1992 (August)
- 5.4 Water workshop and water study day - Tuesday 26.08.1992 (August)
- 5.5 Open day programme at a suitable hall - parents, schools invited. Thursday 10.09.1992 (September)

PROJECT WATER 1992

Mrs McCarthy of the Integrated Arts Division of the Faculty of Education was most willing to participate in the curriculum development project related to water. She suggested that her drama students and my Science Education 3 students collaborate in developing a drama package for practising teachers. She expressed the desire for her drama students to visit the local river with me as science educator. We agreed that there was a need for me to talk to her students during the drama period with the intention of setting the context of the curriculum development project.

I met with her students on 11 June 1992 and discussed the cross-curricular approach to environmental education which featured in the last school in 1991. They were excited about the water theme and I described the water problems of South Africa by focussing on drought, pollution, and the imbalanced distribution of water in South Africa. They were willing to work with my science education students in producing a 10 minute drama sketch related to water. The students insisted on me accompanying them on a study of the Palmiet River which runs through the campus. They suggested a movement and dance sequence in which they would move freely and imaginatively to the sounds of liquids. They were keen on watching and interpreting the flow of water from taps, streams, hoses, rain, fountains, and waterfalls.

The Drama students finally produced a sketch called "Waterella" which portrayed a droplet of water called Waterella. Waterella is depicted as a droplet of water which falls in a catchment area, quite happy at being "born" there. Her happiness is soon turned to sorrow as she passes through urbanised areas where she becomes a victim of pollution. Her sorrow soon turns back to joy when she enters the open arms of mother ocean. The students presented the sketch to the pupils of Durwest Primary School during the Awareness Day programme. The pupils were most excited by the sketch. It helped to set the scene for the implementation of the project. The sketch took a very interesting turn when the drama students decided to write a script for publication. The sketch was developed further during our curriculum development experience with our fourth year students at Umgeni Valley, Howick, where these students spend a weekend developing curriculum materials for environmental education. "Waterella" finally became a national publication of the education service of Umgeni Water.

Mrs McCarthy informed me that she did not feel comfortable with the thought that the practising teachers at Durwest primary school were not directly involved with the planning and development of the sketch. This was not a democratic form of curriculum development since the school was not directly involved in its planning and development. I suggested that she ensures that in the next project the practising teachers be involved.

Problems of acquiring human and physical resources

3 June 1992

I discussed problems related to acquiring certain human and physical resources with my colleagues. These were a water related dance drama produced by NAPAC for schools and physical resources provided by Umgeni Water. There was no guarantee that these resources were easy to obtain. They were useful due to their high quality which would serve to enhance the project. My colleague suggested that if people were not available, other alternatives would suffice. After all, the purpose of curriculum development is to enable teachers to contextualise their curriculum materials. Drama productions from the outside would only serve to decontextualise this process. The development of drama could quite easily be accomplished by UDW drama students. At this point I realised the need to communicate with Mrs McCarthy of our Integrated Arts Department.

Discussion of questionnaire with Dr D.S. Rajah

7 June 1992

I developed a questionnaire to assess the status of curriculum development practices at tertiary institutions in KwaZulu-Natal with the assistance of My colleague. He suggested that I test the document's acceptability to respondents by trialling it with science teacher educators outside the Province. He also suggested that Dr D S Rajah, a senior lecturer in Curriculum studies, examine the items on the questionnaire. I presented the document to Dr Rajah who stated that the items be classified into categories for coding purposes so that they can be scored and interpreted for purposes of analysis. My colleague responded by stating that the research was a case study based on a descriptive analysis of a case study and therefore could not be classified as not empirical (experimental) research, subsequently categorisation of items in the questionnaire was not necessary.

Some commitments from key teachers

23 June 1992

1. The English teacher willingly agreed to serve as the internal coordinator.
2. The teacher of History and Art already has a one and a half week programme forecast for teaching issues in her subject related to water education. She also volunteered to prepare posters depicting water issues.
3. The Right Living teacher stated that she will develop water concepts related to right living.
4. The Principal and Deputy Principal will negotiate with the City Health Department to conduct talks related to water borne diseases and other health related issues.

5. The science teacher will assist in the planning of the river study.
6. The Geography teacher will plan the visit to the Durban Heights Water Works.

Communication about the progress of the project within the school

1. Subject coordinators will be appointed to assist the student teachers and to drive the cross-curricular approach.
2. Poster displays in the staff room will be used to inform staff about important announcements pertaining to the project.
3. The external facilitator (teacher educator) will update his personal file which will be housed in the Principal's office.

Some critical moments observed by the Researcher

1. A democratic school with a democratic principal was necessary for the project to succeed.
2. The facilitator has to be an outsider for a curriculum development project to be successful within a school. This observation stemmed from a claim from a practising teacher, Mr Khader, that he preferred me to promote the project because when he attempted to coordinate a cross-curricular project in his previous school, the project fizzled out due to a lack of continued support from his colleagues.

The library science teacher was up in arms against my intervention at the school and refused to support the project due to her claim that when she attempted a similar project, there was no support at all from staff members. I was however supported by most of the teachers at the school, some of whom advised me to ignore her, and continue with my role as external facilitator.

3. Although teachers were committed in principle to support the project, they had a tendency to dash off after school, and some looked at their watches during our planning meetings which were held during the last hour of the school day. The student science teachers were more cooperative and were disappointed and upset at the lack of cooperation from some subject teachers.
4. The science student teachers felt more confident to work in groups when preparing lessons for teaching. They also preferred to teach in small groups.

Some ideas in Mathematics for a cross-curricular integration in the environment

I was anxious about the ability of the student science teachers to develop curriculum materials in Mathematics and the environment. I decided to approach Professor M Moodley, our Head of Department, to obtain his ideas. He suggested that to relate mathematics to the environment for the sake of doing it was not relevant. It ought to be applied where possible. He suggested the following:

1. The rate of flow of the water in a stream could be determined mathematically.
2. The formula for calculating the volume of a cylinder can be applied to calculate the volume of a liquid in a can of Coca Cola.
3. The relationship between cubic centimetres and millilitres could be established.

He suggested that the Maths Education students in the group should be given the task of developing mathematical concepts related to water.

Project Water with School C : 1993 and 1994

School C 1993

The Principal of Hillview Primary School had invited our Faculty of Education to use his school for research purposes. I decided to seize this opportunity due to the school being about half a kilometre from our campus. It was a fully resourced school which was initially built to house "Indian" pupils. It soon became a "white elephant" because it failed to attract enough pupils from the middle class community which surrounded it. Fortunately, due to the imminent political transition in South Africa and the release of Nelson Mandela, the school adopted an open door policy for admission and as a result prevented its closure. Unfortunately the principal was transferred to another school and was replaced another. In November 1992, I successfully negotiated with the new principal to plan and develop a curriculum development project with his school. I visited his school in February 1993, only to discover that he had taken early retirement and was temporarily replaced by his deputy principal until the appointment of a new principal. The deputy principal expressed her commitment to the project and was willing to work with my student teachers. She also suggested like the other principals that she required the consent and approval of her staff and would meet with them to discuss the project before inviting me to address them.

I went back to her school in late February and was informed of her staff's decision to participate after consulting with me. I arranged a meeting with the staff and explained the need for a participatory approach to curriculum development and the role of my student teachers therein. The staff were willing to participate in the curriculum development project. I sensed a tension between one head of department and the rest of the staff who appeared to feel threatened by the horizontal powerplay which was welcomed by the latter. His initial resistance was defused by some of his staff members who convinced him of the need to co-create the curriculum. Several meetings were arranged with the science student teachers and the school staff. The participants accepted the format of the implementation phase proposed by the previous two schools. The student teachers prepared curriculum materials in their groups and were fully prepared for the implementation. The deputy principal played an instrumental role in ensuring that the project went off smoothly.

It was unfortunate that prior to the implementation, the newly established South African Democratic Teachers' Union (SADTU) decided to go on a strike which resulted in a cancellation of the implementation phase of the project. The student teachers were very disappointed at such a turn of events which prevented them from testing their curriculum materials. The staff suggested that the project be repeated the following year. I preferred to accept the offer due to the good logistics associated with the close proximity of the school to the University Campus.

School C 1994

I visited the school quite early in the year and was informed by the deputy principal that a new principal, was appointed. I was introduced to her. She appeared to view the project with a negative tendency and attempted to subvert it by discouraging the collaboration. She indicated that she was a new principal who needed to get familiar with a new staff and this required time. She made it very clear that her role was to ensure that the curriculum (syllabus) of the education department was to be implemented at all costs, and that she agreed with its aims and objectives fully. It was quite clear that she was not prepared to listen to my view point. I informed her of her staff's commitment to the project as agreed upon during the previous year and suggested that she discuss the issue with them prior to making her own decision. The deputy principal also vouched for the previous year's promise and convinced her principal to consult with the staff.

The staff, who were by now quite used to my presence in the school and the merits of a collaborative curriculum development project, were not prepared to abandon the project. They took it upon themselves to keep to their promise and continue with the project. It was quite obvious that they were influenced by SADTU's democratic position on teachers. A few teachers confided in me that they did not approve of the autocratic approach adopted by this principal and were determined to show her a point by cooperating with me and our student teachers.

The student teachers and practising teachers met and planned the alternative curriculum together. The principal agreed to allow the project to resume but kept a low profile and allowed the deputy principal to be in charge of it. Again I was able to enlist the support of Mrs McCarthy to develop a drama sequence for the project. She was careful this time round to involve the support of a few practising teachers and produced an excellent interactive drama sequence related to water. She was able to also produce a few puppet shows which were very educational to the pupils during the implementation. At no stage did the principal show any interest in the process of development which her staff experienced during the intervention of the collaborative project with her school.

By now I was becoming tired of working with schools which were of an "Indian" character and decided to discuss with my colleagues the possibility of working with a "Black" school which represented a disadvantaged context. They were very keen to support such an endeavour. I now had to scout around for a democratic school in such a context for the following years' project.

Project Water : School D 1995 and 1996

1995

I approached two of our ex-students who were appointed as practising teachers at School D in KwaDabekka (Clermont). This is a "Black" African township situated next to New Germany and at a distance of 15 Km from the campus of the University of Durban-Westville. They were very keen to serve as an internal coordinators for the project. Their previous experience as student teachers in a similar project would encourage their colleagues in the school context to collaborate with our student teachers. I was very pleased with their response and decided to visit the school for the first time early in March 1995.

13 March 1995

The principal was on the verge of retirement. The deputy principal is a very dynamic gentleman who is very concerned about improving the education of his pupils in a school which is classified as being in a disadvantaged context and under-resourced. With the advent of a political democracy in South Africa and a new Government, changes were taking place in disadvantaged schools which were becoming visible. For the first time the school was fenced and a new block of classrooms built and fully furnished. This block was in marked contrast to the existing drab classrooms.

School D has 21 teachers and 1300 pupils. The classes range from class 1 to standard 5. There are three graduates on the staff which appeared to be generally friendly. The school is clean and kept this way by the pupils who are given the menial tasks of cleaning the toilets and sweeping the classrooms and the school yard. It has a duplicator and an overhead projector. A photocopier was donated to the school by the Anglo American Corporation. A nutrition scheme is in progress at the school and the pupils appear to be a happy lot with bright faces. Instruction up to standard 2 is in the medium of the mother tongue language, viz., Zulu. Science is offered for the first time when pupils enter standard 3 with a sudden change in the medium of instruction. The principal's office has a telephone and posters on its walls. A very interesting sight was the presence of a mission statement which clearly outlined that,

"...to provide an innovative and purposeful education suitable and relevant to the child's world."

also,

"Tell the child and he will forget.
Involve the child and he will learn."

This encouraged me greatly and I knew that I was at the right school. The deputy principal's office was even more appealing with wall charts and posters related to history, english, and art. The staff room had a large table and a few desks which did not appear to be adequate for the needs of the staff.

I was made to feel most welcome by the principal and her deputy principal. I discussed the role of the project from a staff development position. They informed me that half the staff was generally away at inservice day programmes/workshops and assured me that the staff will accept the project. I once more explained the need to consult with the staff and to obtain their endorsement for the project. The deputy principal stated that he would prefer to be the internal coordinator for the project. I suggested that he inform me as to whether the staff would be prepared to meet with me to discuss the project.

The principal at the end of our meeting stated, "We hope Mr Pillay that with your coming here we will have more improvements. We are tired of waiting. We are waiters." This statement saddened me.

First meeting with the staff

20 March 1995

I met with the staff during the last hour of the school day. Mr Khumalo did not invite the junior primary teachers who had already left for home. I presented the project to the teachers as I had done previously. I indicated that the theme "water" could not be changed because our key funders were interested in promoting water education at schools and that funding was otherwise difficult to obtain.

I discussed the need for teachers to engage in reflective teaching by moving away from inflexible, rigid, and restrictive traditional teaching methods. They needed to move away from practising in isolation and had to learn to plan, develop, and implement their teaching by collaboration with their colleagues.

The teachers were keen on adopting the procedure which other schools had accepted. They also agreed to collaborate with our student teachers and I arranged a date for the two groups to meet.

3 April 1995

I arranged for the transport of 70 science student teachers to the school. I suggested that Mr Khumalo chair the meeting.

Some observations/critical moments:

1. The student teachers and practising teachers sat in the staffroom in their own groups and a cold silence separated them. The deputy principal suggested an ice breaking session to get the two groups talking. He finally succeeded in integrating the two groups of teachers and proceeded with the discussion.
2. The principal suggested that a few pupils also be involved in the planning and development of the project and called them in.

3. The student teachers were busy making notes of the proceedings. They were keen on reporting on the action research as part of their year mark. They had to compile a file in three parts: A reflective diary, an action research report, and a record of curriculum materials.
4. It was difficult to get the practising teachers directly involved in the action research process. They were willing to assist the teachers in developing materials as per subject, but indicated that they lacked the time to do research. I had the impression that they did not understand the process. The presence of my ex-students among them did not help. They were also studying for a higher degree part time.
5. A student teacher suggested that since the "Indian" students did not have an idea of the culture of a "Black" African school, they wished to observe a few lessons before developing curriculum materials. They were keen on observing how these teachers handle second language learners and their disadvantaged context.
6. The deputy principal noticed that most of his teachers were not fully committed to the project and informed them that a sum of R6000.00 was at stake and that they should be considerate. He assured me that he would talk to them to motivate them further for their full cooperation.
(Note: the use of funding to "bribe" the school to participate. Some funds to be used for refreshments for pupils, teachers, and parents). He stated that his teachers will produce curriculum materials with their pupils for the implementation phase.
7. It appears that the teachers are part of an authoritarian regime. Although the senior management appears to be democratic, the teaching culture of subservience prevails. Why? Is it that African teachers respect authority, especially that of older principles?
8. The teachers were reminded that their school's mission statement relates perfectly to our contextualised project.
9. The two ex-student teachers have kept a low profile. I am still waiting to see when they will feature. After all, one of them, introduced us to the school.
10. The deputy principal stated that it is difficult for teachers to change from the old school of thought. They were accustomed to teaching English in Zulu and now must change. This makes teaching their pupils more difficult because all their pupils come from homes where the mother tongue language is Zulu. I suspect that even the teachers have a second language problem.

Discussions with science student teachers during lectures

First discussion:

The students were introduced to the curriculum development project. Reference was made to previous projects. They were reminded that the second year projects were campus based and their materials were never tested in a school context. This project enabled them to collaborate with school teachers in producing an alternative curriculum and implementing this in the school context (reality site). The student teachers were excited at this prospect and were willing to accept the project as a challenge. Some of them were worried about losing lecture time in other subject areas. I assured them that I would make time during their science education lectures and practical periods to enable them to develop materials. Student group leaders were identified. Subject groups were formed to facilitate a cross-curricular approach. I insisted that each group should also produce science materials related to water education.

Second discussion:

The students were introduced to the RDDA model and the action research model for curriculum development. They realised that the latter model was useful in challenging the status quo in science education and wanted to apply it in the school context and among themselves. I explained to them the need to keep a reflective diary and to plan their action research strategies in their groups. The need to interview teachers and pupils was made quite clear.

Third discussion:

The student teachers wanted to know what to expect at the school. I informed them that most of them had never been to a disadvantaged school context and that they should reflect on their reading experiences of news paper articles and to also discuss issues with student teachers who have been educated in such schools. They already realised that second language problems would exist, but had no idea of the reality. They were looking forward to the first visit to the school.

Fourth Discussion:

This meeting involved a review of the student teachers' first visit to the school for a meeting with the practising teachers. Discussions typical of previous projects occurred. They requested a tour of the school to visit classrooms. I encouraged three integrated arts lecturers to also accompany us with a few of their student teachers. This group planned a useful materials development process with two practising teachers.

Some student teachers were not too pleased with their interaction with some of the practising teachers who appeared to be disinterested. Other student teachers found their interaction with some of the practising teachers to be most encouraging. The student teachers generally sensed that a lot of the effort would be theirs with the practising teachers serving as mentors in the

process. They realised the need to plan materials with a zulu background to enhance concepts. They requested a day to implement classroom teaching and the "Indian" students realised that this would not be possible without a "Black" colleague's assistance with zulu. The student teachers suggested the need to raise additional funds to provide resources for the school because they appeared to sympathise with its plight. They also requested a letter to their lecturers in other subject fields to be excused from lectures during future visits. They made a further request that the next four double period practicals and a few lectures be devoted to materials development because they found it difficult to meet with their colleagues after hours.

Fifth discussion: an assessment of materials prior to implementation:

The groups displayed their materials in the science laboratory. This included posters, charts, models, experiments, puppet shows, games, etc. these materials were assessed by me and comments were made about their usefulness or relevance to the context of the pupils. I felt that their materials were prepared well with a lot of effort and suggested that the student teachers develop strategies for their implementation during the Awareness Day programme which was scheduled to take place in two days time.

The Implementation of the Project

1. The Awareness Day programme commenced with an assembly of the pupils addressed by the principal, the researcher, a student teacher, and a representative of Durban Waste Water Management who spoke to the pupils about abuse of sewage and storm water systems. The programme was eagerly received by the pupils because the curriculum materials developed by the student teachers were displayed on the walls of the school's quadrangle and represented an enriched educational environment which the pupils were not exposed to previously. After the assembly, groups of pupils visited the work stations set up by the student teachers who had interesting discussions and interactions with them. The context was now set for the the next two weeks of teaching around the concept water.
2. The excursion day programme included a visit to a sewage works, waterworks, and a river. We were fortunate to have with us Professor Mike Savage of the Africa Foundation for Childrens' Literacy in Science and Technology Education. He provided us with a written evaluation of the days experiences. He found that the practising left most of the actual river study to the student teacher and the principal. They appeared to be disempowered. The pupils enjoyed the educational outing.
3. The Open Day Programme: This programme had an excellent response from the parents who were exposed to water problems related to our rivers, diseases, sewage abuse, etc. The student teachers interviewed some parents and

teachers to assess the impact of the project on education at the school and for the community. This was an appropriate community problem solving strategy in environmental education. The problems of waste water abuse were discussed with the parents by an education officer from Durban Waste Water Management using a model. Refreshments were served to all the participants at the end of the programme.

The 1996 project with the same school was not spectacularly different. Among the few significant developments were the following:

- * The student teachers wrote their action research reports in groups.

- * One teacher developed a very close working relationship with the Integrated Arts lecturer.

C **Photographic evidence of the curriculum development project**

APPENDIX C: EVIDENCE FROM PHOTOGRAPHS



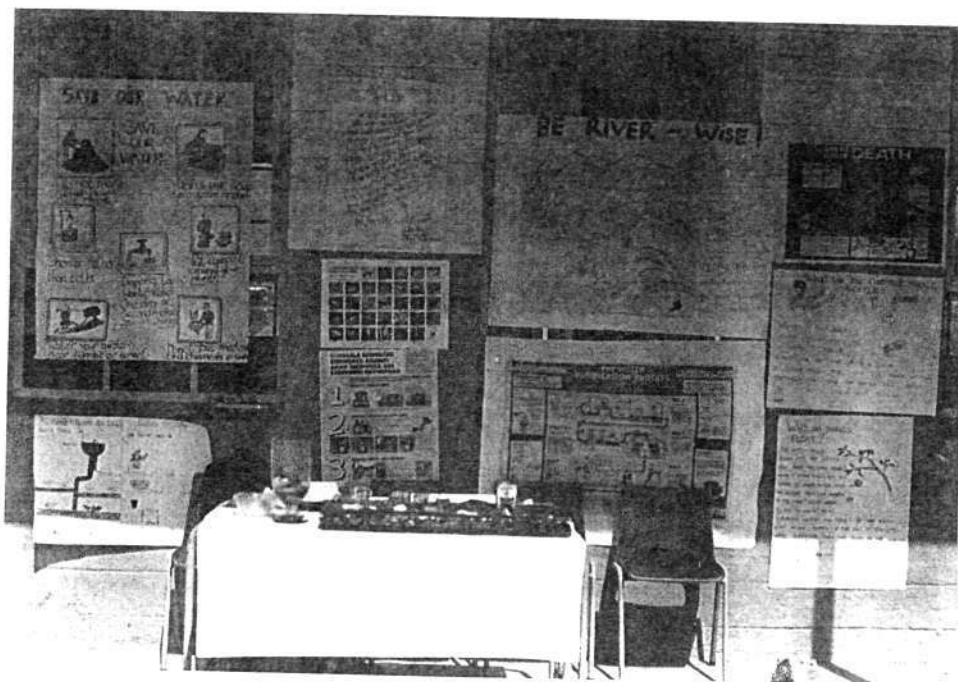
1. Students arriving at School D for their first visit



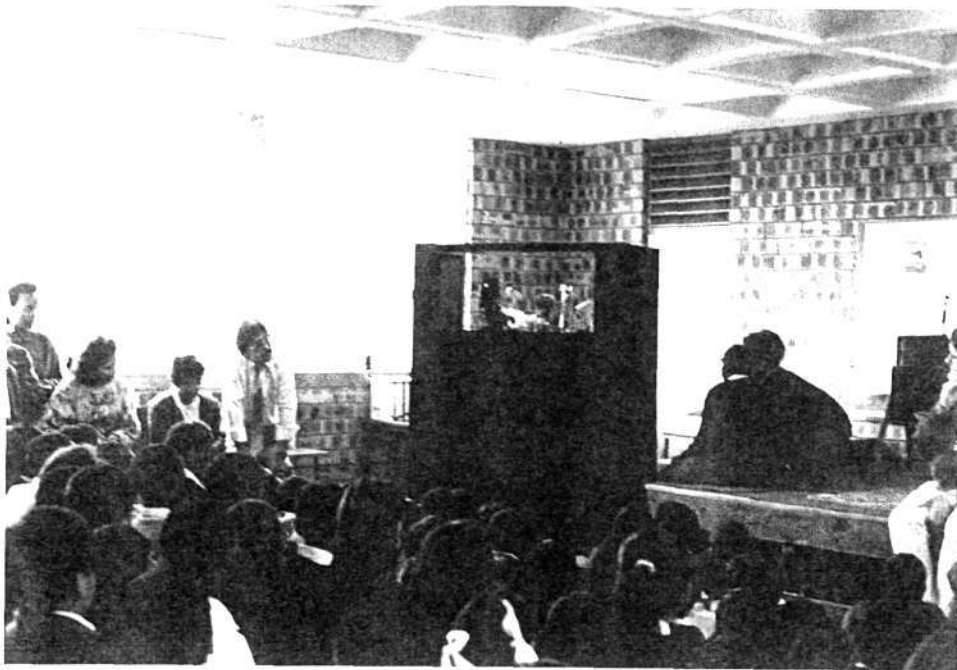
2. Students planning curriculum materials



3. A display of posters and charts during the Awareness Day programme



4. A display of experiments, models, posters, and charts during the Awareness Day programme



5. Pupils viewing a puppet show during the Awareness Day programme



6. The teacher educator (researcher) demonstrating the use of a low-cost water quality monitoring kit prior to a visit to a river



7. A student and pupils arrive at the river



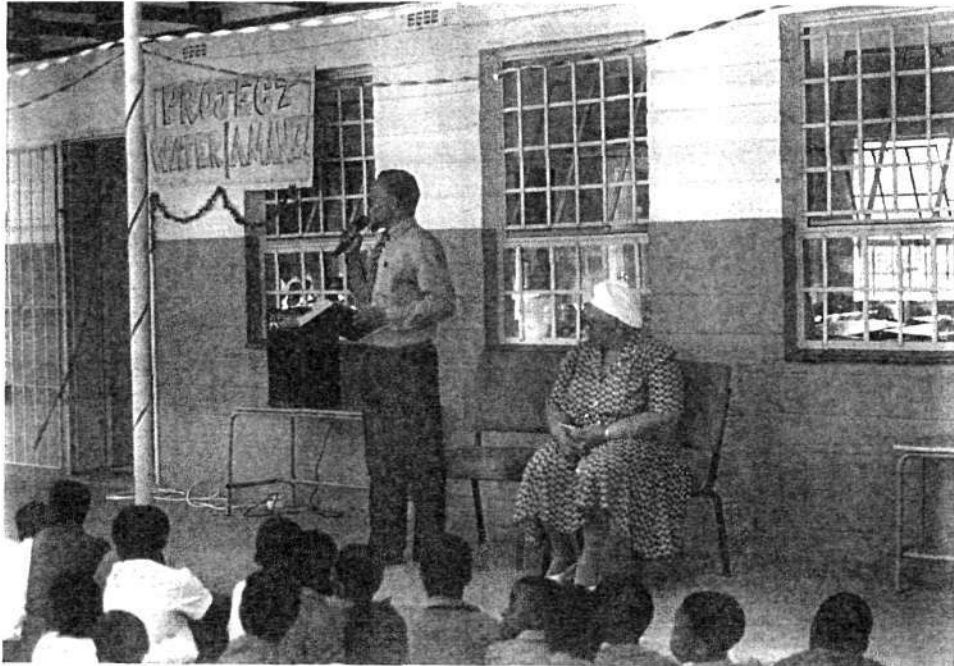
8. Groups of students and pupils discussing the use of a water quality slide



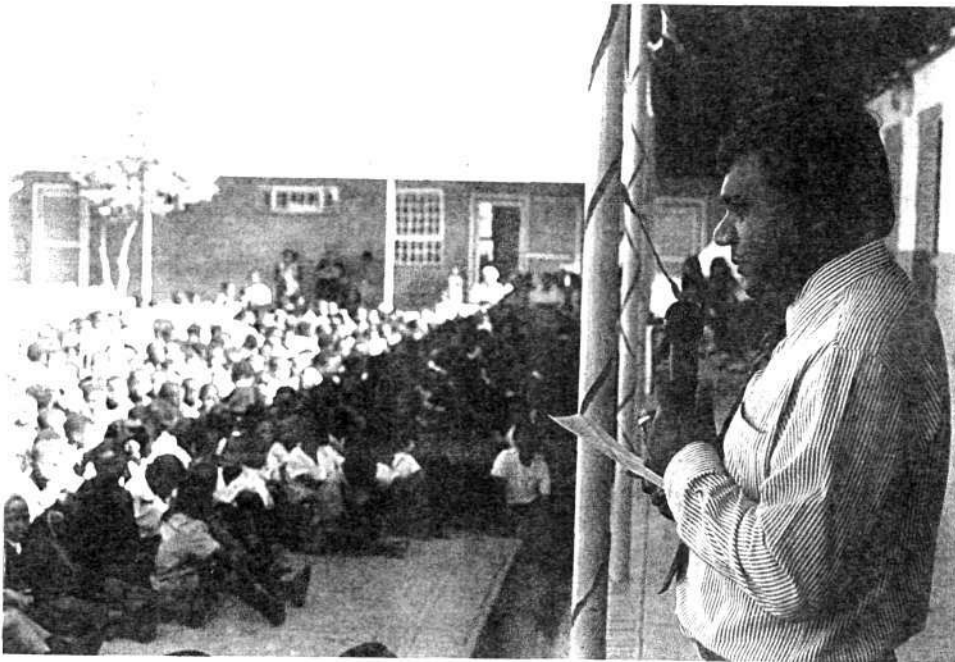
9. Two pupils examine the under-surface of a rock for aquatic organisms



10. Pupils looking for aquatic life forms



11. The deputy principal presents his address during the Open Day programme



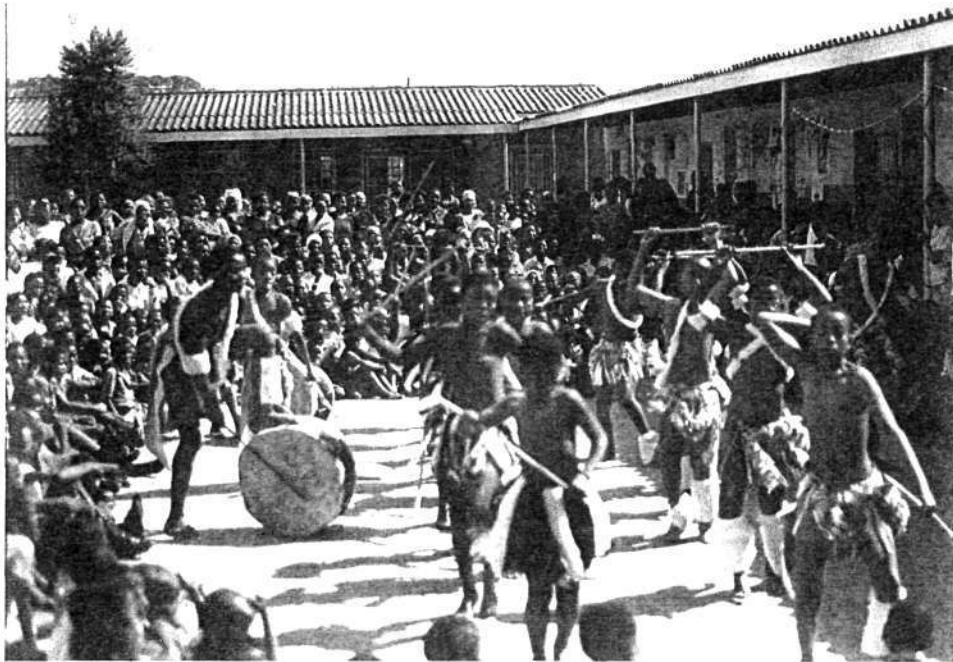
12. The teacher educator addresses the school (pupils, parents, students, and teachers) during the Open Day programme



13 A section of some of the parents invited to participate in the Open Day programme



14. A section of some of the students present at the Open Day Programme



15. Pupils present at a Zulu dance related to water during the Open Day programme



16. Pupils present a sketch related to water



17. The school choir sings a song related to water



18. A parent examines some of the models displayed during the Open Day programme

D Transcripts of formal (structured) interviews

POST IMPLEMENTATION INTERVIEW WITH THE PRINCIPAL OF SCHOOL B

Interview questions posed

1. Researcher: You appeared to have a democratic approach to education during our interactions with you. Did you have any fears about deviating from the usual trend in schools?

Principal: I think there is a need for freedom in education as long as the pupils benefit. They should be the main benefactors. There was a lot of merit in what you have done and you have my full support.

2. Researcher: Did you have any concerns that the curriculum development project would have cut across you teachers' tuition time?

Principal: If you want children to benefit from such a project, there is no need to worry about tuition time being lost. They were involved with the same theme in every subject anyway. I feel that our children have to be exposed to such a project.

3. Researcher: Were you at any stage worried about your pupils' safety during the many excursions which were undertaken?

Principal: No I feel that there was enough manpower to handle this. I have complete confidence in my staff and the fact that you and your student teachers accompanied them.

4. Researcher: Do you believe that this project was a learning experience for your teachers?

Principal: Definitely. This was a new experience to them. They were not exposed to such an experience before. In most cases they were glued down to their text books and to the four walls of the classroom. There was no such thing as field education. There was just one excursion per year per standard and this limited the exposure of our teachers and pupils.

5. Researcher: Do you think that a school should be given a degree of autonomy in deciding what should be included in the curriculum?

Principal: I think it depends entirely on the principal. I think that if you are free and willing to meet the challenges of education, then I don't think that there is a need for any rules and regulations to bind you. I have always mentioned

to my teachers that good rules are flexible and we should take advantage of that.

6. Researcher: Do you feel that most teachers are slaves to a prescriptive curriculum?

Principal: In the present system I would say yes. But if you expose your teachers to a situation like this where you have children involved in field education where teachers also take an active part, then I think that will fall away. I think it depends entirely on the administration of a school.

7. Researcher: What do you think about teachers working together to produce an alternative curriculum?

Principal: I think that it is a fantastic idea.

8. Researcher: Do you think if they work in isolation they will be successful curriculum developers?

Principal: No. I do not think that we should have water tight compartments in schools. Subjects should not be water tight. I think that there should be integration. All subjects should be closely involved in such a way that teachers can play an active role.

9. Researcher: What are your comments about team work among teachers during the project?

Principal: I think it was generally good. Your student teachers were positively motivated and they worked well with my teachers. If you did not come in from the University, we would have been still working in water tight compartments.

10. Researcher: Did you see any merit in implementing a cross-curricular thematic approach during the project?

Principal: Definitely. As I said by integration we do not teach subjects in isolation. Your approach has largely assisted my teachers and pupils in achieving this so that we do not work in water tight compartments.

11. Researcher: Do you expect the approach used to become an on going process at your school?

Principal: In fact it has changed the whole system of education at this school. Our approach is now

very different.

12. Researcher: Would you regard your teachers as implementers of curriculum or as curriculum developers?

Principal: Definitely. I think the approach has changed. At one time you had the principal and adminin staff telling teachers what's to be done. But now with this new concept in education, I think that they are more than implementers. They are now forming the curriculum.

13. Researcher: Do you regard the process of curriculum development as having a place in our education system now that you have experienced a project such as this one?

Principal: Yes, definitely. I think there is a need for the introduction of this project in the education system.

14. Researcher: What is your opinion of this form of preservice teacher education, i.e., student teachers coming to your school and collaborating with yor staff in developing curriculum?

Principal: By exposing your student teachers to this kind of approach, I think that they will become better teachers than those who go to a teacher training college and learn only the academic part of teaching and confine it to the four walls of the classroom.

15. Researcher: Did any of your teachers resist the project?

Principal: There may have been that fear of the curriculum development project because they have been used to rules and regulations of the education department and slavishly following the syllabus.

16. Researcher: Did your pupils benefit in any way from the project?

Principal: Yes. We have to expose our children more to this kind of experience. It has allowed a transfer of knowledge from school to home. Not only have my pupils benefitted, but also my teachers and myself. This kind of education is common overseas but rare in South Africa.

17. Researcher: Do your subject advisors/inspectors collaborate with your staff members when a new syllabus is

handed down to schools?

Principal: There is a need for communication between subject advisors and the school as a whole in order to work out a strategy to implement the new syllabus. They need to come to the school like you have done and collaborate with the teachers, rather than just giving us the syllabus. I think that a programme like this (project) should be introduced to every school.

18.Researcher: What were some of the comments of parents of pupils to the project?

Principal: A few parents phoned me and said that thier children are benefitting tremendously from this programme. That idleness at home and even their approach to reading and watching TV has changed tremendously. They have become aware of our project.

19.Researcher: Do you think that parents should be given the opportunity to develop the curriculum too?

Principal: I agree with you. I think that there should be parental involvement too.

20.Researcher: Are there any questions that you would like to ask?

Principal: Mr Pillay, I am not going to ask you any questions, but I am going to tell you one thing. You have introduced something in education which is a new concept. I am not sure whether it exists in other official (education) systems but I do hope that you will visit other schools and introduce a thing of this nature. It is a new approach altogether and my staff, pupils, and myself will miss you. We are very grateful. The approach (to education) is now different.

21.Researcher: Thank you. On behalf of the University I wish to thank you and your staff for their cooperation in this research project.

POST IMPLEMENTATION INTERVIEW WITH THE ENGLISH TEACHER
(COORDINATOR OF THE PROJECT) AT SCHOOL B

Interview questions posed

1. Researcher: What subjects do you teach?

Teacher: English and some Guidance.

2. Researcher: Did you participate in the curriculum development project?

Teacher: Yes, fully as its internal coordinator.

3. Researcher: Are you aware of teachers who resisted the project?

Teacher: Yes.

4. Researcher: Can you provide details of this resistance? Why did they behave this way?

Teacher: Basically many teachers are so set in their ways and are so established with promoting syllabuses handed down by the department (of education) that they don't focus on relevant education. They just simply go by the book irrespective of what they are teaching is relevant to education. Like for example the Maths teacher who will only do the Maths that is prescribed in the syllabus and nothing else out of that context. Even the Afrikaans teacher did not see it as very much as an example for collaborative and participatory work.

5. Researcher: Do you think that the system made them that way?

Teacher: No. I think it is more of an attitude (problem). I think that teachers have become so much in a rut. They are so used to taking things are handed down from the Department (of education) that that they don't consider creating their own (curriculum?).

6. Researcher: You seem to be very concerned about environmental education. How do you approach this important aspect of education?

Teacher: How I tackle environmental education is really my concern in my subject (English). Language skills and aspects come in but over and above at the end of the year I must be able to say that I send out

a group of very aware standard 5 pupils who are environmentally conscious and can make a difference.

7. Researcher: Do you feel that many teachers need to be re-educated about teaching and learning?

Teacher: I think definitely. Orientation courses are needed to re-orientate teachers to the whole purpose of education. Even in this 3 week programme there were so many teachers who although were willing to collaborate and participate in the curriculum development project but in between they tended to go back to their old ways. Like, they said they have a test programme unrelated to the project and which has to be done to please their head of department. So, many of them were bound by prescription.

8. Researcher: From what I have observed so far, you do not seem to follow the prescribed syllabus strictly. Do you generally tend to experiment with the curriculum and create your own?

Teacher: Well, I told you my focus in teaching is producing environmentally aware individuals. I like to use newspaper articles. I think they can be used to develop skills. I don't like focussing on established text books. Their approaches are outdated and irrelevant. So I feel that making up my own curriculum materials is in fact important.

9. Researcher: So it appears to me that there is a degree of autonomy in your subject area?

Teacher: There is a great deal of autonomy which should be directed to making the subject matter in English relevant.

10. Researcher: Do you think that one of the criteria of being a professional is to have the freedom to be autonomous?

Teacher: But you know, Alan, the freedom comes from your doing what you think is right and then fighting for that. Like in the Cape (Cape Town) there were so many Coloured teachers who refused to go by the prescribed syllabus and did what was relevant. Coming from that kind of situation to Durban I did not feel that I had to follow what was given to me.

11.Researcher: Were you in a Coloured school then?

Teacher: No - in an "Indian" school. But, the University of Western Cape runs grammar courses where you work on language programmes. This is for teachers from all schools (contexts).

12.Researcher: Did you find the collaboration between student teachers and practising teachers useful in any way? Could you comment further.

Teacher: Well it taught me that you don't have to focus on content as such as much as an exercise (in developing it).

13.Researcher: Do you prefer to be an implementer of curriculum or a curriculum developer?

Teacher: What do you mean by implementer of curriculum?

14.Researcher: An implementer is a teacher who slavishly executes a syllabus without questioning its relevance to a given context.

Teacher: I see the teacher as a curriculum developer because we are in such close contact with children that this makes us qualified to develop the curriculum for them.

15.Researcher: Did you have any experience of curriculum development at the preservice level (during your initial teacher education programme?)

Teacher: No, not at the preservice level. But, this is my second opportunity at an inservice level. My first was at Cape Town where I attended a language workshop and I also served on a national education committee.

16.Researcher: How do you view our approach (UDW) to teacher education as experienced during the project?

Teacher: This is very encouraging. It was the first time that university student teachers and practising teachers got a chance to work together. Normally lecturers come in to see their student teachers and there is no contact with practising teachers who are supposed to be guiding them.

17.Researcher: Was the approach beneficial to your colleagues and your pupils?

Teacher: I cannot speak for the other teachers, but, for my part it was my first experience in putting together a programme from the variety of feedback I got from the pupils. I mean from their writing they have thoroughly enjoyed it. Many of them said thanks to the lecturer from the University of Durban-Westville and the student teachers who took the time off to to teach us. We have something we will never forget. It's so different from learning from this context than learning from a text book. That's the heartening thing because despite what colleagues had to say, a positive response like this from the pupils makes you feel that next year we have to go ahead and improve on this and make it a better experience.

18.Researcher: What is your opinion of how the student teachers functioned during the project?

Teacher: I don't think we had any problems. They were typically student teachers because they are still not qualified. They still need to learn how to handle so many problems in the class - likr discipline. Quite frankly they worked very hard and did quite a bit. Very pleasing in fact.

19.Researcher: Do you wish to comment on your collaboration with your other two colleagues, the art and science teachers?

Teacher: We managed to collaborate and discuss. When I did creative writing in English, the art teacher would do creative work in art like button design. Things started off in the English period that continued in the art period but were related to water. What i was saying in words to my class, she was expressing in colours and paints and relating to the topic. So we extended the children's senses extensively for the three weeks.

The science teacher and I worked closely as well because in my reading material I was bringing out facts like: Why is the sea salty? There were also various other features related to water. Things (concepts) that she was going to discuss in a science lesson which were difficult for the children to grasp or understand, I would deal with in my vocabulary lesson. I would say that that was collaboration in a way. We were not doing things in isolation. The children were learning vocabulary skills and concepts which were fitting in nicely with the theme.

20.Researcher: So you found that language developed in the process?

Teacher: Yes, there was no language in isolation. The vocabulary was relevant. You were not looking at a word for the sake of a word but you were using it because you needed it (for the context?).

21.Researcher: How did your second language learners (Black African pupils) benefit?

Teacher: They have benefitted. All the pupils had so much of fun with the crossword puzzles. And the Black learners, what we try to do is because they are disadvantaged, we do not use the black languages, which I can speak, but we try to simplify it so that they can atleast pick up words. If they learn atleast one word for the day, that apparently is good enough. So long as they can handle the language.

22.Researcher: Have you any further comments?

Teacher: I just have to say that the field trips were absolutely marvellous. Many of them (the pupils) commented on how lovely it was to learn from experience. We took our pupils to the science exhibition at the Teacher's Centre. The primary science pupils from schools were asked to do models. So many had things on pollution or hydro-electricity. There were models from other schools related to water purification. These were done in isolation and from reading books or from a class lesson. None of them had gone out to a purification works, unlike our pupils during the project. It was like out of context for them and what they put down on paper did not really make sense to them as much as it did to our pupils. This is because nothing was done in isolation with us. Even when we did water borne diseases like bilharzia and cholera we had newspaper articles about children dying from such diseases. Our pupils could therefore easily relate to it and this came out in the dramatic class presentations. So overall, I thought it was a most marvellous learning experience and colleagues initially were not very helpful and I had to end up putting the programme together myself. At the end of it they had to say that it was very well done. And that was the reward I got.

23.Researcher: Do you have any questions to ask me?

Teacher: Ah! Well - are we going to have this programme

again next year.

Researcher: We could if the new set of studnets would be willing to.

24.Researcher: Would you like to work with the same theme again?

Teacher: Yes it just means taking it because we do not have the same pupils all the time. The standard fives will go out and the standard fours will continue. I have suggested to colleagues that we select a different theme like flight or space for a three week period and see if we can get the same type of collaboration and participation.

25.Researcher: Thank you for all you have done for the project, especially as its coordinator!

POST IMPLEMENTATION INTERVIEW WITH THE SCIENCE TEACHER AT SCHOOL B

Interview questions posed

1. Researcher: What subjects do you teach?

Teacher: Mainly science with some Geography, health, guidance and right living.

2. Researcher: Did you participate in the curriculum development project?

Teacher: Yes.

3. Researcher: Are you aware of teachers who resisted the project?

Teacher: I am aware of one. She gave her views. She resisted because when she tried such a project in another school, she was not given the necessary help. So she did not want that to happen here. She wanted to remain neutral. But there are some teachers who had it easy without involvement (that's why they did not collaborate?). Teaching has to be a challenge.

4. Researcher: Have you been following the syllabus strictly in science?

Teacher: Not very strictly. Where I could adjust according to the environment, I have been doing so. Where I could go beyond a desk bound lesson, I tried to experiment (with learning).

5. Researcher: Do you approve of the existing syllabus? Does it cater for all the needs of pupils?

Teacher: I don't think so. They don't look at all the individual needs and our schools are now open to all race groups and I feel that now our syllabus should be geared to take into account racial groups, their neighbourhood, and their home environment. When we visit homes and talk to parents, we realise that the syllabus does not cater for these aspects.

6. Researcher: Do you think a teacher should be given the freedom to create his own syllabus.

Teacher: Definitely yes. We as teachers work with pupils and we should know what their needs are.

7. Researcher: Does the curriculum development project related to water solve the problems of the existing science syllabus?

Teacher: Yes. It helped me to work closely with other teachers. I went to the english teacher and gave her the concepts which we use in science and geography and then she develops it and passes it on using worksheets.

8. Researcher: Do you see yourself as an implementer of curriculum or as a curriculum developer after your exposure to the curriculum development project?

Teacher: I now see myself as a curriculum developer.

9. Researcher: Have you ever been engaged like this before? Have you had previous experiences?

Teacher: No this has been the first one and I have really enjoyed it. When I went to a meeting on role play and I mentioned this project there, the Chairperson was very pleased and he wanted you to come along there and speak to the teachers.

10. Researcher: Have you ever had curriculum development experiences when you were training as a teacher?

Teacher: No, I did not. That's why I found this to be such a difference.

11. Researcher: Can you think of any way in which this project can be improved?

Teacher: No. It was excellent.

Researcher: What have you gained from the project personally?

Teacher: I myself have learned a lot from the ideas of the pupils, student teachers, yourself, and the teachers from our school. I have never myself seen the need to save water. I used to drop the excess water in my kettle at home into my sink in the morning and refill it with fresh water to make tea. But now I fill it into a dish where I soak my dish cloths or use the water for other purposes. So I have learned from this project. I have educated myself.

12. Researcher: Do you think that student teachers have improved their education by working with practising teachers?

Teacher: Yes. The sharing of ideas through team work was very important. Their peer teaching approach has helped to gain the attention of pupils.

13.Researcher: Did you experience any constraints during the project?

Teacher: No. I had the freedom to explore and found no barriers.

14.Researcher: Can you and your colleagues now work together as a group without an external facilitator for future projects?

Teacher: Yes. As responsible people we should now be able to work together and improve the project further. It will not stop here. Our lessons will now become pupil centred and not teacher centred.

Pupils are now asking us , "must we do this topic - why are we doing it?", especially a prescribed topic. Now we as teachers can change and we need to change. We as teachers are there to change. And it does not take much work, just a little initiative. There are certain topics which I don't like. We need to bring in this creativeness.

15.Researcher: Do you think that working with the english teacher and other subject teachers helped conceptualisation in science?

Teacher: Very much so because as we teach we come across new concepts which overlap with other subjects. We contacted each other daily to share new ideas and concepts.

And you know, as we are implementing the curriculum it works very well. There about 12 of us who are working closely and enjoying it (the crosscurricular approach) as we are sharing our ideas. More teachers are joining us. The junior primary pupils are disappointed as to why we did not include them in the project.

16.Researcher: Did science terminology improve?

Teacher: Yes pupils became much more aware of these concepts. We were able to do cross word puzzles were using these concepts.

17.Researcher: What are your comments about the development of language in science through collaboration with the english teacher?

Teacher: That's very important. The english teacher is practically involved in all this for the child to understand better and get more meaning.

18.Researcher: Do you have any questions or further comments to make?

Teacher: Besides the water theme, are you thinking of any other ideas or topics? Because we also have other topics in the syllabus which we can develop, e.g., soil. Next year I am going to introduce similar ideas (from this project) in working with soil from Geography.

19. Researcher: Thank you for your time. It was very interesting.

POST IMPLEMENTATION INTERVIEW WITH THE ART TEACHER AT SCHOOL B

Interview questions posed

1. Researcher: What subjects do you teach?

Teacher: Art, History and Right Living

2. Researcher: Did you participate in the curriculum development project?

Teacher: Yes

3. Researcher: Are you aware of teachers who resisted the project?

Teacher: Yes

4. Researcher: Do you know why they have resisted the project?

Teacher: They are generally apathetic. They are very negative.

5. Researcher: Can you give me an example of how you changed the syllabus to accommodate the topic "water".

Teacher: I intended to discuss the Satyagraha Movement in history, but I was able to incorporate water. The projects I gave the pupils were very interesting. I had phone calls from parents who wanted to know if I could do the history of water in India. In fact two parents phoned me at home to find out what the water theme was all about and especially about the assignment. One lady asked me if she could help her son with an aspect related to the River Ganges in India.

6. Researcher: Do you think that the teacher should be given the freedom or autonomy to develop his/her own curriculum?

Teacher: I think he/she should be given a certain amount of freedom.

7. Researcher: Do you as a professional feel that the curriculum should be imposed on you?

Teacher: Well, first of all, you need a guide. But, as to detail of content, I feel that we should be free to approach it the way we want to.

8. Researcher: Were you ever stifled in that respect?

Teacher: Yes. There is no time actually because of the physical restriction at times in school and one cannot do much that is out of the prescribed curriculum. This year we had a lot of

interference.

9. Researcher: Were you able to integrate art with water education?

Teacher: Yes. I was able to draw from all my past experiences and bring matters that were relevant to water. I found that there were a lot of things that could be done which I had never thought of before.

10. Researcher: Did you work with other teachers in the curriculum development project?

Teacher: Yes. I worked with the English teacher mostly and with the science teacher to some extent.

11. Researcher: How would the English teacher benefit from you in terms of her teaching?

Teacher: She has taken my button design into her creative writing programme.

12. Researcher: Would you like to be a curriculum implementer or a curriculum developer now that you have been exposed to the project?

Teacher: I don't know much about the difference.

13. Researcher: An implementer is a teacher who slavishly executes a syllabus without questioning its relevance to a given context.

Teacher: I would like to be a curriculum developer.

14. Researcher: Did you have any curriculum development experiences as a student teacher?

Teacher: No. I had the opportunity of studying it but I did not. I chose philosophy and sociology instead.

15. Researcher: Would this be your first experience at curriculum development?

Teacher: Yes.

16. Researcher: What is your view of the collaboration between student teachers and practising teachers in developing the curriculum?

Teacher: It is a good idea. It encourages innovative thinking.

17. Researcher: Can the existing school system accommodate such a change in approach?

- Teacher: No. The structure imposes a constraint to real education and its practical applications. The system is too prescriptive. It is not meaningful. The whole system needs to change to focus on real education.
- 18.Researcher: Has this cross-curricular approach improved your teaching of art in any way?
- Teacher: It has been a very positive project.It has changed our thinking in all subjects. It has been an eye-opener in lots of ways. In the past we have done a little bit of integration here and there, but never on this scale. We never knew that it could be possible. It makes the pupils feel so important.
- 19.Researcher: Who has generally resisted the project?
- Teacher: The older teachers. When new things occur they have a tendency not to participate. This is a selfish tendency due to apathy. They don't like to be disturbed from their traditional routine. Also at staff meetings when we discuss something they will always come up with something that will divide the staff. They don't want to commit themselves to anything. They say they are confused when confronted by change.
- 20.Researcher: Did anyone try to derail the project?
- Teacher: No. But there was this envy when certain teachers were succeeding, others tried to sabotage their efforts. For example on Awareness Day, when the (internal) coordinator of the project addressed the pupils, some staff said:"She just gives me the creeps". This was because was too sure of herself. (confidence through curriculum development?).
- 21.Researcher: Do you think by the end of the three weeks of implementation that the resistant teachers changed their attitude?
- Teacher: Yes. When the programme was on they enjoyed it and they can't deny it.
- 22.Researcher: Did my role as external facilitator help in any way?
- Teacher: Yes, it did. It depends on the nature of the person, and with you it worked very well.
- 23.Researcher: Thank you for your time. It has been very interesting listening to you.

POST IMPLEMENTATION INTERVIEW WITH THE AFRIKAANS TEACHER AT SCHOOL B

Interview questions posed

1. Researcher: What subjects do you teach?

Teacher: Afrikaans and Right Living

2. Researcher: Are you aware of any teachers who did not cooperate or resisted the project?

Teacher: No. Everyone was very cooperative.

3. Researcher: Were some of your colleagues uncertain at the beginning?

Teacher: Yes

4. Researcher: Could you explain why.

Teacher: I suppose they were not sure about what to expect. But when they saw that the senior pupils were becoming involved, they wanted to be part of it.

5. Researcher: Did you find the theme "water" useful in enhancing the teaching of your subject?

Teacher: Yes, very useful. For example, when we went to the water works, the pupils were able to describe the different processes in Afrikaans.

6. Researcher: Do you think that we should be given the autonomy or freedom to develop the curriculum like we did here.

Teacher: I think we should be. This does not lend itself to every theme, but where it does, we have to.

7. Researcher: Do you feel that it enabled you to function as a real professional?

Teacher: I think that people become more responsible because you do what you feel is right and unlike when something is asked of you and stipulated, you do it half heartedly. (Failure of RDDA?)

8. Researcher: Did your initial preparation as a teacher equip you to fit into a system that is not prescriptive?

Teacher: No.

9. Researcher: Can you function with autonomy as a professional if you did not have a syllabus?

Yes, a qualified doctor is not told what to do.
He uses his (professional) training to implement his practice.

10.Researcher: Did you collaborate with any teachers during this project?

Teacher: Yes - the english teacher. Whatever was done in English was done in Afrikaans.

11.Researcher: Would you have liked to be trained as a curriculum implementer or a curriculum developer in your initial teacher preparation now that you have been exposed to the project?

Teacher: Teachers should be trained as curriculum developers and not as implementers of curricula.

12.Researcher: Is this your first experience in curriculum development?

Teacher: Yes.

13.Researcher: Were there any constraints in the implementation of this project with respect to things like time, planning, or development of materials.

Teacher: No. It depends entirely on the principal. This freedom does not occur in every school. I have served under a very firm principal in another school. This strips you of everything. - especially your individuality. You just become a part of the whole system.

14.Researcher: Did you find that this cross-curricular approach enhanced teaching and learning in your school.

Teacher: Yes, the children went out into the field and lived this experience in the the classrooms (in every subject).

15.Researcher: Do you think that PRESET should have a reality site intervention of this type?

Teacher: Yes. I was trained at a college and very little that was done there helped me. By them (lecturers) coming to schools like this means that they will also learn a lot.

16.Researcher: Did it help to have me as an external facilitator?

Teacher: No, I don't think so. It needs a lot of research. It needs to be planned and not simply implemented.

17.Researcher: Thank you for your time. It has been very interesting listening to you.

GROUP INTERVIEW:

POST IMPLEMENTATION INTERVIEW WITH THE A GROUP OF STUDENT TEACHERS AT THE UNIVERSITY OF DURBAN-WESTVILLE

Interview questions posed

- * ST 1 = First Student Teacher
- ST 2 = Second Student teacher
- ST 3 = Third Student Teacher,
etc.

1. Researcher: Did you find working with (qualified) practising teachers useful in your growth as a teacher?

ST 1: Yes. We and them did not impose our ideas. We had to collaboratively assess our work to the advantage of our pupils.

ST 2: It would have been more successful if the resistant teachers cooperated.

2. Researcher: Why did you think that some teachers did not cooperate with you?

ST 1 : One basic reason is that they were not exposed to this when they were at college (of teacher education). They don't know what to do. They simply come to school to earn a living and go home at the end of the school day.

ST 2 : I agree with my colleague. The teachers who resisted did not know what to do. They were confused (used to certainty). They only saw things towards the end. They agreed that if we come again next year, it will make more sense and they will participate more.

3. Researcher: Then, do you view them as curriculum developers or implementers of the curriculum?

ST 3 : They are more implementers. Change (political?) in South Africa must be accepted for them to shift away from being implementers.

ST 4 : I think it is linked to their traditional way of teaching. They look at this project as if they are going to lose time. But on the last day (of the implementation) they saw it as a success.

ST 5 : Just like us. It took us a long time to understand what was curriculum development. I take strong exception that they were not cooperative. Even if they wanted to cooperate, they did not understand how to cooperate.

4. Researcher: When you qualify as a teacher will you become an implementer of the curriculum or a curriculum

developer?

- ST 1 : We may not be able to take the world by storm, but we will make our presence felt. We will go as far as we can.
- ST 2 : If someone at the top stops us we have to stop.
5. Researcher: If you are a trained professional, is it fair for someone to impose their views on you?
- ST 1 : It's not fair.
- ST 2 : There is an hierarchy which needs to be respected.
- ST 3 : It is not only dependent on the principal. It also depends on the cooperation you get from the teachers.
6. Researcher: If you decide to become a curriculum developer, do you think you have developed enough skills to facilitate such a project in a school?
- ST 1 : I think we know more now how to organise things, like inviting speakers from the outside. It is very difficult to get the teachers to work. I may be the only one at that school.
- ST 5 : We must not impose. We must use our skills as a starting point. Curriculum development must be a collaborative process.
- ST 6 : We can't impose our will on teachers.
7. Researcher: Did this project interfere with your studies during the year? Was it too demanding or imposing on your time?
- ST 1 : No. We used our free time on campus. A well organised time table is necessary.
8. Researcher: Do you have any comments about my role as facilitator?
- ST 4 : I feel that you should be more assertive.
9. Researcher: I did this to avoid losing the cooperation of participants (horizontal power play?)
- ST 5 : By you doing this you did lose the cooperation of people. They took you as an easy guy. We could get away easily with some of the work (and not be reprimanded).
- ST 2 : Some student teachers did not like you commenting

ST 2 : Some student teachers did not like you commenting on my good work as an example to the class.

ST 3 : We lost the unity between students this year. You changed our plans and we felt confused.

10.Researcher: Do you think there was curriculum change?

ST 1 : Well, in History the practising teacher told me that "water" did not feature in the syllabus. We looked at the text and there was something on water" which was not specified in the syllabus and included this in our programme.

11.Researcher: Were you viewed as resources to the practising teachers?

ST 4 : Yes.

12.Researcher: What were the responses of the pupils?

ST 1 : There were no negative responses.

ST 3 : They viewed the field trip as better than sitting in the classroom. It helped to demystify science.

13.Researcher: Thank you students. I have to go to another lecture.

E Transcripts of unstructured interviews

INTERVIEWS WITH PUPILS AND TEACHERS DURING THE AWARENESS DAY PROGRAMME AT SCHOOL B

Interview questions posed

1. Researcher: So, what do you think about this programme?

Pupil 1 : I think that it is a very interesting programme. It makes people aware of how important water is not only to adults but also to children.

Pupil 2 : I think it's good. It is better than being in the classroom. Because here we can see it with our own eyes and can learn it. It's not like the teacher taking out a book and writing this and that about water on the board.

2. Researcher: What did you learn during your excursion to the Durban-Heights Water Works?

Pupil : About purification and where the water goes to.

3. Researcher: Is this your first visit to the water works?

Pupil : Yes.

4. Researcher: Did any of your parents go to the water works?

Pupils: No.

5. Researcher: Did any of you go to the Umgeni Valley Nature Reserve?

Pupils: Yes.

6. Researcher: What was educational about the reserve?

Pupil: We used a water testing kit to look for bacteria and all the other organisms in the water.

7. Researcher: Did you go home and tell your parents about your experiences?

Teacher: Yes. They learnt a lot from us.

8. Researcher: Your teachers taught you about "water" in every subject. What do you think about this form of learning?

Pupil: Every ^{thing is connected} ~~thing is interesting~~ sir, and it makes it very interesting -

Lesson

9. Researcher: Do you have any questions to ask?

Pupil: Yes, sir. What happens at Durban Heights Water Works during the night?

10. Researcher: Work continues as usual with people working night duty so that we can have a 24 hour supply of clean drinking water.

11. Researcher: So what do you think of the project at this stage?

Teacher: Well, some teachers are not cooperating. But I think it is a great success. Mrs Naidoo and I have started with english already. The pupils have returned a project on water to me.

12. Researcher: What standard are you in?

Pupil: Standard 2.

13. Researcher: What have you learnt so far?

Pupil: We learned about the importance of water. We must not waste water. Water may be polluted. Without water you cannot live. We cannot survive without water. In a farm they have to boil it before drinking it.

14. Researcher: Tell us about your project.

Pupil: It is a sort of a recycle. Once you fill the water in the bowl the electricity keeps recycling it.

POST IMPLEMENTATION INTERVIEW WITH A PUPIL OF SCHOOL B

1. Researcher: Did you experience a project of this nature before?

Pupil: No.

2. Researcher: What did you like about the project?

Pupil: The excursions.

3. What did your parents think about this project?

Pupil: Most of us did not tell them about it.

4. Researcher: Are you taking care with water now and in what way?

Pupil: We don't leave the tap running when we wash our hands, face, or brush our teeth.

5. Researcher: What did you think about the Umgeni Valley trip?

Pupil: It was most exciting.

6. Researcher: Was it more exciting than the classroom?

Pupil: Yes. The classroom is boring. We have to sit down and listen.

7. Researcher: What did you see at Umgeni Valley?

Pupil: Lots of living things.

8. Researcher: Thank you for answering my questions.

INTERVIEW OF TWO PUPILS AFTER THE IMPLEMENTTION OF THE OPEN DAY PROGRAMME AT DURWEST PRIMARY SCHOOL

Interview questions posed

1. Researcher: Have you had any experiences of this type before?

Pupil : No, not at school.

2. Researcher: What are your impressions of this particular project?

Pupil : I think it was very educational and something different. Something in a new way.

3. Researcher: Did it take the boredom out of schooling? Some people complain that the existing system is a boring form of education.

Pupil : It was better to go out and see things instead of looking only at a textbook - I mean on the field trips and actually see things first-hand.

4. Researcher: Have you been to the Durban Heights Water works before?

Pupil: No. To be quite honest I used to just pass it and say, Oh, it is just a reservoir. But when we actually went there and saw the different processes, it was very exciting. We did not even know that there were so many processes that water goes through before it actually comes to us.

5. Researcher: Did you talk to your parents about the project.

Pupil: Yes, they think it was a good idea.

Pupil 2: Yes, they like it. My mother is a teacher and she is in favour of it. They do think it is a very good programme and it makes it easier and a lot more interesting.

Pupil 3: They think it is good. We told them about what we learned and now we know how important water is.

6. Researcher: Tell me, are you taking care at home to save water now?

Pupil: Yes, like before I was not just worried about closing the tap properly, but now I am much more careful about saving water.

Pupil 3: Yes. And our parentys are really shocked that we are saving water because when we used to brush our teerth and wash our faces we used to leave

the taps running all the time. Now its just a little.

7. Researcher: During the three week study of water as a theme, did every subject teacher teach you about water?

Pupil: Yes, generally.

8. Researcher: And Mathematics?

Pupil: Well, Maths, not really so much.

9. Researcher: And in other subjects?

Pupil: In history, the teacher went back to do water transport.

10. Researcher: Has your language in science improved?

Pupil: Yes, all those words. When we first heard them we said "Oh, boy!". But we understand them now.

11. Researcher: What did you think about the excursion to the river?

Pupil: Oh, that was what I enjoyed most. It was fun finding things and actually doing an experiment. We do it in class but it was better to actually do it there.

12. Researcher: Do you like the idea of teachers working together in teaching you?

Pupil: Ya. Usually we do (totally) different things (in each subject). Now we do just one theme.

Pupil 2: Yes, when all teachers concentrate on the same theme, you get a broader knowledge of the theme.

INTERVIEWS WITH PUPILS AND TEACHERS OF SCHOOL B DURING THE RIVER STUDY

Interview questions posed

ST = Student teacher

1. Researcher: Do you know why you have come here?

Pupil: To study the bacteria in the river.

2. Researcher: What have you found here?

Pupils: Sludgeworms, mayfly larvae, and bloodworms.

3. Researcher: Is the hands on booklet helping you to find animals and identify them?

Pupils: Yes.

4. Researcher: Have you ever come to a river with your school before?

Pupil: No.

5. Researcher: What have you found?

Pupil: Two bloodworms, a damselfly, and a snail.

6. Researcher: That's a leech. Gee, you also have a planarian.

Pupil: I have a whirlygig beetle and a crab.

Teacher : If we have a whirlygig beetle then we can write a play. Do you know that I studied planaria in standard 8 but have never seen one.

7. Researcher: Do you find the information in the hands on experience booklet useful?

Teacher: Very. It helps to conceptualise science. So many pupils have never seen these lifeforms before and did not even know that these exist. A study of this type will help them to enrich their knowledge. Now that they are doing it themselves, they seem to be enjoying this first hand experience which is so important.

8. Researcher: This is a structured learning experience using work books. What do you think of experiences where pupils are taken on an excursion without any structured guidance and where such an experience usually ends up as a picnic? Will they learn much?

Teacher: No, they need some sort of guidance in the form of a worksheet. A field trip has great value. Our senior pupils get bored with regular classroom activities and this out door experience improves their involvement and takes out the boredom.

F A survey questionnaire to assess the status of curriculum development in institutions of teacher education in KwaZulu-Natal



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1 June 1993

RESEARCH QUESTIONNAIRE


Dear Colleague,

I am a Science Education (Biology) lecturer in the Faculty of Education at the University of Durban-Westville. I am currently engaged in research towards a Masters Degree in Education at this University. The title of my dissertation is, "Curriculum development for science teacher education: An action research study." I view the curriculum as a contextualized social process and curriculum development is used in the context of this research as a process or exercise which transcends the prescriptive curriculum (syllabus) by being innovative, creative, participatory and evolutionary. It usually results in a curriculum package adapted to its context.

I believe that while science student teachers may be "trained" to develop the curriculum at their institution of teacher education, there is no guarantee that they will implement this training as practising teachers. It also appears that there may be few or no opportunities for curriculum development at schools and that other qualified practising teachers may lack the necessary training. I have therefore realised the need to transfer the process of curriculum development from the institution of teacher education to the reality site, viz., the school. A move of this kind will allow science student teachers and qualified practicing teachers the opportunity to collaborate in developing the curriculum. In the process a culture of participation will be promoted in which the two groups of teachers will develop and the researcher will also serve as a participant and facilitator. The principles of involvement and improvement on which action research is based will empower the teachers by encouraging a sense of ownership of the curriculum.

One of the outcomes of the research will be the emergence of a model for curriculum development which could be implemented at institutions of teacher education. Your co-operation in completing the attached questionnaire is therefore needed to enable the researcher to assess the position of curriculum development in science teacher education at your institution.

Thanking you
Yours sincerely


S. Pillay (Alan)

The Questionnaire

There are nine questions, some of which are sub-divided into further questions. If the space provided is insufficient, kindly attach a page to the questionnaire and continue any incomplete responses on it. Question 9 is related to a curriculum development project currently involving my science student teachers with qualified practising teachers at a primary school close to our university. In this project I am using "water" as a theme to be developed over a three week period of implementation. The theme will be developed across all the subjects in the senior primary school.

Please complete the questionnaire at your earliest convenience and return it in the self-addressed and stamped envelope provided.

QUESTIONNAIRE : CURRICULUM DEVELOPMENT FOR SCIENCE TEACHER EDUCATION AT COLLEGES OF EDUCATION AND FACULTIES/SCHOOLS OF EDUCATION AT UNIVERSITIES IN SOUTH AFRICA

Prepared by S.Pillay (Alan)
Faculty of Education
University of Durban-Westville
Private Bag X54001
Durban 4000

Phone: 031 - 8202586 / 8202602 A/H 031 - 411579

Place a cross (X) in the appropriate box. Further information requested may be supplied in the space provided.

1. Name of institution : _____

Post held : _____

Department: _____

Subject/s : _____

2. Does your institution prepare science teachers ?

YES Proceed to question 3

NO You have finished.Thank you.

3. In preparing science teachers, does your programme include training in curriculum development?

YES Go directly to question 4

NO Answer the rest of this question

3.1 If no, why?

8. Has your institution conducted workshops on curriculum development with qualified practising science teachers?

YES Answer the rest of the question and proceed to question 9.

NO Go to question 9.

8.1 Briefly describe the approach used.

G **A post-implementation questionnaire (School D) addressed to science student teachers**

QUESTIONNAIRE FOR SCIENCE EDUCATION 3 STUDENTS (1995)

This questionnaire relates to a Curriculum Development Project involving student science teachers from the University of Durban-Westville and practising teachers from Ekujabuleni Primary School in the Township of Clermont. It was planned and developed between March 1995 and July 1995 and implemented in August 1995.

You are expected to complete this questionnaire in your working groups. Each working group may be sub-divided into two smaller groups. At least five students will be permitted to fill in the questionnaires individually if they choose to.

If the space allocated to a response is insufficient, kindly continue on the bottom or the reverse side of the page.

QUESTION 1 : Are you completing the questionnaire as an individual or as a group?

QUESTION 2 : Indicate the name/s of the students and next to each name the other major method, apart from Science Education 3.

QUESTION 3 : What are some of the problems which you experienced in developing materials due to a lack of resources?

QUESTION 4 : Some students have experienced working in a Black school for the first time. How significant was this experience to the process of curriculum development and your future role as a teacher in a changing South African context?

QUESTION 5 : Was there a need for an external facilitator like Alan Pillay, the teacher educator? Explain your answer

QUESTION 6 : Was there a need for an internal facilitator like the Deputy Principal, Mr Themba Khumalo? Explain your answer.

QUESTION 7 : Explain the extent to which the entire Curriculum Development Project was democratic/undemocratic.

QUESTION 9 : List the advantages which you experienced while working with the practising teachers.

QUESTION 10 : List some of the problems you may have experienced while working with the practising teachers.

QUESTION 11 : What did you gain from the Curriculum Development Project as a future science teacher?

QUESTION 12 : Was the Project a success or a failure. Give reasons for your answer.

QUESTION 13 : If you are placed in a school in your final year for teaching practice, explain whether your experiences during the Project will enable you to develop materials with teachers from other disciplines/subject areas to improve your science teaching.

QUESTION 14 : What were your observations of the materials developed by your colleagues from the other groups?

QUESTION 15 : What are your concerns (if any) regarding the use of lecture time from other subjects to visit the school.

QUESTION 16 : Comment critically on the following statement :
"The practising teachers at Ekujabuleni Primary School have a lot of experience in developing curriculum materials"

QUESTION 17 : What are some of the problems you encountered while developing curriculum materials for the project?

QUESTION 18 : To what extent did your interaction with the practising teachers improve your ability to plan and develop materials? (What did you learn from the teachers?)

QUESTION 19: To what extent did your interaction influence/improve the practising teachers' ability to produce materials? (What did the practising teachers learn from you about curriculum development?)

QUESTION 20 : You and your colleagues developed curriculum materials related to science in coordination with teachers from other subject disciplines in the school curriculum. To what extent did this cross-curricular approach which focussed on "Water Education" as a theme help to develop science teaching generally?

QUESTION 21 : How did action research relate to the participatory development of the curriculum?

QUESTION 22 : Cornbleth defines the curriculum as " a contextualized social process". To what extent does this definition relate to your experiences in the Project since its inception? (since its commencement)

If you have any additional comments, kindly indicate them below

END OF QUESTIONNAIRE. THANK YOU FOR YOUR COOPERATION!

H A questionnaire addressed to fourth year science student teachers

QUESTIONNAIRE FOR B.PAED 4 STUDENTS (1995) WHO PARTICIPATED IN
A CURRICULUM DEVELOPMENT PROJECT IN 1994 RELATED TO WATER

You have been exposed to a school-based teaching practice experience this year. The purpose of this questionnaire is to establish whether your experiences during the Curriculum Development Project (Project Water) in 1994 were useful to the development of curriculum materials during your school-based teaching practice.

If the space provided on the questionnaire is insufficient for your responses, kindly continue at the bottom of the page or on its reverse side. Your cooperation is urgently required as an evaluation of your 1994 experience. Your home telephone number and address are also needed to enable me to follow your progress in curriculum development when you practice as a teacher from next year and onwards.

FULL NAME : _____

ADDRESS : _____

HOME TELEPHONE NUMBER : _____

MAJOR SUBJECTS IN THE B.PAED DEGREE : _____

SPECIAL METHODS SUBJECTS : _____

SUBJECTS TAUGHT DURING SCHOOL-BASED TEACHING PRACTICE : _____

QUESTION 1 : To what extent did the Curriculum Development Project in 1994 based on the theme "water" assist you during the planning and development of curriculum materials for your school-based teaching practice?

QUESTION 2 : To what extent did the participatory collaborative approach used in 1994 assist you in your relationships with your peers and resident teachers at your school.

QUESTION 3 : What did you learn from the resident teachers about curriculum curriculum development (materials development)?

QUESTION 4 : What did the resident teachers of this year learn from your experiences of curriculum development in 1994/1993?

QUESTION 5 : Do you have any further comments about the 1994 experience and its influence on the 1995 experience?

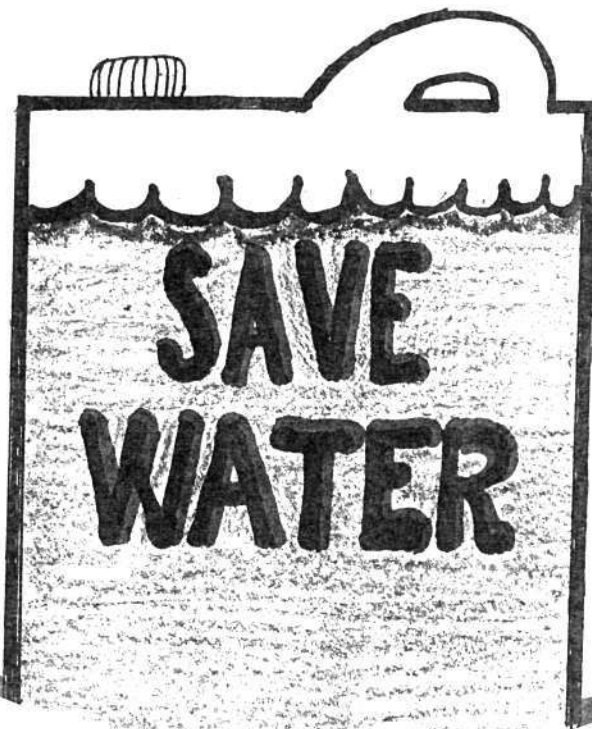
QUESTION 6 : To what extent was the action research experience of 1994 useful to the 1995 implementation of school-based teaching practice?

THANK YOU FOR YOUR COOPERATION AND THE BEST OF LUCK IN YOUR EXAMS. IF YOU HAVE ADDITIONAL COMMENTS TO MAKE, KINDLY DO SO IN THE SPACE BELOW:

I A sample of curriculum materials produced by the science student teachers

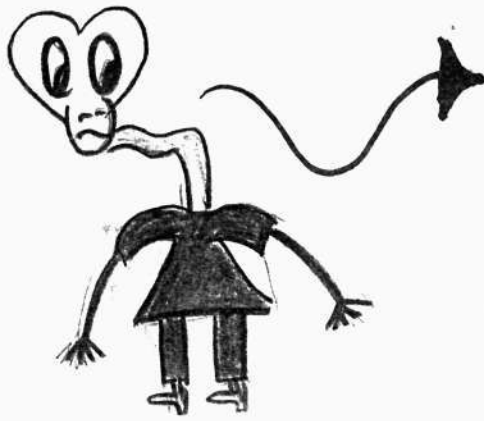
Representation of FOSTER :

**EVERYDAY
IN
EVERYWAY**



TERMINOLOGY ON WATER

1. CHEMICALS (IMITHI)
 - substances obtained by or used in chemistry.
 2. RURAL (ASEMAPHANDLENI)
 - belonging to places which are far away from cities + towns.
 3. CHANNEL (UMISELE CHAMBA AMANZI)
 - bed in which water runs.
 4. BOREHOLE (UMGODI WAMANZI OJULILE IPITSI)
 - deep hole made especially to find water.
 5. WINDMILL (UMSHINI OMPHEPHELA OSEBENZA MIBOMBYA ODONSA AMANZI EPITSINI)
 - mill worked by wind acting on its sails to draw water from a borehole.
 6. IRRIGATION (INKASA, USUCHELA)
 - watering of land or plants.
 7. COLLECT (WOGA, GOWANA)
 - bring or come together.
 8. SEASON (ISIKHATHI SONYAKA NJENGEHLORO, IRWINDLA, NJALONJALO)
 - time of the year, eg. summer, autumn etc.
 9. FILTER (EWENGA, HLUZA)
 - remove impurities by passing liquid through a device made for this purpose.
-

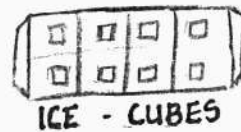


Good morning, It's me ET.
Today I am going to teach
you a very easy trick, that is
too catch a cube using a thread.
It sounds impossible !!!
Let me show you how it is done

You need :



,



,



Step 1 :



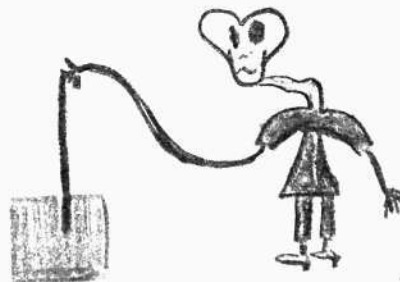
soak the thread
in water
lay it on the ice cube

Step 2 :



sprinkle some salt all along the
thread
wait for about 30 seconds

Step 3 :

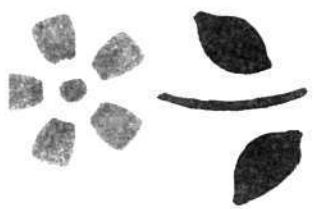


lift the thread and up
comes the ice cube

That was fun !!!

Try this trick at home.

MATHEMATICS GAME ~ RECYCLABLE NUMBERS



4 PUMPS ~ Square the product.

5 RESERVOIR ~ Multiply by the square of the denominator. Add the seventh multiple of the denominator to this number.

20 CARDS

6 HOME ~ Double this.

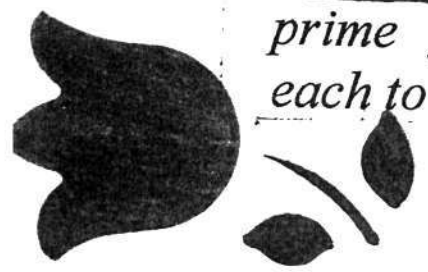
3 CHEMICAL PHASE ~ Divide the sum by 3 and multiply by $\frac{1}{2}$.



2 SAND FILTER ~ Find prime factors and add each to get one sum.

7 DRAINS/SEWERS ~ Is the number divisible exactly by 5? If not, play again.

1 DAM ~ Pick up a number.



LESSON PLAN

SUBJECT: GENERAL SCIENCE / ENGLISH

STD: TWO

TOPIC: WATER

TITLE OF LESSON: DISTRIBUTION OF WATER

AIM: TO ENCOURAGE PUPILS TO BECOME ENVIRONMENTALLY AWARE.

OBJECTIVES: PUPILS SHOULD BE (1) able to understand the distribution process of water (2) able to interact in groups and contribute to the discussion.

METHOD:

ACTIVITY	WHO DOES IT	PURPOSE
1. Discussion	Pupils facilitated by teacher.	To familiarize pupils with the various processes and the content, also to link pupils' previous knowledge with the content to be discussed.
2. Worksheet (1) (attached)	Pupils in groups	To avoid monotony and include creativity and also so that pupils can actively see the various processes involved in distribution of water.
3. Feedback	Group representative	To clarify misconceptions and so that pupils are able to contribute to the discussion.
4. Worksheet (2)	Pupils	Essay - Journey of H ₂ O (English)

REFLECTION: Unfortunately lesson was not taught.

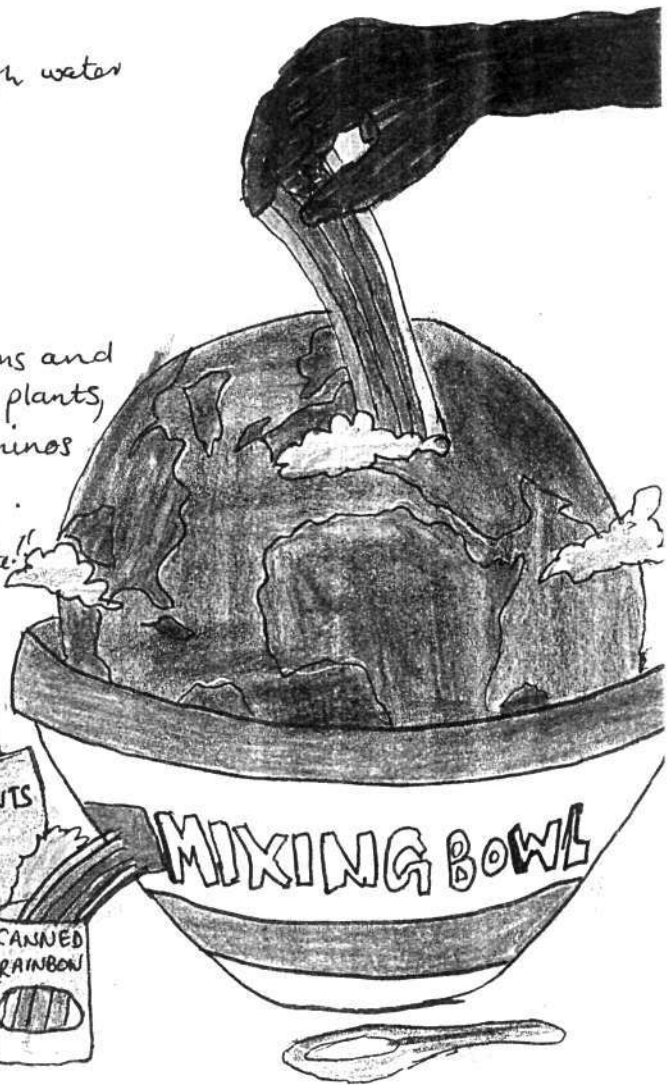
WORLD

00 000 jumping, playful dolphins of every species
 00 000 free, freindly, frisky whales of every species
 00 000 strong Indian and African elephants
 00 000 cratty feline animals
 000000000 leafy, fresh leaves/trees
 50 000 Black and white rhino
 60 tons of colourful plants and grasses
 00 000 000 000 litres of sparkling sea and blue fresh water
 155 000 000 acres of lush, fertile land

(for flavour add fish and rodents)
 Decorate with one glowing rainbow

Method

spread the land over the water. Put all the dolphins and
 whales into the sea water. Sprinkle land with plants,
 trees and grass, mix feline animals, elephants, rhinos
 and then place all over the land.
 Now place fresh water in low-lying areas of
 the land. Add your flavouring and decorate.




EARTH: THE BIGGEST SAVING WE CAN MAKE!


What does it take to destroy a planet that's been
 in existence for about four and a half billion years?
 Human Beings.
 Only we can save the earth from its only enemy: ourselves.
 By getting involved in projects that help not
 only the land, but also the communities that
 depend upon it for their existence.


Because our planet's the only one we have, we
 are helping to keep it the way we'd like
 it to be found in a few thousand years!




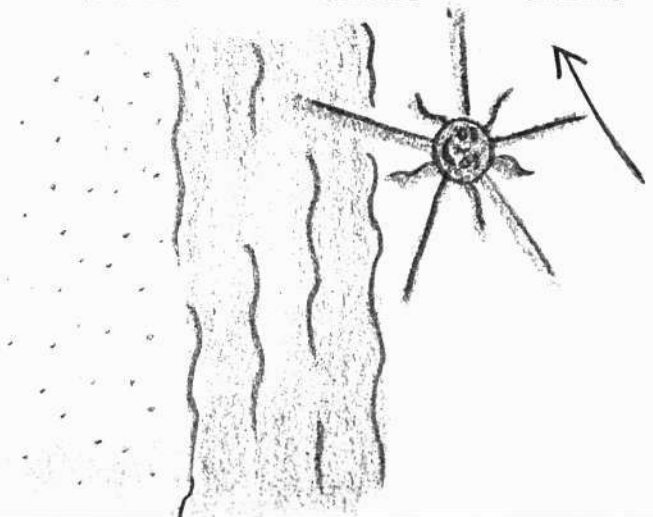
SEE which fish swims to the ocean first.
 START with the number on each fish, and follow its' trail along its' tributary.
 OBEY each instruction along the trail. The fish with the highest score wins.
 LET SWIMMING...

1  → $\boxed{\text{add } 78}$ → $\boxed{\text{divide by } 3}$ → $\boxed{\text{subtract } 16}$ →

2  → $\boxed{\text{multiply by } 26}$ → $\boxed{\text{add } 38}$ → $\boxed{\text{divide by } 9}$ →

3  → $\boxed{\text{subtract } 47}$ → $\boxed{\text{divide by } 8}$ → $\boxed{\text{double your number}}$ →

4  → $\boxed{\text{divide by } 9}$ → $\boxed{\text{add } 11}$ → $\boxed{\text{multiply by } 0}$ →



FINAL SCORE

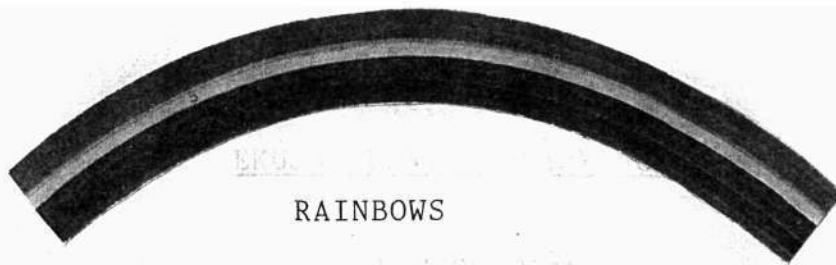
WHERE IS THE WATER ?

WATER IS FOUND IN ALL THESE.

CAN YOU SEE THEM IN THE PUZZLE ?

POOL DRAIN LAKE TANK
JUG STREAM SINK BARREL
PUDDLE BOTTLE OCEAN BUCKET
RIVER OASIS RESERVOIR CANAL

P X H A R W T E O M T B Y I
G E Z K J P Q A L O O P V N
U P U D D L E W N L C T S A
C W D O B M F B S K D I Z F
R L N H O U U I G Z S K L O
E R A S D V C Z S A Q E X C
S B A K R R Y K O T R W J E
E F U B E I A O E R R L N A
R L P V M W C I A T A E G N
V V I S D S K B N Z L R A L
O R J N T Q I H A T E X A M
I Y M E J G W N T R C N W I
R H B Y U O U O K R A T H Q
S F V D G Z B M J C L P G P



RAINBOWS

Have you ever seen a rainbow?

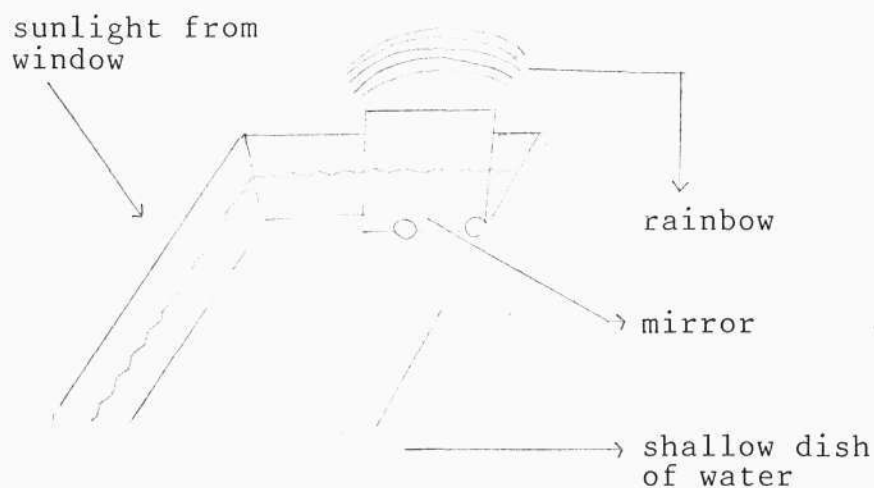
Rainbows are formed when the sun is shining while it rains. Sunlight is a mixture of different colours. When the sun shines on the raindrops, the sunlight is split up into different colours forming a rainbow.

EXPERIMENT :

We need a : shallow dish
mirror
plasticine

Method : Make a dish stand on a window sill. Place the mirror in the dish. Hold the mirror firmly with plasticine to prevent the mirror from falling. Fill the dish with water which must be absolutely still. Can you see a rainbow on the wall or ceiling.

Cause a ripple in the water by stirring it with a pencil. What happens to the rainbow.



Extra activity: Make soap bubbles and look at the rainbow colours that can be seen in them in sunlight. Look at the Rainbow colours that can also be seen in puddles by the roadside.

EKUJABULANI PRIMARY SCHOOL

LESSON PLAN

SUBJECT : GEOGRAPHY STD: 5

TOPIC : RAINBOWS

ASPECT : WEATHER

PRE-REQUISITE : _____

OBJECTIVES : MUST MUST BE ABLE TO UNDERSTAND THE FORMATION
OF RAINBOWS . PUPILS MUST DO AN EXPERIMENT TO
FORM RAINBOWS

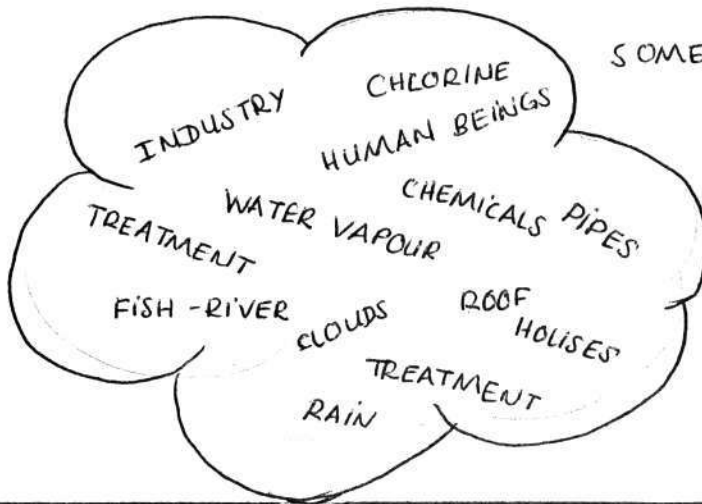
RESOURCES : WORKSHEET
MATERIALS (DISH, MIRROR, PLASTICINE)

METHOD : GROUPWORK
ORAL DISCUSSION

CONTENT : DISCUSSION ON HOW RAINBOWS ARE FORMED, WHEN IT IS
FORMED . AFTER DISCUSSION , PUPILS MUST WORK IN GROUPS
& DO THE EXPERIMENT ON THE FORMATION OF A
RAINBOW

APPLICATION : _____

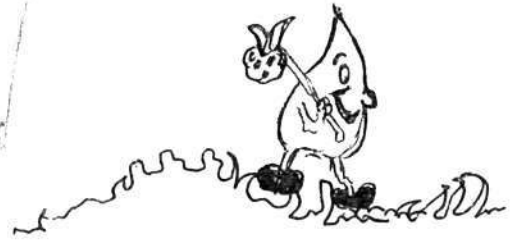
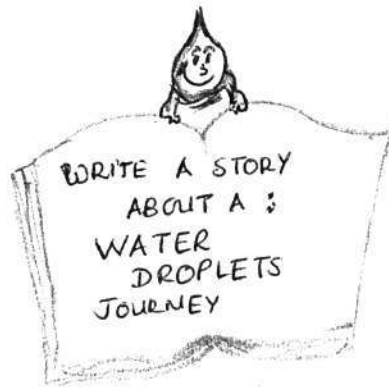
ENRICHMENT : TO PRACTICE THIS EXPERIMENT AT HOME UNTIL
PUPILS COME RIGHT WITH IT .



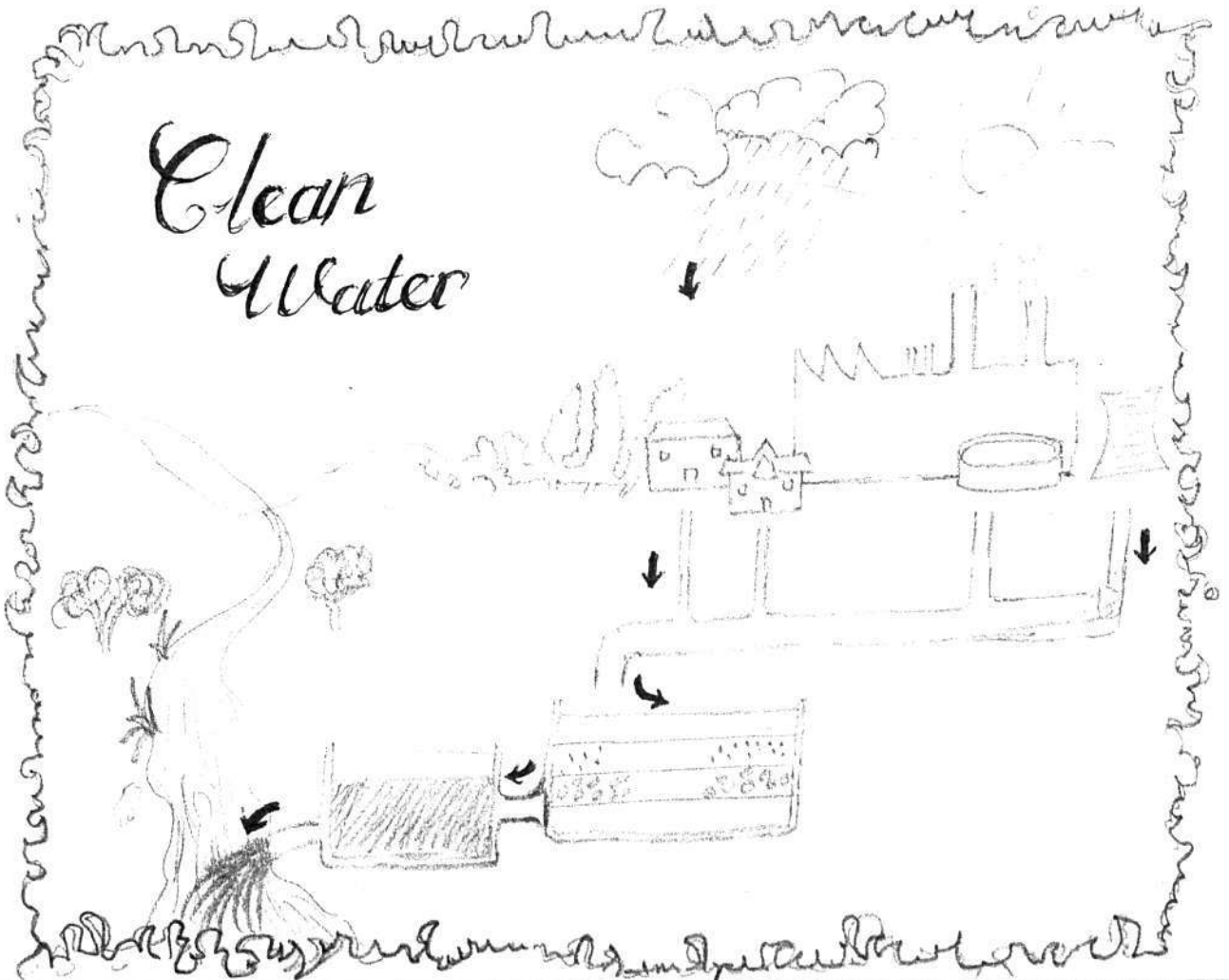
SOME WORDS TO HELP YOU
 ON YOUR
 JOURNEY



S NAIDOO
 9257630
 GROUP:H



Clean Water



SAVE OUR WATER

Water is very important, there is very little of it in our country. We must therefore conserve (save) it.

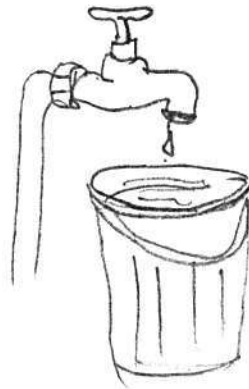
ACTIVITY

Study the pictures and in small groups try to think of some other ways to save water.



Shower rather than bath.

Dripping taps waste water. One drop a second makes 26 litres in 24 hrs.



Water your garden around sunset or sunrise.



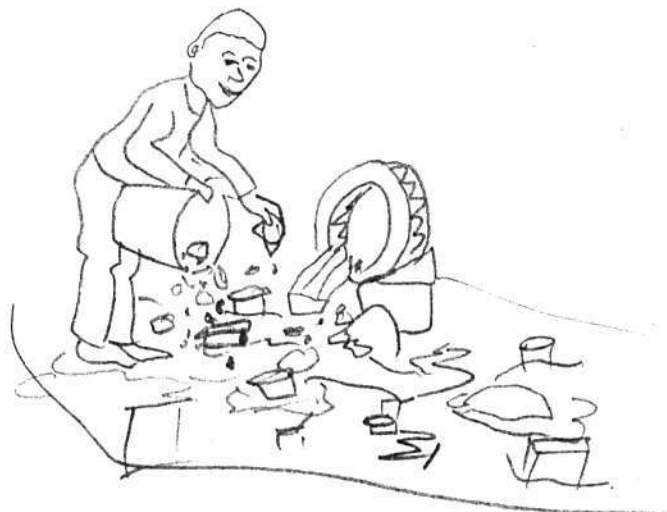
Put compost around your plants



Do not use soap in a stream or a dam.



Don't put grease, medicines or chemicals into toilet or sinks



J A questionnaire addressed to teachers at School D

QUESTIONNAIRE FOR CURRICULUM DEVELOPMENT : A COLLABORATIVE PROJECT BETWEEN _____ PRIMARY SCHOOL AND STUDENT TEACHERS FROM THE FACULTY OF EDUCATION, UNIVERSITY OF DURBAN-WESTVILLE

TO BE ANSWERED BY THE PRACTISING TEACHERS AT _____ PRIMARY SCHOOL IN CLERMONT (SCHOOL A)

Dear Teacher,

You have agreed in principle to participate in a curriculum development project by collaborating with student teachers. The theme is "water" and the approach will be to produce curriculum materials in your subject discipline related to water. You and the student teachers will produce a relevant curriculum based on "water" which will be implemented over a period of two or three weeks. Kindly answer the following questions based on the project so that future planning can be based on it. Space is provided for your answer after each question. If the space is not enough, you may continue with your answer on the reverse side of the question sheet. Mr Leonard Bendane will assist you if there are further queries.

QUESTIONS

1. What do you understand by the term "curriculum"?

2. Have you been involved in a curriculum development project as a student teacher or as a practising teacher?

3. If you have been involved in a curriculum development project as a student teacher or as a practising teacher, briefly describe the nature of the project.

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4. "Water" is an environmental education theme. The lack of water in some regions of Southern africa is a very serious threat to the survival of our people. Have you taught your pupils the skills of saving tap water or purifying it (before drinking) if it is taken from a river? Briefly explain your answer.

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5. Should water education be the responsibility of the science teacher only, or should it be taught by all the teachers in all subjects (i.e inter-disciplinary/cross-curricular)? Give reasons for your answer.
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6. Name the subject/s that you teach. Is it possible to teach concepts related to water in your subject/s? If your answer is yes, give a simple example of the content of such a topic in this/these subject/s

7. Are you committed to fully supporting the curriculum development project based on "water"? Briefly explain why. If your answer is no to this question, kindly give reasons for your answer.

8. Have you tried planning a lesson or other activity related to your subject with other teachers? If your answer is yes, give details of problems you encountered (if any). If your answer is no, explain why you have not tried.

K Papers presented at international conferences

**TITLE : CURRICULUM DEVELOPMENT FOR STUDENT SCIENCE TEACHER
EDUCATION : AN ACTION RESEARCH STUDY**

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ABSTRACT

Current curriculum development and implementation practices in schools and teacher education institutions for science education in South Africa are outlined together with a critique of present practices which emanate from the application of the RDDA (Research- Development-Dissemination-Adoption) model for curriculum development. Since South Africa is currently undergoing a phase of socio-political transition from a modernist apartheid ideology to a democracy, the RDDA model is no longer relevant. An alternative innovative and creative approach in which, firstly, the process of curriculum development is transferred from institutions of teacher education to the reality site, that is, the school; and, secondly, in which the collaborative participation of student science teachers and practising teachers using a cross-curricular thematic framework around "water" and water quality monitoring was developed across all subjects at the primary school level, is described and evaluated. A new model for curriculum development which could be implemented in science teacher education at colleges and universities in South Africa is proposed. The qualitative research methodology used in developing the model is reviewed and evaluated and the role of the teacher educator as a researcher, participant, and facilitator is also described.

1. INTRODUCTION

The research-study project dealt with in this paper is a curriculum response to meet with society's demands that our educational programmes should contribute towards preparation for life and that science and technology education must reflect these demands and expectations. It examines critically the current state of science and technology education with specific relevance to curriculum development in colleges and universities providing teacher education in South Africa and outlines the development of an alternative model which is innovative and creative and which more closely approximates the ideals of a demanding society.

The present science curriculum in South Africa has not addressed problems related to such issues as water, and, technology education is expected to be implemented in our schools for the first time in 1995. The recent scientific and technological advances of a modern world have also not impacted upon our society to the extent of enabling people to effectively utilize these to solve environmental problems. The existing autocratic decontextualized education system designed by the engineers of apartheid has failed to empower people to make informed decisions regarding problematic issues such as drought, water pollution, and wastage of water.

In keeping with the theme of this symposium, the presentation will attempt to explicate the connection between the topic "water" and the educational needs of a demanding society. It will reflect on research, practical innovations, and their implementation in a school context.

2. PRESENT CURRICULUM PRACTICES

2.1 A Critique

The existing science curriculum in South Africa is designed by using the RDDA model. This involves research (R) by experts (limited in this country), who then develop (D) the curriculum, disseminate (D) it to schools for adoption (A) with some adaptation (A) by teachers. The implication for the use of such a model for curriculum development is that the curriculum is centrally planned by experts and is then implemented at the periphery by teachers. Innovations and educational change are expected to be introduced into the curriculum by the use of the RDDA model.

While the RDDA model had been useful in some instances, it was bureaucratic, technicist, and failed to (effectively) implement innovations. Some major weaknesses of this model were:

- it viewed social change and change of natural phenomena in a similar way, i.e., one of control and manipulation (Popkewitz, 1989) via the rational process of external management and innovation diffusion (O'Donoghue, 1989);
- it did not account for the context variation of users (teachers) (Papagiannis et al, 1982);
- a communication breakdown occurred between the central planners ("experts") of the curriculum innovation and the implementers (teachers) of the innovation (Olsen, 1982);
- it lacked user (teacher) participation in designing curriculum innovation (Eisner, 1985) as it viewed teachers as technicians (Robottom, 1987); and,
- adoption and implementation failed at the "grass roots level" (teachers).

The weaknesses inherent in the RDDA model and its implementation in South African schools has produced teachers who were merely implementers of a "handed-down" curriculum. These teachers felt incapable of adequately challenging the problems that surrounded them at school. Inadequately designed teacher education programmes, poor teaching qualifications, or a lack of qualifications added to a feeling of disempowerment. Teachers became victims of the system and developed apathy (Samuel et al, 1992) and implementation failure resulted. They tended to work in isolation and to resist any form of collaborative participation. As a result, a culture of non-participation of teachers in curriculum development developed with few or no skills in this field.

2.2 Need for Change

A radical change in approach to curriculum development is indicated. Such an alternative would be the overturning of the RDDA model of curriculum development and the substitution of one in

which the participation of teachers is paramount. This would have to be done in a way that enabled participants to take a large share of the initiative and to become confident thinkers and doers. From this perspective, teachers are seen as partners in the process of innovation and are more likely to accept the changes which occur in a democratic spirit. This would lead to a better implementation of the curriculum change.

A democratisation of educational practices will generate a culture of participation in curriculum development in South African schools which is necessary in the current context of political and educational transformation. Colleges of education have a major role to play in this process since they educate teachers at a pre-service level. There is also an urgent need to re-educate the existing generations of qualified teachers so that they may also contribute to the process of educational change through curriculum development within an action research framework.

3. CURRICULUM DEVELOPMENT : DEFINING CONCEPTS AND FUNDAMENTALS

In the context of this research study, a project was undertaken in which curriculum development was conceived as a process which transcends the prescriptive curriculum (syllabus) by being innovative, creative, participatory, and evolutionary. It was seen to result in a curriculum package adapted to its context and allowed for the differences in context variation characteristic of rural and urban areas. The curriculum is viewed as a contextualized social process (Cornbleth, 1990) and not as a syllabus document produced by a committee of educationists who are subject specialists with very little or no experience in curriculum theory and research. The science curriculum produced by the latter concept has failed to relate to the demands of a society in which the majority of the population live in economically depressed rural areas characteristic of third world conditions. The new mission statement of the University of Durban-Westville which was developed as a response to the political transformation of South Africa places a commitment on staff and students to engage in outreach programmes with the community at large as an improvement strategy.

4. A CURRICULUM DEVELOPMENT PROJECT AS A CASE STUDY AIMED AT ADDRESSING THE ABOVE ISSUES

While curriculum development appears to be non-existent in the curriculum of a majority of institutions of teacher education in South Africa, the few that practice it confine the process to campus-based initiatives. This was quite evident in earlier practices at the University of Durban-Westville which enabled science student teachers to develop curriculum packages in science which lacked implementation at the reality site, viz., the school. Attempts to implement a developed curriculum package based on environmental education by our science student teachers at a school succeeded with the pupils benefitting tremendously from the real contextualized educational experiences. The practising teachers, however, were passengers in the process and developed a dependency syndrome in which they regularly requested our intervention without participating. Such a relationship prompted us to seek

other alternatives to engage the experienced practising teachers. We also realized that when our science student teachers qualified and became practitioners, they failed to continue with the process of curriculum development at their schools. It was assumed that this problem arose from the lack of opportunities at schools for curriculum development and that most or all of the experienced teachers with whom they worked had no training in developing the curriculum. We felt that this situation could be remedied by transferring the site of curriculum development from the teacher education institution to the reality site, viz., the school. Such a practice resulted in a joint collaborative-participation involving a partnership of science student teachers, qualified teachers, and teacher educators (lecturers).

4.1 Choice of Theme for Research Project

The concept "water" was chosen as a theme because of its relevance to the serious drought which ravaged Southern Africa and the pollution of its water resources. It also enabled the researcher to facilitate a cross-curricular approach with the practising teachers and pupils who were able to relate to such a concept across all subjects since water is a vital entity for survival.

There is a serious imbalance in the distribution of rainfall in which 80% of the rain falls where 20% of the population lives (O'Keeffe, 1986). Despite large scale water management projects, the water crisis has reached alarming proportions in Southern Africa. Our water resources for expanding human numbers and vital economic growth are under great threat from catchment destruction and pollution. In 1991 about 20 000 people, mainly children and the aged, died as a result of water borne diseases and about 80% of all medical expenditure in Africa can be traced to poor water and sanitation (O'Donoghue, 1992).

The present science curriculum in South Africa has not addressed problems related to water, and technology education is expected to be implemented in our schools for the first time in 1995. The recent scientific and technological advances of a modern world have also not impacted upon our society to the extent of enabling people to effectively utilize these to solve environmental problems. The existing autocratic decontextualized education system designed by the engineers of apartheid has failed to empower people to make informed decisions regarding problematic issues related to water such as drought, pollution, and wastage.

The demand for water quality monitoring in our society has resulted in scientists studying river systems and their catchments. The scientific knowledge produced has been used by the GREEN (Global Rivers Environmental Education Network) support services (Southern Africa) to develop low cost water testing kits as a techno-scientific innovation for cheaper and easier river study by people. The water testing kits and supporting materials have been developed and distributed to teachers through a group called SHARE-NET. This curriculum development project (water) involving science student teachers and practising teachers was a strategy for responding to a post-modernist societal demand from

a curriculum view-point by using the SHARE-NET resource materials in the context of a school.

4.2 Research approach used in the Project

(a) The curriculum development process was conducted within an action research framework. Action research is grounded in the principles of involvement and improvement. The involvement in this research occurred by a process of collaborative participation between the student teachers and qualified practicing teachers at the reality site (the school) and resulted in the production of an improved curriculum package. The failures of the prescribed curriculum developed by the RDDA model were overcome by this involvement of teachers. Teachers participating in action research also became more critical and reflective about their practice - a feature which enhanced empowerment for the educational reconstruction of a post-apartheid South Africa (Walker, 1993).

(b) The teacher educator (lecturer) served as a researcher, participant, and facilitator during the research.

(c) The qualified teachers and student teachers functioned as reflective practitioners and researchers as they studied their classroom practices for improvement. The process of action research produced more skilled and flexible educators who would be able to respond positively to the needs of a demanding society.

(d) A research diary was used to record critical moments during the research. An analysis of tape recordings of interviews with practicing teachers, student teachers, and pupils was also conducted.

(e) In conventional empirical research improvement in education was expected to occur after the research was completed. In action research, however, the improvement occurred during the research and was almost guaranteed. The change generated by action research was more important to science education while traditional education methodology had failed to develop and improve practice in relation to varying contexts such as in rural situations.

4.3 The need for a cross-curricular, thematic approach

(a) The environmental education emphasis in the research became very useful in developing the curriculum package. A cross-curricular, thematic approach used the concept, "water", as a pervading theme across all the subjects in the school.

(b) A rigid division of the curriculum into subjects tended to interrupt the children's train of thought and interest and hindered problem solving (Lancaster, 1990).

(c) A theme or central topic cut across the boundaries of subjects. The process of integration maintained continuity. It played an important role in conceptual learning in the sense that it enhanced the conceptualization of science by enabling a better interpretation. It was interest based. The class visited places of

interest related to water, e.g., a water purification works. Problem solving was encouraged, e.g., a design for a water purification system for people living in a rural area was produced.

4.4 The fieldwork related to the project

Three phases were involved in the fieldwork:

(a) Planning phase : student teachers and qualified teachers planned the curriculum together at the school. Excursions to water-purification works, mangrove swamps, the aquarium, and the sewage works were arranged. Health educators were invited to school to conduct talks related to water-borne diseases and water cleansing.

(b) Development phase : involved the development of curriculum materials such as posters, models, lesson plans, water testing kits, sketches related to drama, etc. Lesson plans related to water were developed across all the subjects.

(c) Implementation phase : occurred over a period of three weeks and involved primary school pupils in standards 3, 4, and 5.

Class lessons related to water were taught across all the subjects. Three significant days were set aside:

Water awareness day - was held on the first day. As a focussing or sensitising experience, pupils were exposed to a variety of posters, films, and discussions related to water.

Field study day - pupils participated in a river study. Water tests were conducted with water testing kits. Water quality slides were used to assess the level of pollution. Oxygen tests were conducted under adult supervision. A coliform bacteria test was also done. The water testing kit was used as a problem solving tool at the river.

Open day - this was the last day of the implementation phase. The community was invited to the school and exposed to a programme related to the water project. Further awareness occurred when they were taken on a tour of the school to view posters and models on display. Pupils explained the content of the posters.

The water testing kit was accompanied by a manual on low cost water quality monitoring prepared in association with GREEN. The water quality monitoring structure is being successfully used throughout the world and the low-cost techniques have been extensively tested for reliability and relevance by participating scientists, teachers and environmental education projects in Southern Africa.

Care was taken to keep instructions and information to an absolute minimum. This was to encourage learning through testing, observation, problem solving and discussion rather than from detailed notes in a book. It was vital that pupils were not robots jumping through the hoops of some predetermined and fool-proof information and instructional sequences if they were to become active and reasoning problem solvers who contributed to a more sustainable and just world (O'Donoghue, 1992). It also gave people an opportunity to socially construct the way they saw the world (Berger and Luckmann, 1967).

the syllabus, especially with regards to science content which was over prescribed and left very little or no time for developing teaching methodology.

6. OTHER ISSUES WHICH EMERGED FROM THE CASE STUDY

6.1 The model for curriculum development used in the above case study served a dual purpose. It addressed the problem at a preservice level and at an inset level. Student teachers working with practising teachers and with access to appropriate resources, human and material and from a university, were able to have an influence on these experienced teachers. In this way there was a "rub off" of skills in curriculum development on the practising teachers. On the other hand, student teachers benefitted from the experience of the qualified teachers in other areas.

6.2 The Science Curriculum Group report of the National Education Policy Initiative (NEPI) included a reference to the model for curriculum development used at the University of Durban-Westville in the following terms:

"In moving the site of curriculum development to the school the example of a project at the University of Durban-Westville is worth noting. Here the PRESET teachers plan their classroom activities in collaboration with the staff at the school where they will carry out their teaching practice. Within an action research framework, curriculum development and teacher development occur together, with the staff participating, reporting, reflecting and adapting the work of the project. The teachers become used to the idea of the curriculum as a process that one adapts in school." (Levy and Kahn, 1992).

This recognition offers the hope that this project will become a part of National Policy for curriculum development in a new education dispensation in South Africa.

6.3 Unlike most of the schools approached, the principal of the school selected for the case study appeared to have a democratic approach to education and to his staff. This was evident from the following transcript of a recorded interview with him:

Researcher: Do you think that the school should have a degree of autonomy or independence in deciding what should be included in its curriculum?

Principal : I think it depends entirely on the principal. I think if you are free and willing to meet the challenges of education, then I don't think there is a need for any rules or regulations to bind you. As I have always mentioned to my teachers, all rules are flexible. We should take advantage of that.

The extent to which teachers were victims of the RDDA model was shown in an interview with the school-based coordinator who used environmental issues in her teaching of English:

Researcher: Are you aware of any teachers who resisted the project or refused to change?

Teacher : Basically many teachers are so set in their ways and are so established with promoting syllabuses handed down by the department that they do not focus on relevant education. They simply go by the book. You know like for example, the Maths teacher who will only do Maths that is prescribed by the syllabus and nothing else out of that context.

7. CONCLUSIONS AND RECOMMENDATIONS

The nature of the research involved in the curriculum development project resulted in the emergence of a model for curriculum development which could be implemented in the curriculum of teacher education institutions. At this stage it is not possible to predict the effectiveness of the extent to which our science student teachers will become curriculum developers and reflective teachers. A longitudinal study is necessary for this to occur. The use of the low-cost water quality monitoring kit as a technological device to assess pollution levels in rivers engages pupils in problem solving in the environment. This is not happening in the majority of South African schools in which teachers engage in a transmissive mode of teaching science and meaningful learning by pupils occurs to a limited extent. There is a need to generate a relevant curriculum which will impact on the needs of a demanding society. A collaborative participatory approach to curriculum development within an action research framework by teachers is necessary to make this possible.

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Case Studies of Science and Technology Education Programmes in
South Africa Designed for Community Problem Solving in the
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ABSTRACT

Two innovative projects of relevance to science and technology education and pertaining to community problem solving for environmental improvement in South Africa are described. Both these projects are presented to serve as illustrations of practical and realistic steps that were taken to cultivate responsible citizenship to alleviate the economic and environmental conditions associated with rural and semi-rural impoverishment, and the extent to which one of these (projects) will have an impact on reducing environmental degradation associated with refugee crises in Africa. The relevance of science and technology in education programmes designed for community problem solving in the environment and the concurrent empowerment of disadvantaged communities will be the central theme of the presentation.

INTRODUCTION

The central objective of this presentation is to demonstrate the relevance and significance of post-modernist innovative interventions designed to leading programmes of sustainable development in rural and semi-rural areas and their consequent impact on solving human and other problems associated with serious environmental degradation. The following case studies will show that communities can be empowered to act responsibly in enabling environmental problem solving in a country with a changing political context due to the advent of a post-Apartheid democracy devised to overcome a totalitarian oppressive political regime.

Environmental degradation in South Africa can be traced to the pollution of river systems by its inhabitants, poor agricultural practices resulting in soil erosion, a decontextualised first world education system in a third world country, and general mismanagement by the former Government. O'Donoghue and McNaught (1991) view the environment and environmental issues as an interlinked array of political, social, economic and biophysical environmental factors. Since 1948, South Africa has been ruled by a Government which practised a policy of separate development (Apartheid) which discriminated racially in favour of its white citizens who comprised 10% of its population. The remaining Black Africans who were in the majority, and a minority of Coloureds and Indians (naturalised by birth) were treated as a landless, voiceless people threatened with moral and physical disintegration by a force over which they had no control. They owned 10% of the land, comprised 90% of the population, and benefitted from 10% of the economy. Such an unfair political,

economic, and social dispensation has impacted negatively on the biophysical environment due to unequal access to resources, extreme poverty, and a lack of environmental regulation. The abnoxious apartheid ideology was designed as a social engineering policy which adopted a modernist approach and became highly exploitive.

DISCUSSION

Case Study One:

Environmental education programmes in South Africa have been dominated by a positivist (behaviourist) strategy of conveying conservation messages and taking pupils and adults on nature trails in places of pristine beauty. The development of environmental awareness is the main objective of such an approach (O'Donoghue, 1993). Despite excellent awareness programmes both at schools and in the news media, environmental problems have only served to escalate. One of the reasons for such a situation is that the development of awareness does not always lead to action to solve the problems. Empowerment through action competence is generally lacking in the formal education system of the country which does not provide for the development of the necessary skills. Jensen (1993 in Uzzell, 1993) states that surveys reveal a sense of powerlessness among all sections of the population, and an inability to turn concern into competence, i.e. knowing how to act to solve the problem.

Community problem solving is employed in the context of environmental education through an action research strategy. Wals et al (1990) define environmental education as the process that enables students and teachers to participate more fully in the planning, implementation, and evaluation of educational activities aimed at resolving an environmental issue that the learners have identified. "Action research" was coined and developed as methodology by Kurt Lewin in the 1940's. He believed strongly in democratic decision-making, a more equitable distribution of power, and using practical problems as a source of ideas and knowledge (Lewin, 1946 in Wals et al, 1990). Rather than ask for "outside" expertise to resolve disputes within a group, Lewin had the affected group articulate, discuss, and eventually act on a particular problem. Through analysis, conceptualization, fact-finding planning, execution, and evaluation - and then a repetition of this whole circle of activities - participants become engaged in a spiral process of task resolution, marked by critical reflection and action.

The author as a science teacher educator at the University of Durban-Westville in South Africa used a techno-scientific device to develop action competence with a semi-rural school to solve a river pollution problem. The device, a low cost water quality monitoring kit, was developed by Global Rivers Environmental Education Network (GREEN) in cooperation with the SHARENET project in South Africa. Science student teachers, through a curriculum development process (Pillay, A. and Naidoo, P. 1994) based at the reality site of a school, collaborated with

practising teachers using a cross-curricular thematic approach to develop an alternative curriculum related to "water". This process was conducted within an action research framework and facilitated by the science teacher educator. For the first time, the school was exposed to a curriculum which was not handed down to the teachers by bureaucratic authorities for implementation in classrooms. A contextualised curriculum was developed by the teachers in consultation with pupils and parents and other support agencies. This is consistent with Cornbleth's (1990) view of the curriculum as being a contextualised social process.

Brody (1995) states that there is a clear need for an integrated, approach to education with a focus on concepts that allow people to understand their environment better. One approach is to reorganise the curriculum around concepts that have the greatest potential for bridging the gaps between disciplines. Although water is integral to all life processes and thus central to the study of biology, it is powerful in its ability to relate to all disciplines in interesting ways. Pupils were therefore taught a concept ("water") in environmental education which was developed across all the subjects of the school over a two week period. The existing rigid subject compartmentalised curriculum was temporarily suspended for that period. An attempt was made to break down the boundaries separating knowledge so that meaningful teaching and learning could take place. Such a process was designed to enhance conceptualization of the alternate contextualised curriculum. All the subject teachers of the school were able to relate to the theme because of its relevance to the environment which affects all who live in it. O'Donoghue and McNaught (1991) concluded that environmental education could not function either as an alternative concept of education or as a discreet fieldwork methodology. It could, however, be seen as a necessary approach to education and thus as a focus for curriculum innovation. Environmental education was consequently treated as a sensitizing construct for curriculum reconstruction in a society under threat from environmental degradation.

The "water" theme was especially chosen because the subcontinent was ravaged by a serious drought arising from the Elnino weather pattern prevailing in the northern atmosphere. Rural and urban survival were threatened by this weather pattern and the fact that South Africa is a water scarce country. The existing limited water resources are also unevenly distributed, with 70% of the country receiving 11% of the rainfall. More than 12 000 000 people do not have access to clean drinking water and 21 000 000 people do not have adequate sanitation. Less than half the rural population has a safe and accessible water supply, and only one person in seven has access to adequate sanitation. As many as 20 000 children and old people have died per year since 1991. They were victims from rural and semi-rural areas who lost their lives as a result of drinking polluted sources of water.

The water testing kit comprised components which enabled pupils to engage with a hands on experience at a river to assess its level of pollution. In the absence of such a kit, teachers were expected to collect a sample of water from a river and send it

to a water quality laboratory for testing. The results of the test would then be conveyed to the pupils by the teacher after receiving it from the laboratory. Apart from a laboratory test for water being an expensive process which most schools cannot afford, the act of sending a sample to a laboratory is a mystery to the pupils and is not conducive to meaningful learning. The low cost water quality monitoring kit, therefore, plays an important role in demystifying science and enhancing meaningful learning.

The planning and development phases of the curriculum development process at the school culminated in a phase during which the alternative curriculum was implemented and parental involvement with pupils was encouraged at all times. This resulted in an excursion to a local river, the Hlawe River, which supplied an informal settlement with drinking water down stream. Student teachers, practising teachers, a few parents, and the chief educational officer from Umgeni Water, a bulk supplier of water, accompanied the senior pupils to the river. Upon investigation with the low cost water quality monitoring kits, the pupils and others were convinced that the river was severely polluted. This serious situation was discussed at school during the English and Science lessons and during the school assembly. The project culminated in an Open Day programme at the school. Parents and other interested community members were invited to participate in a water education agenda where water issues and the river pollution problem were discussed with great concern for the environment. Soon after the conclusion of the project, it was reported that a paint factory owner was prosecuted for dumping harmful chemicals into the river. This resulted from representations made by the local community to the law enforcement authorities in the area. Such an act of action competence endorses Malone's (1993) view that environmental education plays a critical role in enabling students, teachers and the community to make a contribution to sustaining our fragile planet.

The more specific field of environmental education should include the development of knowledge, skills, positive attitudes, and motivation to take action towards the prevention and resolution of environmental problems (Howe and Desinger 1991 in Robottom and Hart, 1993). Ideally, environmental education should involve students, teachers, and community agencies in collaborative investigations of real environmental issues in their local environments.

An analysis of the situation described above showed that an empowering process developed due to the use of the water testing kits and the cross-curricular thematic approach. The use of environmental education as a sensitising construct during the cross-curricular approach encouraged responsible behaviour by parents, pupils and teachers which climaxed in the exposure of the paint factory through written articles to the news media complaining about the severe pollution. This experience served as a good case for community problem solving in the environment leading to responsible citizenship. Ramsey and Hungerford (1989

in Robottom and Hart, 1993) state that the most important skill development is that associated with citizen participation in environmental problem solving, and it has long been recognised that the key goal of environmental education is the acquisition of responsible environmental behaviour.

Case Study Two:

Rural and semi-rural communities in South Africa comprise a very large proportion of the population and are generally Black African. These are economically depressed communities with high unemployment rates. They have developed in close proximity to natural resources such as water and areas which have an agricultural potential. Settlement may occur in river catchment areas or where boreholes are the main source of water. The ablution facilities which prevail are primitive and, in some instances, non-existent. Rural settlements are in a state of flux because inhabitants tend to migrate when natural resources begin to dwindle. Some rural populations have been forced to survive on barren land allocated to them during the separate development policy of the Apartheid era. These poorly skilled communities which have been further disadvantaged by a low rate of literacy have added to the environmental degradation which already existed. With the abolishment of the influx control laws of the former Apartheid Government, there has been a recent tendency for people from rural communities to move closer to cities where better survival resources prevail. Here, they form informal squatter settlements along river banks and lack any form of infrastructure such as water-borne sewage systems and storm water drainage. Sanitation becomes a major problem.

This case study focuses on the Umsindusi rural area through which flows the Dusi river which has been regarded as one of the most seriously polluted rivers in Africa. The two sources of pollution which have been identified are poor sanitation facilities in the rural communities, bovine contamination due to uncontrolled grazing, and damaged sewage pipes servicing the large city of Pietermaritzburg. Heavy rainfall usually results in sewage entering the Dusi River and increasing the coliform bacteria to dangerous levels which make the water unfit for human consumption due to water-borne diseases which become transmitted.

An innovative development, the Phungalutho pit toilet, has taken place in the Dusi region to ensure an improvement in rural sanitation by addressing various sanitation problems. This toilet was developed by Don Crawford, a researcher from the Institute of Natural Resources based at the University of Natal (Pietermaritzburg), a historically white liberal University which sympathised with the plight of oppressed Black people. The Phungalutho toilet is an alternative to other Ventilated Improved Pit (VIP) toilets (such as the Blair and Reid) because they had certain characteristics which did not measure up to the users' expectations. The request for an improvement came from a Black African Chief (leader) who desperately expected something better

than the Blair or Reid VIP which were expensive, not easy to build, unsafe because the floor was capable of collapsing, attracted flies and generated very unpleasant odours. Mr Crawford agreed to design an improved toilet on condition that the Chief and his people helped to identify construction problems as well as areas where existing toilets needed to be improved.

The improved toilets have now proliferated through community problem solving structures, with skills training, to foster small business development by the users in the rural community. The erection of a Phungalutho toilet can provide a "Toilet Construction Contractor" with an opportunity to earn between R600.00 (\$150.00) and R2500.00 (\$625.00) per month. Much of this is being done through community forums linked to development support groups or nature reserve neighbour programmes. Two significant major variations of the Phungalutho toilet have been developed (Crawford, 1995). The first is its adaptation known as the Modesty Rock which has been designed specifically for use in pristine wilderness areas where it is deemed undesirable to erect conspicuous man-made structures. This structure is a glass fibre imitation rock made to blend completely into the environmental background and comprises the full "Phungalutho Pit" technology, the pit cover being represented as an imitation rock and the vent pipe as a dead tree. Such a technology is seen as a response to the ever increasing need of providing a sanitation facility for people who use protected wilderness areas for hiking purposes and abuse these due to a response to the call of nature. The other variation of the Phungalutho toilet is its latest development in the form of a pre-fabricated field unit which serves the purpose of instant emergency on site sanitation. It comprises a pit cover, squat pan and flap and a screened vent pipe. Such instant VIP toilets are light (15Kg), stackable and unbreakable to the extent that they can be air dropped into remote areas during refugee crises which have become endemic in recent years in certain African and Eastern Block countries.

An analysis of the above development shows that a community problem solving strategy was initiated which has the potential to impact positively on the water quality of the Dusi River by the construction of the Phungalutho toilets. The high rate of unemployment among the rural inhabitants has been also partly overcome by the offer of a free enterprise opportunity to them due to the courtesy of Mr Crawford. The environmental degradation which emanates from refugee infiltration into remote forested regions can be partly surmounted by the "instant" VIP toilets.

The principle of modernism rests on the assumption that there exists a legitimate centre - a unique and superior position from which to establish control and to determine hierarchies (Connor, 1990). The policy of Apartheid was initially planned by the previous Government as a sincere solution to the control and management of racial diversity in South Africa and as such can be viewed as a modernist strategy. It had a social engineering tendency with an intention to shape the destiny of its people on racial lines and self-determination. It unfortunately ended up as a movement which pursued a direction of racial oppression and

tyrannical totalization based on extreme capitalistic exploitation resulting in rural impoverishment. Such a strategy is contradictory to postmodernist thinking and in the face of political extremism in the form of Apartheid ideology denied rural communities decision-making privileges in sanitation and water delivery agencies.

The capitalist role of providing the consumer with commodities which are produced by industrial forms of production becomes a postmodern endeavour when abstract qualities like love, goodness, and knowledge which had previously been thought to be immune from the operations of buying and selling, themselves enter the realm of exchange value (Connor, 1990). This is a form of "consumer" capitalism which appears to underly the thinking behind the postmodernist intervention which served to economically empower the rural community to solve some of its problems and, at the same time, to impact positively on the environment.

CONCLUSION

In the description and analysis of the case studies, it is apparent that community problem solving in the environment presents a feasible answer to decrease the environmental degradation which occurs in most third world countries. Post-modernist innovative interventions are needed to empower people with a degree of action competence to collaboratively solve environmental problems. Education systems have to deliver programmes on the environment which are sustainable within communities. A narrow focus on science or technology in isolation can be detrimental if these disciplines are not integrated into social demands through a science-technology-society (STS) intervention. In the new Government's advocacy for a post Apartheid democracy in South Africa is a commitment through its Reconstruction and Development Programme to address the problems associated with rural water and sanitation. The Department of Water Affairs is determined to provide water and sanitation to all South Africans by the year 2010. Of special significance is the commitment by Umgeni Water, a bulk water supplier with the reputation of having the best water education policy in Africa, to provide a supply of safe water by the year 2005 in the Province of Kwa-Zulu Natal. Its rural areas water and sanitation plan (RAWSP, 1995) has recognised the importance of community involvement and commitment in planning its water projects.

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L Reflective diaries of science student teachers

**1995
PROJECT WATER
REFLECTIVE DIARY**

GROUP B1

- | | |
|---------------------|---------|
| 1. Anusha Kisten | 9262218 |
| 2. Lisa Prakash | 9300421 |
| 3. Samantha Moodley | 9307120 |
| 4. T.J.N. Qwabe | 9302036 |
| 5. Zuma Zwelabantu | 9255351 |
| 6. Thavie Govender | 9300341 |
| 7. M.P. Buthelezi | 9307041 |
| 8. M.E. Makwarela | 9306289 |
| 9. Darrin Dharampal | 9301608 |

SCENES CAPTURED BY CAMERA DURING PROJECT

SAM, LISA, ANUSHA & THAVIE ARE BUSY MAKING THE MODEL



REFLECTIVE DIARY

24 / 02 / 95

The project was first introduced to us in February and this meant that we will be going to a school in Claremont to plan and implement our project . Students will be required to develop curriculum materials with the teachers and conduct Action Research at the school . The materials development involving 3 phases : Planning ; Development ; Implementation. The objective of our Action Research is to enable us as practioners to improve our practice especially in the new South Africa and this improvement will be by collaboration . Qualitative action research is different from conventional empirical research .

The students did not share the same views about the project . Some did not have any hope for the success of the project whilst others saw this as an opportunity to implement curriculum materials and viewed it as a challenge . As students were not used to being involved in this process , the idea of using the constructivist approach was very interesting to all in the group . We all agreed that the teachers need to be more aware of the situation they are placed in . By learning how to become curriculum developers , we become directly involved with the materials and methodology .

01 / 03 / 95

There is now a change in ideology from then to now that is oppressive to democratic , therefore we need to change emphasis from passivity to active critical thinking . There is now a need to reeducate our teachers so that they can liberate the child through his / her education. But because there is a big difference between the old and the new , we need a course to bridge the gap . This can be in the form of in - service education .

08 / 03 / 95

Our group met to discuss what was required . Darrin was concerned about the cost and the duration of the project . The question of time was also raised .

Previously , when students went to schools , the practising teachers entered a dependency syndrome . How do we get them actively involved ? We need to work collaboratively with the teachers and pupils . Therefore we need to form the link between preservice and inservice teachers . That link will be in the form of our internal facilitators for example , at the school Leonard Bendane and Florence Cele who are ex - UDW B.Paed. students . Allan is the external facilitator and the students are the agents of collaboration .

09 / 03 / 95

An important point that was raised was whether it was possible to implement our project in the school . Jasmin said that teachers were not prepared to change from old to untried methods . Allan explained that teachers were suffering from the dependency syndrome and therefore we should draw them out of their feelings of intimidation by getting them involved in the development process .

16 / 03 / 95

There are three steps in the action research process : PLAN - DEVELOP - IMPLEMENT. Instead of doing the first two stages on campus , we will now be exercising at the reality site. Teacher educator and student teachers will go to preliminary site to obtain permission to carry out project at *SCHOOL Δ* . This means that there is a change in the site of implementation , from UDW to Claremont . Why ? This is an ex - DET school , it is convenient and it staffs two ex - UDW students .

On each visit , only one bus will go therefore only 40 students will go to the school at each time . Which 40 students will go ? Allan decided that 4 students from each group , of which 2 of the students will always go and the other 2 will rotate on different visits . Anusha thought that this was a very good method for the permanent students as they will be able to report back to their groups on each visit and in doing so will be able to keep all visits in perspective . In our group (B1) Darrin and Anusha volunteered to be permanent members. As *SCHOOL Δ* is an ex - DET school , it provides the opportunity for Indian students to go to these schools . It has a very different atmosphere from ex - HOD schools and is therefore a unique learning experience .

Our project will be made up of :

- 1) Reflective diary
- 2) Research document
- 3) Materials

All members of a group will get one mark . Anusha requested that we have individual diaries for the following reasons :

* reflection is personal

* reflection and recording shows individuality

* saves on time required to collaborate ideas into a group diary N.B. there is a lot of time required in other aspects of this work and we have very limited common times with group members to do all aspects of work . But a majority vetoed this idea and opted for a group diary . Another suggestion that Anusha made with regard to our assessment was that for a project of this nature , the practical side is just as or even more important as the theoretical side . As curriculum developers , we must also show initiative , display positive interpersonal skills, be able to improvise in difficult situations , show leadership qualities , and display responsibility with regard to volunteering services , etc. However , again Allan did not agree to this but suggested that individuality will be considered in the materials development . Here we will receive individual marks . It was a compromise but how can we make a worksheet using the constructivist approach when your implementation of it goes back to the traditional mode ?

17 / 03 / 95

Funding was discussed and it was decided that R5000 was needed to complete our project Allan was sure that he was going to receive R2000 from Umgeni Water . Students wanted to know how the money could be raised . Suggestions were film shows and cake sales etc. We were required to approach businessmen , sponsors etc. to raise money for awards , materials for models, transport , etc. by means of a donation sheet . Also , the pupils need incentives to participate in the various activities planned , therefore we have decided to buy them prizes . However students did not very keen on raising any as they saw it as a bother. The question of transport was also raised and it was not known whether transport would be provided by the UDW bus .

Also, each group had to prepare questionnaires .The questions from each group's questionnaire will be condensed and summarised into a questionnaire for the practising teachers and one for the pupils .The questions were limited in terms of correct language i.e. not being ambiguous and easy to answer .Anusha felt this would contribute to our project tremendously for it would give us " inside " information . Teachers and pupils could answer them openly and we could ammend or change our approach accordingly .

22 / 03 / 95

There was a report back on the fund - raising attempts by the students . Some students felt strongly that teachers at the school should be involved in fund - raising . However Allan disagreed saying that we as student teachers were the initiators of the project and have the responsibility of raising funds .

24 / 03 / 95

A student posed a question with regard to our code of dress at the school . Allan's response was : " we cannot be provocative - have to abide by the rules of the school ..." . Then Anusha brought up a point about our objective in this exercise which was to break away from the traditional , authoritarian (ties and stocking) approach in curriculum development to the progressive teacher - learner approach . Both are vital contributors to curriculum development and the dress code (uniforms , tie , coat) after all is part of the hidden or covert curriculum which oppresses its' subjects . So this could be a chance to experiment on the effect of informal dressing on the pupils and their responses to us as " teachers " . Allan added that we should be careful in how we communicate with the teachers . But why ? The whole purpose of this ACTION RESEARCH project is to find out how the school operates , to implement our approach and thereafter note its effects and the teachers ' responses to it . How then are we able to assess the situation if we could not openly talk to the teachers , make suggestions and thereafter compromise in order to develop our materials ? (All of this was obviously done very tactfully with due respect to the teachers - we are afterall adults) Allan said : " ... with negotiating change , we have to be tactful , can't be cynical but be humble" We agree fully . The same message can be put across in many different ways and yet each may have very drastic implications . This could be a very good exercise for us to practise this important skill in social interaction .

In *SCHOOL D* we observed that there were no laboratories , no equipment and no library. Therefore , one of the solutions could be to bring pupils to the University and get them to do their practicals in groups in our science labs . But the underlying requirement to ensure this happening , is funding for transportation of the pupils . Mtembeni suggested getting FULCRUM to participate as they are a " white elephant " . Allan welcomed this idea . The objective is to win over the school by providing the school with resources .

27 / 03 / 95

Lucky and Mtembeni went with Allan to *THE* Primary School , to meet with the principal and deputy principal . The bus was scheduled for the 25 / 04 / 95 for our (students) first visit to the school . We are supposed to leave at 12H30 and arrive back at campus at 14H30 . Those students with other committments such as lectures , practicals , T.P. , etc. were told by Allan that they could obtain letters from him to hand to lecturers excusing them from attending . We were given the breakdown of the project by Allan and the dates of the implementation i.e. the first two weeks in August . Students were also required to have a file in which we were to keep all collected documents : notes , readings, articles , magazines , etc. on the theme " water " .

07 / 04 / 95

There was an ammendment to departure time to 11H40 which is during the science practical time on the 25 / 04 .

25 / 04 / 95

For some of the students , this was their first visit to an ex - DET school . The image we had of this project and the school in which we were to implement was totally different on campus from our experience at the site of our project . Our whole approach and ideas towards the materials development and its implementation in the classroom will now have to be reviewed The reasons for the review was our observations :

* children were without shoes

* by " our " standards the classes were very rowdy but then again maybe this was normal in this school

- * girls wore green uniforms while boys wore khakhi shorts and shirts
- * no labs , or library or resources
- * language of instruction was English only from Std. 3 onwards

We were taken to the staff room where we sat with members of the staff and pupils . We were introduced to the principal . . . and the teachers . The meeting of pupil , students and teachers was very positive towards our alternative curriculum development after all all three are vital components in this process . However we were very segregated , that is teachers grouped together . Pupils were seated in the center while students stood to one side. We felt that this arrangement intimidated the pupils as they did not voice any opinions or comments . We presented the teachers with real education which will be relevant to their environment and school . But we must work collaboratively .

05 / 05 / 95

When we arrived at the school , the students and teachers were divided according to subject groups . Together we sat down to discuss the planning of the curriculum for the two weeks. Only 12 teachers out of 25 teachers turned up at this meeting . It was evident from talking with the teachers that they did not understand what was required from them . The teachers talked about how the pupils learned in class and their responses , in other words the problems they had in teaching in English .

This was the outline of the plan as it stands i.e. the framework :

- 1) AWARENESS DAY - the aim is to create a sensitising experience for pupils and staff . It also introduces them to what we will be doing at the school for the next two weeks .
- 2) RIVER STUDY DAY - pupils will be taken to the river and all subject teachers will be involved .
- 3) OPEN DAY - pupils will stage a drama written by the students ; put up pupils' posters ; students' posters and models ; etc. Parents will also be invited on this day . Previously we had a compartmentalised education and we want to change that into an intergrated cross - curriculum .

Anusha asked a question concerning the problems associated with English as medium of instruction . Leonard replied that many of the pupils do understand English but that we need to speak slowly , deliberately and use practical , simple English instead of formal English .

12 / 05 / 95

Presently , we are working with standards 3 , 4 , 5 in all subjects using the cross - curricular approach . Kobis' concern was : " how do we concentrate on all three standards ? " . She felt that it was too much and her suggestion was that we concentrate on only one standard either 3 , 4 , 5 . Anusha supported this but suggested that as a class we decide which groups focus on which standards . She felt that this would ensure that each group has only one standard to focus on but catering for all the standards in the school . Unfortunately , some students did not agree with this . We did not come to a consensus and as a result we decided to stick to Kobis' suggestion and chose standard 5 .

Allan mentioned Leonard's personal research in students being difficult when taught in English especially if they know that a teacher can speak Zulu . Therefore , he wants to experiment on the effects of the following student teachers on the pupils :

- 1) A student with no Zulu but is African
- 2) One who will speak only Zulu
- 3) Leonard will speak both English and Zulu
- 4) One Indian student who will speak only English

He wants the above to teach the same content . From this experiment he is interested in what the pupils' understand best , what are the problems and other issues that may arise . He also wants to see if the teacher being African or not has any effect .

16 / 05 / 95

A small group of students went to the school to finalise proceedings for awareness and open day . The excursions and other trips were planned . Also , they tried to finalise what refreshments would be served to the parents . Darrin and ^{DEPUTY PRINCIPAL} the _^ volunteered to arrange sponsorships from Coca Cola and a bakery . However , non of the refreshments were finalised .

23 / 05 / 95

This was our second visit to the school and the campus bus could seat only 35 students . Allan asked for 6 per group which is equivalent to 60 students . Some were forced to remain behind and some had to stand on the bus . We felt that this showed poor organisation on the part of the coordinator. When we arrived at the school , we got into our subject groups . However the Maths teacher did not know what was going on and the math students had to enlighten him . Also , he did not seem very enthusiastic . But we understood that this was the first time such a project was held at the school . Florence gave us a copy of the std 5 syllabus . We requested that she teach the topics : capacity , percentage , volume , measurement during August when implementation of the project takes place , for our convenience . The theme " water " can then be easily applied and she agreed willingly .

26 / 05 / 95

Allan handed out appeal forms to students . Kobi suggested that we hand in the forms and the money as soon as possible as groups will need money to buy materials for models , etc. It was decided that monies would be collected by 14 / 06 but we could continue throughout the holiday so that we will have more money which we could use for Open Day ; refreshments ; awards ,etc. The ^{DEPUTY PRINCIPAL} suggested a meeting with staff , Allan and students on 06 / 06 . Allan asked for four volunteers . Anusha , Darrin , Anushia , and Renuka volunteered but then Allan counteracted this to make it racially and gender balanced . Where is democracy ? Are these now " volunteers " in the true respect of the word ?

By deliberately balancing the students I think Allan is inadvertently being racist and sexist , therefore he is making race and sex an issue . Four students who are keen volunteers taking the initiative irrespective of their race or sex .

31 / 05 / 95 We were first exposed to the proposed budget as following :

MATERIALS DEVELOPMENT - R400

AWARENESS DAY - R310

RIVER DAY - R450

OPEN DAY - R3600

EXCURSION (OTHER) - R900

TOTAL -----

R5660

Umgeni Water Board - R2000 Therefore , we need to raise R3660 . Anusia worked out that students need to raise approximately R50 each ; $R50 \times 70 = R3500,20$.

20 / 06 / 95

During the months of May and July , the school was frequented by many students . Their main concern was the lack of support and initiative from the teachers . Allan said that he would try to persuade teachers like Leonard to talk to the rest of the teachers in order to get them to co - operate with the students .

31 / 07 / 95

We went to the school with Tholangs' van and two buses . Students were excited and enthusiastic about this visit to the school . Initially , our group experienced a few problems in getting our model to campus which we worked out later . Also , there was a problem with the models . Not all of the models could be transported in Tholangs' van as all the models could not fit in the van . This resulted in some students having to carry their models with them on the bus as well as the groups' charts , posters , and other materials . Students chose a part of the quad in which to display their groups' efforts . During the break , pupils were allowed to view the display of models , posters and other interesting materials which was also captured on video for later viewing . Our groups' effort was a success as each student in our group had a chance to explain the model to groups of pupils and the pupils' questions . It could be clearly seen that the pupils' enjoyed learning in this new way which gave them the confidence to question and offer comments. The ^{DEPUTY PRINCIPAL} _A complimented our effort and thanked our group sincerely . Pupils ' seemed very interested in our project .

15 / 08 / 95

This visit was allocated for the student teaching day . Allan was not able to come with us due to previous engagement . As a result , students did not know which classes to go to and because of our large numbers , we were not able to teach individual lessons . The ^{PRINCIPAL} DEPUTY [^] told us that it would be therefore be better to conduct informal lessons with the pupils . Our group went to one class and divided the pupils into groups and each student attached themselves to a group . Another student , Beni stood in front of the class to tell the pupils which concepts would be discussed in their groups and acted as a facilitator . Our approach was pupil centered , making pupils feel that their interpretations are important . We also used the model to explain and concretise certain concepts . We were not given a chance to spend more time with the pupils as other groups wanted to rotate . However , we tried to improvise as best as we could on the spur of the moment but felt that this class was responsive and enjoyed learning in this way . On the whole , this visit was poorly co - ordinated and disorganised .

22 / 08 / 95

A group of students left with Allan to co - ordinate the final stage of our project at SCHOOL D . This group was responsible for decorating the stage that using crepe paper to highlight parts of the quad . Also , some of the group helped to make the sandwiches for the rest of the students , teachers , and parents . They set up the tables and the refreshments in the staff room . They allocated places for groups to set up so that they would not waste any time before the program began . There was a great deal of parental support , less than 50 parents showed up for the Open day . The program went well with sketches , dances , a short play about water , informative speeches ,etc . Pupils , teachers and students enjoyed the creative aspects of the program and parents were impressed with the efforts of the pupils . The group mentioned above also dressed as clowns who gave out sweets to pupils if they answered a question and most pupils loved this idea although , the smaller pupils were at first scared to approach the " clowns " . From our observations , we feel that everyone enjoyed this day and we hope that they learnt a lot from our project " water " . Also , our group left behind the group model at SCHOOL D . for the teachers and pupils to make further use of learning potential .

AN INDIVIDUAL REPORT

NAME: SHABASHINI MOODLEY

REG NO: 9303922

REFLECTIVE DIARY

The Curriculum Development Project on Water was introduced to the Science in Education 3 students by our lecturer Mr.S.Pillay.

The concept of "curriculum development" was introduced after a serious look into existing curriculums operating within schools in our country.

Following this various questions were raised; namely:

*What curriculums do schools follow?

*Are things that are thought meeting the needs of the child, w.r.t. relevance and active pupil involvement?

*Who produces curriculum materials? Are teachers involved in this process, if not -why not?

On looking at the the dilemma that confronted the education system , curriculum development had to be introduced as an approach that demanded a new way of thinking of educationists in order to follow the goal of education, which is a process for preparing a socially efficient citizen for a challenging and demanding society.

Included in the project, was the essential need of also seriously focussing on environmental education as part of curriculum development in schools.

So the Curriculum Development Project on Water was to be to be carried out by the Science in Education 3 students of the University of Durban Westville. Previously students had engaged in the project by only developing the materials and thus were not given the opportunity to implement their work at the reality site, a school.

Following this the need for collaborative participation between student teachers and practising teachers was realized in order to take the responsibility to use their innovation and creativity in developing a curriculum that moved away from traditional and oppressive styles of teaching. However after creating such an atmosphere it was discovered that practising teachers were not accepting the new challenge but rather depended exclusively on the student teachers' for developing materials and activities using a cross-curricular approach that linked with all subjects. The topic water was chosen as the country was facing a crisis of water shortage as a result of water wastage and water pollution.

As present year students we firstly looked at all of the events that had taken place in the past.

We were going to engage in an action research approach that entailed improving practice through involvement of student teachers and practising teachers. Mr. S. Pillay also the external facilitator (the vigorous catalyst) in the project negotiated with a nearby Black primary school in Clermont to permit us to implement our project at their school. Mr. Pillay made contact with the school prior to our visits, establishing good relations with the school. It was the first time that the Indian students were to be directly working with a Black school. Although this encounter was seen as an opportunity to familiarise ourselves with a different culture, a sense of anxiety was prevalent in that initially I thought that I would not be able to fulfil some of the expectations. The reason for my doubt was that I could not communicate in the medium of instruction (ZULU), that was used in the school. This was just early jitters that I was able to handle later on as that I was able to handle as the project progressed.

The following information is a bit of knowledge about the school:

NAME OF SCHOOL: School A

LOCATION: CLERMONT

PRINCIPAL: MRS X

DEPUTY PRINCIPAL: MR Y

MISSION STATEMENT OF THE SCHOOL: MAKE LEARNING SUITABLE FOR THE LIFE WORLD OF THE CHILD

MEDIUM OF INSTRUCTION: ZULU

NO. OF PRACTISING TEACHERS: 26-30

NO. OF PUPILS: 1000

CURRICULUM OF SCHOOL: (D.E.T.) SYLLABUS PACKAGE CONSISTING OF DIFFERENT INDIVIDUAL SUBJECTS BROKEN DOWN INTO MODULES. TEACHERS FOLLOWED THIS AS ONE WOULD FOLLOW A RECIPE.

DESCRIPTION IN TERMS OF FACILITIES / RESOURCES : NO LIBRARY, NO VISUAL MEDIA EQUIPMENT, HAS ONLY ONE O.H.P., STAFF ROOM HAS NO FURNITURE. FUNDING OF THE SCHOOL WAS VERY POOR.

25:04:95

FIRST VISIT TO THE SCHOOL:

Student teachers together with our external facilitator was transported to the school by bus. When we arrived at the school the principal was otherwise engaged so we were welcomed by the deputy principal Mr. Y. . Majority of the teachers were not aware of curriculum development and were further not accustomed to collaborative participation. This was going to be a first time experience for both the practising teachers and student teachers. Two of the teachers at the school were products of our university and thus were aware of what our intentions were. One of these teachers MR LEARN . was given the responsibility of being the internal facilitator. His task would be to inform teachers on a regular basis on the project and assist teachers with any problems that they may encounter.

On this day teachers were also given questionnaires to fill in. The questions were prepared by the student teachers with the guidance of our external facilitator.

CRITICAL MOMENTS:

There seemed to be some tension present. Perhaps this was due to the teachers not understanding our true motivations and thus felt that we were disrupting the school and further disempowering them.

This made me realize the paramount importance of communication in heading a project of this nature. Communication was vital to clear misunderstandings and other disturbances that may arise.

23:05:95

SECOND VISIT TO THE SCHOOL:

The goal of this visit was to "break the ice". The method used was simple. It was decided that we would change our seating arrangement, by arranging the chairs in a circle, followed by teachers and student teachers coming with each other. This may seem paranoid to many but actually it was very effective in that one could observe that people were feeling much relaxed.

Included in this group setting were pupils as well after all it was their education that was being discussed. The purpose for this setting was to bring about an understanding that nobody was going to be taking an authoritative role instead we were all going to work as a unified team. After this relaxed atmosphere there was a discussion of the implementation dates and what programme was going to be followed on each day. Pupils were also asked whether they would like to participate in the activities so that they would learn about water and at the same time be given the chance to win prizes. The pupils responded with enthusiasm.

CRITICAL MOMENTS:

Teachers felt that it would be difficult for them to develop curriculum materials as they had no resources available. The school did not have a library and they were further used to following a syllabus package that they adopted.

THIRD VISIT:

Student teachers were to work collaboratively with practising teachers that were teachers of their subject areas. Hereon the student teachers were to have a look at the teaching styles used by the practising teachers and the written lesson plans that was also used. I used this opportunity in showing the teacher that I worked with all the materials that I collected to use in developing my materials. Discussed the drama that we were going to prepare for the students to perform on Open Day.

Also discussed the competitions that pupils were going to partake in.

* A coloring competition

* Essay competition

26:05:95

DISCUSSION OF FUND RAISING:

This discussion entailed the different ways that we were going to raise funds. Appeal forms were made available to us by Mr.S.Pillay. Each group was to share a form between two members and try their best to collect funds from the public and some sponsors. We needed these funds to aid the project.

31:05:95

Looked at budget expenses

Umgeni Water sponsored us with a sum of R2000.
A cake sale was also held by the Science in Ed.3 students.
A few groups also held film shows on campus to raise funds.
The school also participated in getting sponsors from the local area.

A total sum of R6000 was needed for the following costs:

- *TRANSPORTATION OF STUDENT TEACHERS TO THE SCHOOL
- *TRANSPORTATION OF PUPILS ON THEIR FIELD TRIP
- *PRIZES FOR THE PUPILS
- *WATER TESTING KITS
- *CATERING FOR OPEN DAY
- *ODDS AND ENDS

IMPLEMENTATION OF THE PROJECT:

31:08:95

AWARENESS DAY:

This was the first day of the implementation. It was directed at creating an atmosphere that would enable the pupils to gain a sensitizing experience of water by being exposed to a variety of posters, models, specimens, experiments on water.

Student teachers arrived at the school at 9h50. In their respective groups they were allotted an area in which to put up their displays.

Pupils then assembled together with the staff and were addressed by the principal. Mrs. X informed the pupils on the reason for our visit and requested that they be as co-operative and attentive as possible. This was followed by an address by our external facilitator and lecturer Mr. S. Pillay who informed the pupils a little on the importance of water and thanking the school for giving us the opportunity to work with them. This was followed by an address by our colleague, a student teacher Mtembeni who spoke on behalf of the student teachers. He also thanked the school for giving us the opportunity to gain such rare and wonderful experience by working in unison with the practising teachers.

Pupils were then supervised by their teachers and walked around observing our displays. Posters and models were explained to pupils and they were exposed to a magic trick dealing with tricks with water that they really enjoyed.

CRITICAL MOMENTS

On asking pupils questions they were very reluctant to answer. Student teachers who could not communicate in Zulu had difficulty in explaining certain phenomena to pupils. However, those groups who were fortunate had members within their groups that were able to speak in Zulu.

15:08:95

RIVER DAY:

On this day pupils were transported to the Palmet River and here they participated in a river study. Water tests were conducted with water testing kits that were purchased at a discount price. Water quality slides were also used to examine the level of pollution present in the river. The water testing was supervised by the teachers and a few student teachers that were present. The water testing kit was used as a problem solving tool at the river.

River Day was a really good learning experience for the pupils as they were able to get actively involved in their learning that was not confined to a classroom. A clear and direct understanding of water pollution and river creatures could be gained. Children could also realize the importance of keeping rivers clean by observing the harmful consequences of polluted rivers. As individuals they would now perhaps take the responsibility in making an effort to keep the rivers clean.

CRITICAL MOMENTS:

Due to a crisis on campus most students were not able to participate in the activities of this day. It is understandable that the event had to go on but students nonetheless should have been informed by means of a notice that the activities planned for the day was to remain unchanged. Interested pupils could have made an effort to get to the river. I personally was disappointed in not being able to participate in this significant event.

TEACHING DAY:

On this day both the practising teachers and student teachers were given the opportunity to teach the lessons that they prepared on water to the pupils. The school made arrangements by altering their schedule and fitting in our programme.

We were given access to the standard two through to the standard five class. Student teachers also made use of their models and posters when teaching. Worksheets were also utilised. The "dependency syndrome" was still prevalent as most teachers relied on the student teachers for developed curriculum materials.

I personally had the opportunity in teaching a standard four class with the supervision of a practising teacher (Mrs. Nellie) I used a cross curricular approach intergrating Science and English. My lesson focused on the aspect of water pollution and pupils were given worksheets that consisted of cartoons that they were to interpret and discuss.

CRITICAL MOMENTS:

- * As it was my first encounter teaching pupils whose mother tongue was Zulu, I was anxious as to whether I would be able to fulfil my expectations.
- * The "dependency syndrome" was still prevalent amongst some of the teachers. This was disappointing as these teachers were not meet the challenge.
- * The bus arrived a little early and some of the student teachers were still engaged in teaching.

OPEN DAY:

This was the last day of implementation. The community mainly comprising of parents were invited to the school and was exposed to a programme related to water. Once again the student teachers displayed their posters and models. Once everybody was assembled the programme commenced. Activities for the day were planned in advance by the practising teachers and a few student teachers. These activities involved the active participation of pupils. The programme started with an opening prayer followed by an address by the principal, the external facilitator Mr. S. Pillay and a student teacher Lucky Khumalo. Each of them briefly welcomed the parents and mentioned a few statements on the importance of water. This was followed by songs, sketches, dances and dramas related to the theme water. In between some of the activities pupils were asked questions related to water and were given sweets by a few student teachers dressed as clowns. A cake decorated with the words "project water" was also cut signifying the success of the project despite some of the problems as this was a first attempt.

Winners of the competitions were also awarded prizes.

Refreshments were then served at the end of the programme.

At this stage I asked the principal a few questions on the project. The questions and responses were as follows:

Q: What did you think of the project?

A: It was very good considering it being a first attempt. I am sure that with further practice, we would be able to eliminate some of the problems that were encountered.

Q: Are you suggesting that you would be keen in working with the university in the future?

A: Yes, I would be happy to work with your institution again. I hope that the next time my teachers would be more co-operative with all the experience that they gained.

Q: Do you think the children gained anything from the project?

A: Yes, they did. They really enjoyed the things planned for them and the learning experience was something new and exciting and therefore will be well remembered.

PERSONAL DEVELOPMENT AS A TEACHER:

As a future teacher of the emerging new South Africa my task is not going to be easy. I would have to deal with situations of a demanding and challenging society.

"PROJECT WATER" has taught me many things that I would always consider as a future teacher.

Firstly, as a future educationist I must move away from a "hanging" system of education whose role is to create an insecure atmosphere and restricted curriculum for pupils, making them paralysed defeated members of society. Rather I would take on an approach that would achieve the true goal of education which is to prepare an individual to become a socially efficient citizen that would be able to use his education to solve problems that he/she came into contact with.

In order to achieve this goal a teacher as an individual must be open minded to changes and be enthusiastic in becoming involved in new approaches that improve the present education system.

As a future teacher I am ready to take responsibility and become an active participant by engaging in eliminating the preparation of curriculum by outside experts that serve to oppress and send down a package that is not contextualised and that does not meet the needs of a child.

This would mean me having to work in collaboration with members of the staff in developing materials using creativity. I am all for this as long as there is a comforting, united atmosphere prevalent.

When a teacher shows the pupil he might remember.

When a teacher tells the pupil he might remember.

But when a pupil is actively involved in his/her learning he /she would understand. I hope to be that teacher that involves my pupils in their learning.

I, would finally like to thank Mr. S. Pillay for providing us with this opportunity enabling us to gain an experience that would be of great use to us as future teachers.

M Action research reports of science student teachers

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INTRODUCTION

NAME OF SCHOOL VISITED: SCHOOL A

In the previous South African education system, the school curriculum was (in most cases), imported from overseas schools and merely implemented in local schools. The cultures and practices of South African schools was not taken into consideration and neither were the availability of resources. Even implementers/teachers were not consulted in designing and planning the school curriculum. Teachers are merely expected to teach whatever was planned by the state for them. In this way the creative teaching skills of practicing teachers became very limited, since they were hardly involved in curriculum development.

The University of Durban Westville, Science Education Faculty has embarked on a curriculum development project. In this programme students are encouraged to develop teaching packages for a specific topic. This programme has been carried over for the past few years. At first the programme did not prove useful because then curriculum packages were merely being designed but not implemented in the classroom. There was no proof that it would work in the real situation. The University then arranged for the students to visit a school. However, over time the practicing teachers developed a "dependency syndrome" whereby they stood back and watched while the student teachers did all the planning and implementation. Practicing teachers were still not receiving any experience in curriculum development.

INTRODUCTION cont...

It was then decided that the curriculum development project would take place with the active participation of the practicing teachers. The key idea was COLLABORATION. In this way, the teaching and learning process becomes more meaningful.

The context of the school that we visited was that of a school in a disadvantaged rural, highly populated residential area.

It is clear that the school could not afford the luxuries of purchasing specialised equipment necessary for science education. It was just as well that the student teachers prepared adequately by making their own models and apparatus before going on to teach.

THE CONTEXT

SCHOOL D IS A PRIMARY SCHOOL ,SITUATED IN CLERMONT IS A PREDOMINANTLY AFRICAN SCHOOL IN AN UNDERDEVELOPED RESIDENTIAL AREA.THE SCHOOL CONSISTS OF APPROXIMATELY 25 TEACHERS AND 900 STUDENTS.THE SCHOOL DOES NOT CONSIST OF MULTICULTURASISM OR MULTIRACIALISM.THE SCHOOL IS NOT SITUATED AT WALKING DISTANCE FOR PUPILS.THE SCHOOL RUN BY THE PRINCIPAL AND TEACHERS SHOWS A LACK OF DISCIPLINE AND ORGANISATION.THE SCHOOL LACKING IN RESOURCES IS KEPT CLEAN BY THE PUPILS . UNDER THE GUIDANCE OF THE TEACHERS.

THE RESEARCH PROBLEM

THE CURRICULUM IMPLEMENTED BY PAST TEACHERS WAS PRODUCED AS A RESULT OF THE RDDA MODEL.THAT IS RESEARCH DEVELOPMENT . DISSEMINATION ADOPTION MODEL.THIS MODEL WOULD HAVE BEEN SUCCESSFUL IF IT WEREN'T FOR ITS MANY FLAWS.THE RESEARCH WAS BASED ON OTHER COUNTRIES EDUCATION SYSTEM WITH NO RELEVANCE TO THE SOUTH AFRICAN CONTEXT.

CURRICULUM DEVELOPED THEN DID NOT INCLUDE THE INTEREST OF THE STUDENTS,TEACHERS AND PARENTS.THE CURRICULUM DEVELOPED WAS IRRELEVANT TO THE EXPERIENCES AND LIFESTYLE OF THE CHILD.THIS IS WHY WINSTON CHURCHILL FELT : " MY EDUCATION WAS INTERRUPTED BY MY SCHOOLING. "

DUE TO THE FACT THAT THE TEACHERS WAS NOT PART OF THE DEVELOPMENT PROCESS THEY DEVELOPED AN APATHY TOWARDS TEACHING.TEACHERS TAUGHT IN THE TRADITIONAL, NON PROGRESSIVE WAY PRODUCED PUPILS WHO WERE PASSIVE,COULD NOT THINK FOR THEMSELVES AS A RESULT COULD NOT QUESTION THE WAY THEY WERE TAUGHT.

THE STUDENT TEACHERS AT DURBAN - WESTVILLE THEREFORE EMBARKED ON A CURRICULUM DEVELOPMENTAL PROJECT THAT WILL TRANSCEND THE ORDINARY CURRICULUM INTO THAT OF A CREATIVE, INNOVATIVE WAY OF TEACHING THAT WILL ALLOW STUDENTS TO DEVELOP CONFIDENCE AND KNOWLEDGE BASED ON THEIR OWN HIDDEN RESOURCES.

THE FIRST DOWNFALL WAS THAT ONE COULD NOT PERCEIVE THE SUCCESS OR FAILURES OF THE CURRICULUM PRODUCED. THE PROJECT WAS THEN IMPLEMENTED IN THE SCHOOLS. AT THIS POINT THE PRACTISING TEACHERS WAS NOT INVOLVED WITH THE PROJECT. THEY JUST SAT BACK AND DID NOT COLLABORATE WITH THE STUDENT TEACHERS. THE THIRD STAGE OF THE PROJECT EMBARKED BY THE 3rd YEAR SCIENCE IN ED STUDENTS IN WHICH MATERIALS WERE DEVELOPED IN COLLABORATION WITH THE P TEACHERS, PUPILS AND PARENTS AROUND A THEMATIC APPROACH.

THE AUTOCRATIC DECONTEXTUALIZED EDUCATION SYSTEM DESIGNED BY THE ENGINEER OF APARTHEID FAILED TO EMPOWER PEOPLE TO MAKE DECISIONS REGARDING ISSUES SUCH AS WATER POLLUTION, DROUGHT AND WATER WASTAGE. IT WAS DECIDED THAT THE THEME WATER RELEVANT TO THE NEEDS OF SOCIETY SHOULD BE IMPLEMENTED SO AS TO MAKE LEARNING SUITABLE FOR THE LIFE WORLD OF THE CHILD.

METHODOLOGY

AIM

The main aim of the research is:

" To develop materials with the practising teachers and to implement the project on water at the reality site that is, the school."

OBJECTIVES

1. To work in collaboration with the practising teachers.
2. To implement the thematic approach on water using the cross curricular approach.
3. To develop materials with the practising teachers at the school and implement it.
4. To gain practice on using innovative, creative approaches and strategies in a classroom.
5. To meet the demands of second language speakers.
6. To gain experience as a future teacher in the new, democratised South Africa.

SECONDARY SOURCES OF DATA

QUESTIONNAIRES

Pupils, teachers and the deputy principal had answered our questionnaires. The aim was to extract information about the relationship between teachers and pupils, wheather teachers work in collaboration with each other and do they use the cross curricular approach. It was also discovered how knowledgeable teachers are with regard to the different approaches as well as strategies. It gave a good overall indication as to how interested and involved practising teachers are in the project water. Attitudes of both the pupils and teachers were revealed with respect to changes. The questionnaires that the pupils answered was to find if they benefited from the project and how.

PRIMARY SOURCES OF DATA

INTERVIEWS

Structured and unstructured interviews were held with the pupils teachers and the deputy principal. A one to one basis is more effective in gaining information because a better understanding is gained when speaking personally to them as compared to when writing it down. Pupils were not able to write English properly in the questionnaires therefore by communicating verbally with them, there was a better understanding.

SAMPLING

Random sampling was chosen in the research study of *the* primary school. This type of sampling allows for all people to have a fair and equal chance of being selected in the sampling process. A sample of 7 was taken.

PROBLEMS EXPERIENCED

Some pupils were not very co-operative in answering the questionnaires and did not take it seriously. Teachers did not collaborate effectively with student teachers as expected when it came to developing materials. The days that were set aside for going to the school kept on changing causing inconvenience.

DATA- ANALYSIS

Project water implemented at SCHOOL D called for collaborative participation of student science teachers from the University of Durban Westville and teachers of the above mentioned school. The objective was to work as a unified team in developing curriculum materials across all subjects using the theme WATER.

In developing materials teachers were expected to use their creativity and try to make things relevant and contextualized to suit the needs of the pupils. They were also requested to move slightly away from the materials supplied in the syllabus.

On taking the initiative to commence with the developing of materials the practising teachers were quite reluctant.

On observing such behaviour my group decided to design a questionnaire for the teachers to answer so that we could examine the reasons as to why the teachers weren't enthusiastic in becoming committed to the project at the beginning stage and why they took a little interest afterwards.

We also had interviews with the principal, the deputy principal and pupils, primarily to be informed on their feelings towards the project and experiences gained from the project.

The following questionnaires are copies of those that were given to teachers, pupils and also included is a written record of verbal interviews that were held with the principal and the deputy principal.

QUESTIONNAIRE

PRINCIPAL

1) WHAT DO YOU THINK ABOUT THE PROJECT ?

2) WOULD YOU ACCOMADATE FOR SUCH A PROJECT IN THE FUTURE ?

2) DID YOU THINK THAT THE SCHOOL BENEFITED. IF SO HOW ?

4) DO YOU THINK THAT THE PROJECT WAS A SUCCESS ?

DEPUTY PRINCIPAL

5) WHAT IS THE MEDIUM OF INSTRUCTION IN THE CLASSROOM ?

6) DO YOU BELIEVE IN TRADITIONAL MODE OF TEACHING ?

7) WHAT DO YOU THINK ABOUT OUR (STUDENT TEACHERS) EFFORT IN THE WATER PROJECT ?

*** *****

QUESTIONNAIRE

STUDENT

1) WHEN WERE YOU INFORMED ABOUT THE PROJECT ?

2) WHAT DID YOU LEARN FROM THIS ENTIRE PROJECT ?

3) WHAT DID YOU FIND TO BE THE MOST INTERESTING PART OF OUR PROJECT ?

4) WOULD YOU LIKE FOR US TO COME AGAIN ?

5) DO YOU PRACTICE SAVING WATER IN SCHOOL? IF SO HOW ?

6) DID YOU TELL YOUR PARENTS ABOUT THE PROJECT AND HOW TO SAVE WATER ?

1) DO YOU USE THE CROSS - CURRICULAR THEMATIC APPROACH IN YOUR CLASSROOM ?

2) IS GROUP WORK USED AS PART OF YOUR TEACHING TECHNIQUE ?

3) WHY WERE YOU RELUCTANT TO DEVELOP CURRICULUM MATERIAL IN THE PROJECT ?

4) DO YOU FEEL THAT IT SHOULD ONLY BE THE EFFORT OF THE STUDENT TEACHERS ?

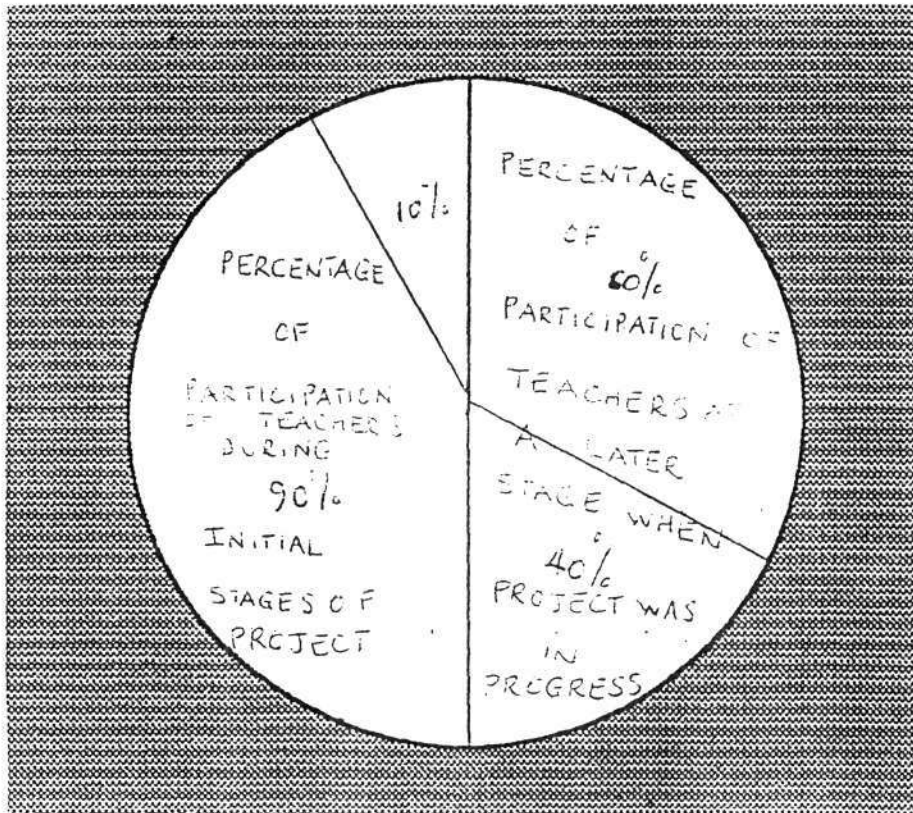
5) WHAT DID YOU AS A TEACHER LEARN FROM THIS PROJECT ?

6) WOULD YOU ACCOMMODATE FOR THE STUDENT TEACHERS IN THE FUTURE ?

7) DID YOU THINK THAT THE STUDENT TEACHERS WERE OF ANY HELP TO YOU?

THE FOLLOWING GRAPHS ARE INDICATIVE OF THE PERCENTAGE OF TEACHERS

1. PARTICIPATION / COMMITMENT TOWARDS PROJECT WATER AT BOTH INITIAL LATER STAGES. (PIE GRAPHS)



ANALYSIS OF DATA:

On looking at the percentages of teachers co-operation at the initial stages we gather they are extremely low. (10%)

Some possible reasons for this could perhaps be the following:

*Teachers may have not been fully aware of our intentions and may have felt disempowered.

*To many teachers this was a new experience and thus have in the past been directed by others and so in turn have not been accustomed to taking responsibility.

*Using of the supplied syllabus has been so closely adopted that difficulty arose in using other resources/trying a new approach.

Also resources were not accessible to the teachers.

*Teachers tried to avoid making decisions

*Being a new experience, fear and anxiety could have been deterrents

that caused teachers into thinking that could not meet the expectations of the project.

10 % of teachers were enthusiastic about participating collaboratively. The reasons for this may be the following:

*Some of these teachers were accustomed to working together in developing curriculum materials independent of a prescribed

syllabus because they were products of an institution namely; (UDW), that provided an opportunity to develop such skills.

*Being a new experience, fear and anxiety could have been deterrents that caused teachers into thinking that could not meet the expectations of the project.

10 % of teachers were enthusiastic about participating collaboratively. The reasons for this may be the following:

*Some of these teachers were accustomed to working together in developing curriculum materials independent of a prescribed

syllabus because they were products of an institution namely; (UDW), that provided an opportunity to develop such skills.

*Others may have wanted to take on the challenge and be open minded

about new approaches towards education that could benefit all and meet the needs of especially pupils in a demanding new SOUTH AFRICA.

The 2nd bar graph is an illustration of an increase in practising teacher and qualified teachers collaboration in becoming more dedicated after the initial stage.

The graph indicates that 60% of the teachers started taking responsibility in engaging in the project.

Reasons for this sudden increase follows:

*Our internal facilitator clarified disturbances such as the issue of empowerment by informing the teachers that no particular party was in authority and that we were to work as a unified whole.

*Teachers saw the opportunity in putting their long hidden creativity into use by planning activities such as dances, dramas and songs related to the theme WATER for the Open Day.

*Being informed about the deterioration of our environment teachers began to see the significance of environmental education and realizing that the project "WATER " placed emphasis on this issue they automatically took interest.

*Another reason for the increased response could be attributed to the school realizing the effort we were putting into the project by raising funds to aid the project so that pupils could be taken on field trips to the river, waterworks and prizes were to be awarded to pupils who performed well in competitions held.

*Teachers could also have been directed by the principal to actively engage in the project.

Finally the remaining 40% of teachers that took on the role of mere onlookers were really unfortunate in that whatever learning experiences that were gained would be beneficial to all individuals permanently.

Reasons for the 40% of teachers that remained uninvolved could be the following:

*Had other tasks to handle that took first priority

*Had the desire to work as little as possible.

*Are fundamentally lazy.

EVALUATION

As a result of the inadequate educational system in the past, children have suffered because it is believed to be that South Africa has the worst educational system in the history. We must move away from the notion that only experts and policy makers have the right and skills to develop the curriculum. Teachers therefore need to be empowered and invoked with the appropriate skills to develop curriculum material.

The inappropriate past educational system affected an individuals personal environment which includes the manner in which they think, feel and live. This may be one of the reasons why pupils have a negative attitude in schools. For the RDP to realise to educational goals, it is imperative that teachers commit them selves to the sustainable curriculum development philosophy. The bottom up approach is essential for successful results which will prove to be more effective in the long run as compared to the top down approach.

For teachers to make decisions, empowerment is essential. This involves an effective grassroots participatory process. This will however take time since the RDP's people driven culture is still in its embryo stages. The RDP is essentially a people driven culture therefore teachers must be part of the drawing up of educational policies. Seeking practical alternatives is an arduous and challenging process. The project was however successful to an extent and believe it still has potential for much more improvment.

RECOMMENDATIONS

There should be a ocntinuous communication and consultation process between the experts and teachers. More innovative educational approaches should be practised in schools to make the learning an effective process. All educational activities should follow a route of sustainable development. More emphasis should be placed on environmental education. Pupils must be more active in the learning processes. Practising teachers should be more co.operative with students teachers in future projects.

CONCLUSION

The University of Durban Westville states in its Mission Statement that UDW is moving towards non-racism, democracy and community involvement. This is exactly what Science Education III students have been engaging themselves in, while implementing Project Water. This has made Science Education so much more meaningful to teach and to learn. According to Professor Jairam Reddy, skilled and highly qualified people are needed in South Africa. This is what UDW is striving towards. This is also what Project Water has tried to achieve on visits to the school. Student teachers have encouraged pupils to think independantly and creatively. This is what our group believes goes into making an active thinking pupil into a remarkable citizen who is of extreme value to their country.

So far in the project pupils have been encouraged to nurture their skills and talents in any possible way, be it in the form of art, drama or building models about water.

N A visiting professor's comments

Mike Savage: Comments on Durban School Visit, 8 August 1995

The visit was highly educational for myself. It was my first extended encounter with primary schools, the legacy of apartheid and with what appears to be a highly authoritative, unquestioning school culture that distances pupils and teachers from their own realities.

My comments are made on a basis of a single visit to an extended interaction between UDW and the school. I undoubtedly have an unformed and prejudiced viewpoint.

To my surprise, both visits appeared to be first experiences for both teachers and pupils. On the visit to the river, many children's comments were that this was the first time they had seen such "big" country. Though I feel it excellent for children's experience to be extended, in ways such visits continue to suggest that learning/schooling is distanced from children's realities. I hope that in other sections of the unit, pupils own realities and experience are drawn on.

Throughout the visit to both the waterworks and the river, I was struck by the spectator role of teachers. The Head was involved, observant and questioning. Perhaps the difference in behaviours may be due to insufficient involvement of teachers in planning and implementation. Understandably; my own interactions with staff were entirely restricted to the headteacher. I feel guilty since my behaviour likely reinforced an already authoritarian school structure.

Despite waterworks models during the awareness day at the school and a worksheet for pupils prepared by the headteacher, pupils' questioning during the visit was limited and tentative. I wonder whether there was a session before the visit for pupils to discuss the models and plant and to generate specific questions. Pupils' behaviour at the river was very different. Given an opportunity to explore reality, they were curious, excited and totally uninhibited about asking students, myself and the headteacher questions. Teachers were ignored and merely stood spectating on the river bank.

UBW students performed admirably during the river visit. They reinforced pupils' infectious enthusiasm and encouraged closer observation of specimens collected by having pupils use the identification booklet in an intelligent manner.

Overall my impression was that this was a wonderful learning experience for UBW students and the school children, but that it had little or no impact on the school culture. Ways must be developed to infect teachers with the same enthusiasm shown by the headmaster. A cynical footnote. Perhaps the behaviour of the headteacher was as much because he sensed personal advantages in involvement with the UDW project as because it reflected his educational beliefs. Students may be able to get a reading on this. I find the model of working through students to change the school culture fascinating and significant.

0 **Comments from a group of HDE students**

HDE SPECIAL METHOD (BIOLOGICAL SCIENCES)
STUDENT TEACHERS.

O U R E X P E R I E N C E S

A T
S C H O O L D

B Y :

Kovila Naicker : 9302718
Nirvashnie Sukdeo : 9256562
Kogi Govender : 9301099

~~It was a wonderful experience and we thoroughly enjoyed the~~
welcome, the activities and we were glad to be part of this
learning experience.

The science students should be commended on their creative and
effective presentation.

It was definitely a move away from the traditional approach
to teaching. We saw the activities that had been discussed in
the special methods class put into practice, eg. the puppetry
and music certainly drew the largest crowds. The children learnt
through activities that was also FUN.

Some of the activities that we found to be extremely interesting
were:

- Badges pinned onto clothing with messages was a wonderful
idea because badges are often associated with authority eg.
prefect badges.
- Paper making was simple, useful and the entire process was
easy to understand.
- The charts / posters were definitely eye catching and was
very effective as many were in Zulu as well. The students definitely
made an effort to overcome the language barriers.

We found that the school had no science laboratory and also
the library was not officially opened for use. We think that
this could certainly be the reason why the children were so
excited and enthusiastic with the entire display. More importantly
they were allowed to participate in the programme.

We think that an activity like this should definitely be part
of our final year programme, because we are able to put into
practice all that we learn and it is also practice for us as
future teachers.

It will most definitely help us deal with the problem of english
as a second language. We will be given practice in the role of
teachers being facilitators. We learn how to create an atmosphere
of social interaction with not only pupils but also
the other teachers. We saw that the entire process was process
orientated and we were fortunate enough to see it in action.

We are at a disadvantage in that because of our pure science
background we have not been given the opportunity to develop
as teachers. This would have been the perfect opportunity for
us to gain experience as teachers.