CHAPTER 3

GENERAL RESEARCH METHODS

Research design is defined as a framework that directs the researcher in the process of assembling, analysing and interpreting information. It proves that the information collected has been carried out in a manner as to reduce the subjectivity of the conclusions and is thus a true reflection of the research done (Nachmias and Nachmias, 1981).

This chapter looks at research methodology in general i.e. qualitative and quantitative in the context of a case study (section A). It then goes on to look at different measuring instruments such as questionnaires, interviews and observations (videos and matrixes) which were used in this research (section B). The literature has shown that environmental educational has shifted towards a participant centred approach to materials development and an action research orientation to research and evaluation. Thus due to the participatory nature (of the researcher) and the dual purpose of the activities used to measure the professional development of the participating teachers (the intervention and the research), the day-to-day activities of the intervention itself are described (section C.1).

3.A.   CHOICE OF RESEARCH METHODOLOGY

Information collected can either be analysed qualitatively or quantitatively. Qualitative research involves assessing the quality of things whereas quantitative research involves measuring quantities of things, more especially numerical quantities (Reaves, 1992). Merriam (1991) agreed with Reaves and indicated that qualitative researchers are predominantly concerned with process rather than outcomes or products. The emphasis in qualitative research is on processes and meaning. Another difference between qualitative and quantitative research is the notational system utilized to report the findings. Quantitative data are represented by figures, numbers and inferential statistics. Qualitative research tends to be presented like a story.

For this particular research project both methods of collecting the results were used. The qualitative approach was more suitable in describing the process of developing the school garden, formulating the booklet and observing the conducting of lessons using videos and the observation matrix. It was difficult to assign a numerical value to people's experiences and opinions. The quantitative approach was appropriate in this research where the participants were involved in pre- and post-test situations such as the completion of "Chacko's environmental literacy" questionnaire and "the knowledge of plants and the environment" questionnaire. There has been concern that it is difficult to measure development efforts,

particularly of the social dimension using the traditional tools (James *et al.*, 1983). The best method to overcome this is to use the interpretative approach (Marsden & Oakley 1999) which is a form of qualitative analysis.

Qualitative research defined by Mertens (1998) is "multimethod in focus, involving an interpretive, naturalistic approach to its subject matter. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them." This definition is similar to that of a case study by Stenhouse (1998).

The objective of a case study is to investigate the characteristics of a particular system of the community (Huysamen, 1994). Case studies are described by Stenhouse (1998) as "…naturalistic, qualitative, descriptive, responsive, interpretative" and the "…collection of data on site is termed fieldwork." The current research is an example of a case study and the methods used to conduct the "fieldwork" were guided workshops, developing a booklet and a school garden. This fieldwork was done at the Siyabuswa Educational Development Trust Centre (SEIDET) and the relevant schools. This methodology was adopted in order to understand what was happening out in the field.

3.B.   RESEARCH METHODS TO ADDRESS ENVIRONMENTAL LITERACY AND BOTANICAL SKILLS, ATTITUDES AND KNOWLEDGE

Certain measuring instruments such as questionnaires, interviews and observations (using videos and matrixes) were used in this research.

3.B.1.   QUESTIONNAIRES

In many studies in environmental education, for example, Bogner & Wiseman (1997), Ryan (1991), and Thompson & Gasteiger (1985), questionnaires were used to investigate environmental awareness, knowledge, attitude, concern, behaviour, etc of the respondents. A questionnaire is one of the most commonly used methods of obtaining information that cannot be obtained personally from a wide range of sources. According to Sax (1979) by asking questions, responses can be obtained about the knowledge, values, preferences, interests, attitudes, opinions, judgement, behaviours, etc. of the respondents. A questionnaire may possibly be regarded as a reliable instrument for collecting data for this study.

It is often difficult to assess the sincerity of a verbal commitment by using a questionnaire. It has been shown by Hines et al. (1986-87) that what people indicate on a questionnaire is often inconsistent with their actual behaviour. Actual commitment infers behaviour in which

the individual is currently engaged. It must be noted that what people say their attitudes are and what their attitudes really are may not be the same. Responses to the questionnaire used may reflect an individual's perception of how he or she should respond rather than his actual personal commitment. The question arises whether it is possible to assess, for example, the attitude of respondents that they may not otherwise divulge. There may be variations in the extent to which people, even if they wish to be truthful, can give accurate responses to statements about themselves. With regard to environmental behaviour, many human beings hold two positions, the one they talk about and the one they act on. Therefore, higher scores in "verbal" than in "actual" commitment would reflect the general expectation. Verbal commitment may normally be somewhat preferable for individuals to the actual commitment levels of engagement. In terms of social desirability, probable behaviour in the future is more likely to be expressed in terms of what one "ought" to say than are descriptions of one's true behaviour. One would normally expect that we are verbally much more in favour of environmentally oriented behaviour than in our actual reported behaviour (Bogner & Wiseman, 1997). According to Leeming et al. (1993), it is not always easy to collect follow up data to determine whether the reported behaviour persisted over a period or not. In this study the verbal commitment of the respondents is seen as an intention to act.

In spite of these disadvantages, the questionnaire remains an invaluable aid in many research projects as it did in the present research project. There is no doubt that the questionnaire plays a vital role in research and overcomes many difficulties in those cases where contact cannot be made between the researcher and respondents from a wider geographic area.

3.B.1.a. VALIDITY OF A QUESTIONNAIRE

In general terms, validity refers to the extent to which a test measures what it is intended to measure as defined by Mulder (1996:215). Chacko (2000) developed and validated a questionnaire. It was validated for a rural population in Mpumalanga similar to the population of teachers which participated in the "Gardening with Flora" project. The validation performed by Chacko is described in Appendix C.1, Table C.1.1

3.B.1.b. RELIABILITY OF A QUESTIONNAIRE

According to Leedy (1990:28) "reliability" means "consistency" while Reaves (1992:8) says it means "repeatability or consistency". Perhaps the best way to look at reliability is the extent to which the measurements resulting from a test are the result of characteristics of those being measured. A questionnaire is considered to be reliable if the reliability coefficient is 0,8 or higher. The nearer to 1, the higher the reliability. Again Chacko's questionnaire which was

used in this instance had been tested for reliability. As shown in Appendix C.1, Table C.1.2 the reliability coefficient for the questionnaire as a whole was 0,945.

Questionnaires alone have shortcomings. However, Leeming et al. (1993) reported that many researchers used only Likert-type questionnaires to assess environmental knowledge, attitude, behaviour, etc. Another form of assessment such as the development of a school garden was also used to assess environmental literacy as awareness and solving of environmental issues are skills indicative of environmental literacy.

3.B.2. INTERVIEWS

Interviews are an ideal tool for gathering information for qualitative research (Krathwohl, 1998). Qualitative interviews usually "…refer to in-depth, semi-structured" types of interviews that "are characterized by a relatively informal style". The interview questions were centred on topics relating to the research (Mason, 1996:38).

In the current research the semi-structured interview method, where structured questions were interspersed with unstructured conversations and variations on the prepared questions, was used. These questions were used to initiate discussion on the topic and where necessary the researcher was be able to clarify information as the conversation unfolded.

While the advantages of the interview method are many, there are certain limitations. These include a high demand on time, energy and money and problems of quantification of qualitative data obtained. Another problem that might occur using interviews and not questionnaires is that although interviews allow for greater depth than is the case with other methods of data collection, they can be prone to subjectivity and bias on the part of the interviewer.

Interviews are verbal reports that are subject to common problems of bias, poor or inaccurate recall and poor or inaccurate articulation. All opportunities need to be taken to reduce bias and increase reliability.

3.B.3. ADDITIONAL METHODS

Observations and videos were also used in the present study in addition to questionnaires and interviews.

3.B.4.   TRIANGULATION

In reviewing each of the questions raised in Chapter 1 different combination of all the above instruments were used. The main advantage of using multiple methods is that it allows for triangulation. Triangulation is essential in the analysis of information where the reliability is often a concern. It gives the opportunity to compare the sources and if they correspond, they cross validate each other and if they disagree, the reason therefore must be explored as it may explain certain things in the investigation (Robson, 1993: 383). Patton (1990:470) sees triangulation as "…a process by which the researcher can guard against the accusation that a study's findings are simply an artefact of a single method, a single source or a single investigator's bias."

3.C.   METHODS MEASURING THE PROFESSIONAL DEVELOPMENT OF TEACHERS

In reviewing the literature on effective professional development, the following framework was found. This framework, proposed by Haney and Lumpe (1995), included three primary components: planning, training, and follow-up:

- In the Planning Phase, training should be planned to be concrete, teacher specific, and extended over a long period of time (Valencia and Killion, 1990). Also in the Planning Phase, teachers' beliefs should be identified and addressed (Haney et al. 1996). Positive teacher beliefs and attitudes toward science teaching provide a strong foundation for the reform process. However, these beliefs must be maintained and nurtured during classroom implementation through the use of support structures. By learning about the images of science that teachers bring to professional development activities, those experiences can be shaped to meet their needs.

- In the Training Phase, teachers need opportunities to engage in hands-on learning experiences, preliminary activities, observe successes of others, and reflect upon their progress (Valencia and Killion, 1990 and Etchberger and Shaw, 1992).

- Finally, the Follow-up Phase should include classroom assistance from teacher leaders, evaluative feedback, and revisions of the programme (Valencia and Killion, 1990 and Glickman et al. 1992).

This Haney-Lumpe framework was a model for the present research. Both aspects of the development and implementation of the project and the analysis of the results obtained in different tests carried out during the project were accommodated for in this framework. To achieve the stated objectives of this research using the Haney-Lumpe framework a time-line of activities was designed.

3.C.1. TIME-LINE FOR THE MAIN STUDY

This time-line outlines the methodology of the research and the actual activities that were carried out during the duration of the project, performed from 14th April 2000 until the 1st June 2001.

PLANNING PHASE

14/4

- Give participants time to complete environment literacy questionnaire **(APPENDIX C)** (1hour)
- Divide participants into groups according to the grades they teach
- Ask them to record in a diagram what they feel needs to be covered with respect to plants at the grade they are teaching (30 minutes)
- Flesh out Syllabus Grade Sheet (30 minutes). Alter their diagrams afterwards
- Discuss the structure of schooling phases and learning programmes
- Discuss the learning programmes for the different phases
- Discuss the Specific outcomes for all the eight learning areas
- Look at the sheets for the botanical aspects for each grade to identify actual plant material to be used and how? (45 minutes) - homework
- Ask them to plan how they would go about developing their school garden (not done) - homework
- Write letter for sponsorship - homework
- Get buy-in from headmaster, staff and pupils – homework
- Develop a lesson plan (learning programme) on plants for your particular grade – homework (none actually handed in at next session)

TRAINING PHASE

14/4 – 12/5 teachers need to actually carry out the planning of their school garden i.e.

- Get permission
- Appeal for funding
- Map out garden
- Take photos
- Look at the sheets for the botanical aspects for each grade to identify actual plant material to be used and how it will be used and what is needed for it to be used
- List requirements
- Work out costing
- Check water availability
- Tools
- Prepare lesson for specific grade using plants.

FOLLOW-UP PHASE

12/5

- Go over buy-in and try to sort out problems (30 minutes)
- Discuss and take in letter of sponsorship (15 minutes)
- Discuss and take in map of garden and photos (30 minutes)
- Discuss and take in the sheets that identify actual plant material used, the methodology used with the plants and what is needed to use these plants (45 minutes)
- Discuss each lesson plan presented – actual material used? (not actually handed in)
- Look again at learning phases (15 minutes)
- Again link learning phases to learning programmes (15 minutes)
- Link learning phases and learning programmes to grades
- Discuss the development of school-based learning programmes (45 minutes)
- Go over the critical outcomes again (15 minutes)
- Go over the specific outcomes again (30 minutes)
- Again discuss the level statements in each group (30 minutes)
- Develop a school-based learning programme using a specific topic e.g. "SEASONS" – the effects on plants for grade 2 (45 minutes)
- Discuss record keeping for assessment i.e. the specific outcomes that should be achieved in each activity (15 minutes)
- Choose a specific topic with a specific activity for your grade and develop a school-based learning programme according to C2005 (60 minutes)
- Give your interpretation of the specific outcomes

- Curriculum 2005 modified at this point and most of the stages used in developing a school-based learning programme have been abandoned except for the Critical Outcomes.

- Choose a specific topic with a specific activity for your grade and develop a school-based learning programme (60 minutes)
- Hand out sheet on "how to plan an activity" and discuss that the earlier conventional way of doing lesson plans was still very relevant today.

TRAINING PHASE

12/5 – 2/6 Researcher to visit each school. Participants start preparation of garden for what they are still going to teach this year and actually plant with the pupils

- Decide what is the most important plant for your grade to be planted in your school ground

- Revisit your school garden map and redraw it
- Develop another school-based learning programme using a specific topic for your grade (with the other members of your school staff). List the problems and the successes (NOT DONE).

PLANNING PHASE

2/6

- Take in plan of school garden and check labels for photos to use as examples of before intervention (30 minutes)
- "Design a Plant" **(APPENDIX I)** – need: glue, sheet of paper, monocotyledon and dicotyledon plants (60 minutes)
- Go over one of their learning programmes done for homework for the 2/6 (15 minutes) NOT DONE
- Hand out and go over critical outcomes sheet (15 minutes)

On the 1/6/2000 it was announced by the Minister of Education, Kader Asmal, that the implementation of Curriculum 2005 was to be revisited and that specifically the format of learning programmes was to be changed. This led the researcher to refrain from asking the teachers to produce further learning programmes in the existing format. She was not too surprised that the authorities had decided to review this particular aspect as she had had first hand knowledge of the difficulties that the teachers were experiencing with the formulation of these programmes. As an exercise she had asked the participants to explain in writing their understanding of the specific outcomes of the Natural Science Learning area and found that the teachers could not explain them, as they did not understand the English. None of the teachers have English as their home language and the specific outcomes were certainly not expressed in basic, plain English (see results on Specific Outcomes).

TRAINING PHASE

Give gardening skills questionnaire **(APPENDIX G)** – one section at a time

- Actually prepare a garden bed
- Record on the back of the sheet how it was actually done (30 minutes)

- Actually water the prepared bed
- Record on the back of the sheet how it was actually done (15 minutes)

- Actually sow seeds in seed trays and give them extra to plant for homework at school
- Record on the back of the sheet how it was actually done (30 minutes)

- Actually water the sown seeds

- Record on the back of the sheet how it was actually done (15 minutes)

- Actually sow seeds in situ and give them extra to plant for homework at school
- Record on the back of the sheet how it was actually done (30 minutes)

- Actually water the sown seeds in situ
- Record on the back of the sheet how it was actually done (15 minutes)

- Actually sow seedlings in soil and give them extra to plant for homework at school
- Record on the back of the sheet how it was actually done (30 minutes)

- Actually water the planted seedlings
- Record on the back of the sheet how it was actually done (15 minutes)

- Hand participants a Mulbry booklet to use as reference when developing their garden at school. The Mulbry project is an initiative started by the South African Nursery Association to encourage children to garden.

2/6 – 21/7 With your class:
- make tools (see Mulbry's newsletter)
- prepare an area at school in which you can grow things during the year
- plant your seeds into seed trays
- show your pupils how to water in a water-wise way
- plant you seeds directly into the ground
- plant your seedlings into the ground.

For each of the above activities write a report mentioning:
- date you did the activity
- who was involved
- the participants attitude to the activity
- how long it took
- problems that you had
- any other points of interest.

Start to prepare your garden listing every step you take and the time spent on each step (this activity was only handed in by Betty and Mandla from Buhlebuzile School)

Do a plan of your own garden at home
List the names of the plants that you have in your own garden

Ask your pupils whether they have a garden at home – make a list with names and yes/no

21/7

Give knowledge on plants and the environment test **(APPENDIX D)** (30 minutes)

Give attitude to plants and the environment test (20 minutes)

Give skills related to plants and the environment test (15 minutes)

FOLLOW-UP PHASE

Go over all the work which was to be done for homework.

TRAINING PHASE

Next give the gardening skills questionnaire – one section at a time

Actually plant a groundcover (VERBENA) and give an extra one to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the planted groundcover. Record on the back of the sheet how it was actually done (15 minutes)

Hand out notes on how to make new plants from old ones and show participants how to make a cutting of VERBENA

Actually plant a perennial (DIETES and AGAPANTHUS) and give an extra one to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the planted perennial. Record on the back of the sheet how it was actually done (15 minutes)

Write thank-you letter to Mayford (a South African based seed producer) for generous donation of "Meadow Mix" perennial seed mixture

Show them how to split a perennial

Give notes on bulbs

Actually plant a bulb and give an extra one to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the planted bulb. Record on the back of the sheet how it was actually done (15 minutes)

Write thank-you letter to Hadeco (a local bulb producer) for generous donation of bulbs

Actually plant a shrub (VIBURNUM and DAISY BUSH) and give an extra one to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the planted shrub. Record on the back of the sheet how it was actually done (15 minutes)

Show them how to make a cutting of a DAISY BUSH

Actually plant a tree and give extra to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the planted tree. Record on the back of the sheet how it was actually done (15 minutes)

Write thank-you letter to Gardena (a producer of irrigation equipment) for generous donation of hose pipe fittings

Actually plant lawn and give extra lawn to plant for homework at school. Record on the back of the sheet how it was actually done (30 minutes)

Actually water the lawn. Record on the back of the sheet how it was actually done (15 minutes)

Write thank-you letter to S.A. Gardening (a publisher of Horticultural magazines) for generous donation of their magazines
Write thank-you letter to "The Smallholder" (a community magazine) for generous donation of their magazines

21/7 – 18/8 Prepare and plant the given plants in their school garden and maintain them
With your class:
- continue preparing an area at school in which you can grow things during the year
- plant your groundcover, perennials, bulbs, shrubs and "Meadow mix" at school
- show your pupils how to water in a water-wise way
- if you need to plant lawn at school get the area ready and start to plant – check first that you have water.

For each of the above activities write a report mentioning:
- date you did the activity

- who was involved
- the participants attitude to the activity
- how long it took
- problems that you had
- any other points of interest

Write up two lesson plans on the topics given to you in class, to be included in the book (remember that you are going to need to show evidence of using plants in your teaching)

Do for homework what is required

18/8

Go over the reasons C2005 has been modified (distribute "The Star" newspaper article – stress that outcomes-based teaching is still the way to go)

Take in homework. Spend a lot of time here going over what the teachers presented –is it what they actually do or what they would like to do in the classroom?

Take individual photos and names for the booklet

Show article from "The Hardware Retailer" (an advertising brochure) where the Siyabuswa Hardware (a local hardware shop) has a write-up. This business could be a source of possible sponsorship or perhaps one of their staff could come to talk to the group to try to resolve their problems such as no fence, no tools etc. This business enterprise is committed to community upliftment.

Research the book by brainstorming the topic "plants". Produce a mind map of what should be included in the book. Start to hone in on what content should be included along with the relevant activities.

Hand out syllabus sheets for grade 1 – 7
- Initial plan of school premises – design your own school garden
- Investigate water including the building of a pond - write thank-you letter to Graemark (a distributor of plastic) for generous donation of plastic sheeting
- Investigate soil and mulches
- Investigate fertilizers – write thank-you letter to Bayer (a chemical company) for generous donation of fertilizers
- Tools needed to develop a garden. Take photos of improvised tools such as: watering equipment, digging equipment, raking equipment, tool carrier and plant protector
- Skills needed to develop a garden – prepare a bed

- Touch on herbs. What is a herb? – need to redo in more detail – bringing in traditional healing
- Investigate vegetative reproduction by actually making daisy bush (herbaceous) cuttings – still hand out sheet on "new plants from old"
- Illustrate how to prune a rose

18/8 – 8/9

Plant herb in school garden

Actually produce a pond and plant around it.

For homework:

- write a page on how you have gone about developing the booklet
- research an activity on each of the following topics: water, soil, seeds

8/9

Collate the different activities into the following topics:

- map and problems – Patricia, Marcus and Tsepho
- water – Mavis, Betty and Frank
- soil – Bobo, Clara, Florence and Sam
- fertilizers – Anna, Queen and Althathea
- pesticides
- tools - Thoko
- vegetative reproduction – Grace and Emily
- seeds - Moela and Alfred
- perennials (ground covers) - vegetative reproduction – Grace and Emily
- seeds, germination, fruits, dispersal - Moela and Alfred
- seedlings – roots, stems, leaves, flowers, pollination
- fungi
- algae
- moss
- ferns
- gymnosperms

Choose the best activities and set them out as if on a page of the book

Brainstorm what should be included at each grade by using flipcharts from Chart Studio (an advertising agency) produced by D. Goodwin. Use all resource material provided to give ideas for book

8/9 - 21/9

- prepare and plant more plants in the garden and maintain it
- continue teaching using plants
- prepare lesson to give in front of all the other teachers illustrating your ability to teach in an outcomes based fashion using plant material got from school garden

21/9

Video five actual candidates teaching in an outcomes-based fashion

Let teachers who are observing the lesson critique it according to Form 1 and Form 2 **(APPENDIX K)**

Give each teacher the sheet of definitions and go over them

Give each teacher the sheet on "how to plan an activity"

Give each teacher the sheet showing the inter-relationships between attitudes, awareness, manual and thinking skills, knowledge and understanding and the environmental implications

Give each teacher the sheet defining primary science process skills

21/9 - 15/11

- prepare and plant more plants in their school garden and maintain it
- continue teaching using plant material obtained from the school garden
- continue compiling book

15/11

Give participants time to complete environment literacy questionnaire **(APPENDIX C)** (1hour)

Give knowledge on plants and the environment test **(APPENDIX D)** (30 minutes)

Give skills related to plants and the environment test with an extra question - (6) - "What skills do you feel you need in order to develop a school garden?" (15 minutes)

The pre-test "attitude to plants and the environment" was not given as a post-test but rather each teacher was asked to evaluate the course and hand in on the 18/11/2000

Hand out sheet on "Pesky pests"

Hand out "Alien Buster" package and discuss weeds

Hand out to all teachers a questionnaire for their:

- heads **(APPENDIX L)**
- peer teachers **(APPENDIX M)**
- students **(APPENDIX N)**
- own evaluation of their school garden
- own evaluation of usage of the booklet "Gardening with Flora"
- visit all school gardens for post photos

18/11 – 19/11

End of year get-together at Segwati Ranch

Graduation ceremony held on Saturday evening with Professor John Rogan as Guest of Honour. He handed out:

- Certificates of participation to successful candidates
- Chart Studio series of 17 Botany Charts
- Booklet, **"Gardening with Flora"** which is the compilation of all the year's activities that the teachers undertook.

FOLLOW-UP PHASE

1/6/2001

This was to be viewed as a feedback session. The participants were told that they would be videoed, recorded and filmed. They were given a short questionnaire to complete regarding the present state of their school garden. These were then verbalized and a great deal of discussion arose.

Another short response questionnaire was given out which dealt with the participants' use of the booklet and the project in general.

It was felt that the booklet could cover more with regards to "water" and that it should include a chapter on "air" and "pollution".

The participants were then asked who would like to have the researcher view their school grounds and 4 volunteered, which was an ideal number for the time allocated to this task (Appendix F - photos).

3.C.2. RESEARCH QUESTIONS

Using the Haney and Lumpe framework, in the **PLANNING PHASE** the base-line information of the participants and their school gardens was gathered from the preliminary study, the "Design a Plant" activity, photos of the school gardens taken at the beginning of the main study and the pre-tests. The training to be provided was planned and was to be concrete, teacher specific, and extend over a long period of time (see Question 1, Question 2 and Hypothesis 1 and 2 and Question 4 and Hypothesis 3). Also in the Planning Phase, teachers' beliefs were identified (see Question 3). It was also in this phase that the research strategy was planned.

Question 1: Can a school garden be improved aesthetically by attending botany workshops in which the necessary skills are learnt?

In a series of studies, (Hines et al., 1986/1987). Ramsey (1993) and Klinger (1980) found that treatments employing both knowledge and cognitive skill components significantly increased in "numbers of actions" as opposed to those with only knowledge component. They concluded that skill in the application of action strategies to issues combined with appropriate knowledge endowed individuals with the ability to take action. It was my intention to see whether this research would corroborate these findings. The development of the school garden was used to assess whether planting skills had been achieved. The differences in the state of the gardens before and then after the intervention and the reasons for these differences were used for the research.

The competencies required in environmental education include being able to initiate a project to enhance the quality of life and exhibit the necessary skills to identify, investigate and contribute to the solving of environmental problems (Robottom & Hart, 1993). Botanical knowledge is necessary to enable the participants to understand plant requirements so that energy put into initiating this particular project will not be in vain and the project will be sustainable. In the project reported here the participants were required to actually develop a garden in order to develop these skills. The assessment of achieving the skills was measured by the degree to which the participants actually developed their garden.

The school garden is thus seen as fulfilling two roles:
- as a vehicle for engagement and context for learning (its progress contributed to the development of the participants)
- as an assessment tool (its reliability was backed up by interviews and written response questionnaires)

Question 2: Can the participants' professional development, specifically with respect to botany teaching, be improved with the production of a booklet on how and what to plant in a school garden?

This question gave rise to hypothesis 1 and 2:

Hypothesis 1: The participating teachers have improved their plant knowledge.

"Knowledge on plants and the environment" test (see Appendix D) was used to assess plant knowledge qualitatively. This test consisted of 36 questions all of which covered basic botanical knowledge that the teachers should have been using in their teaching. The test also included basic questions about plants and the environment. When scrutinized for "content" the topics covered in the test matched the botany syllabus that the participating teachers were supposed to be teaching i.e. the questions revolved around the syllabus content thus the test could be regarded as being valid for content.

Looking at the individual question differences between the pre- and post-test scores in the "plant and environmental knowledge" questionnaire a huge problem arose here in that the group number was often reduced, as not all of the participants answered every question in the pre- and post-tests. The group was small to start with and this factor reduced it even more, sometimes to the extent that the statistics were no longer meaningful. However because the test has items that are scored with just zero or one, the Kuder-Richardson formula 21 was used to test for internal consistency. Internal consistency focuses on the degree to which the individual items are correlated with each other and is thus often called homogeneity. Requiring only the test mean, standard deviation (or variance) and the number of items, the Kuder-Richardson formula 21 is a simple reliability formula which is useful for evaluating some classroom-developed tests. This test given to the participating teachers could be looked at as such a test and as such does not need to have an exceptionally high reliability coefficient. As more students master the content, the test variability will go down and the coefficient for internal reliability will go up. In this instant a reliability coefficient of 0.50 or 0.60 may suffice.

TABLE 3.1. **RELIABILITY OF "PLANT AND ENVIRONMENTAL KNOWLEDGE" QUESTIONNAIRE**

OBS	BTOT = X	X=X-mean	x^2	ATOT = Y	y=Y-mean	y^2
1	53	-0.5	0.25	60	-2.9	8.58
2	57	3.5	12.25	70	7.1	50.01
3	60	6.5	42.25	59	-3.9	15.43
4	52	-1.5	2.25	55	-7.9	62.86
5	61	7.5	56.25	63	0.1	0.01
6	47	-6.5	42.25	71	8.1	65.15
7	52	-1.5	2.25	66	3.1	9.43
8	64	10.5	110.25	65	2.1	4.29
9	59	5.5	30.25	77	14.1	198.01
10	45	-8.5	72.25	50	-12.9	167.15
11	49	-4.5	20.25	59	-3.9	15.43
12	48	-5.5	30.25	60	-2.9	8.58
13	44	-9.5	90.25	57	-5.9	35.15
14	58	4.5	20.25	69	6.1	36.86
	749		**531.5**	881		**676.93**
Mean	53.5			62.9		
Variance	36.96					47.35

X = total score for pre-test

Y = total score for post-test

BTOT = pre-test total scores for each participant

ATOT = post-test total scores for each participant

On the actual test there were 99 items

The Kuder-Richardson formula 21 for the pre-test was 0.33 and for the post-test 0.53. It appears that the participants guessed many of the answers in the pre-test hence the low reliability whereas in the post-test, the answers showed more understanding hence an increase in reliability.

The "Design a plant" activity was also used to assess plant knowledge qualitatively (hypothesis 1). This tested the participant's plant knowledge directly, in particular:

- the parts of a plant
- the reproductive mechanism of the plant
- the different types of plants i.e. monocotyledon or dicotyledon

Hypothesis 2: The participating teachers are using outcomes-based teaching methods due to their involvement in developing the "Gardening with Flora" booklet and their own school garden.

The "Science Observation Matrix" (Appendix K) and videos were used to account as accurately as possible exactly what happened in the classroom (21/9) after the intervention had occurred. As the new educational policy (Centre for Education Policy Development, 2000) stipulated that teachers should be able to devise their own teaching resources this project, it was hoped, would enable the participants to learn how to produce a resource about flowering plants that they could use in their teaching.

The production of the booklet would highlight all the aspects needed to develop the school garden. The completed booklet would show how these and other activities could be used to teach a specific aspect from the curriculum for a particular grade. Its development was used to assess qualitatively whether the participants were using outcomes-based methods.

Question 4: Can knowledge, skills and attitudes towards the environment be changed with active engagement in these dimensions through (i) the production of a booklet on what to plant in a school garden and (ii) the actual development a school garden?

This question gave rise to hypothesis 3:

Hypothesis 3: The participating teachers have become more environmentally literate due to their active involvement in developing the "Gardening with Flora" booklet and their own school garden.

To investigate question 4 and hypothesis 3 Chacko's (2001) "Environmental literacy" questionnaire (see Appendix C) was used. It assessed environmental literacy quantitatively. This questionnaire consisted of environmental concepts and for each concept there were items to test awareness, knowledge, attitude and participation in environmental issues. Chacko developed this environmental literacy questionnaire to be used as a standardized test for environmental literacy for rural areas in South Africa.

The questionnaire was considered to be a valid and reliable instrument to measure environmental literacy of teachers. Chacko had the content validation verified before the questionnaire was presented to the teachers in his study by submitting it to eight specialists in environmental education, ecology and sustainable development (see Appendix C.1, Table C.1.1).

Although the group in the present research was small, the results can be compared to Chacko's results as his sample was taken from the same geographical area in which the present group of teachers live and work. The environmental literacy questionnaire assessed direct *self-reported* performance of *behaviour* and *intention* to engage in a given behaviour rather than *actual behaviour* by teachers.

Question 3: Can the attitude towards plants and the environment be changed with the production of a booklet on what to plant in a school garden and the actual development a school garden?

The attitude questionnaire (see Table 5.12) was used to assess attitudes to plants qualitatively. A competency required in environmental education is the ability to cultivate positive values and attitudes about aspects of the environment, and plants are seen as one such aspect.

The training in the **TRAINING PHASE** was to be concrete, teacher specific, and extend over a long period of time. The teachers needed opportunities to engage in hands-on learning experiences and both the development of the booklet and the school garden provided these (see the Time-line pages 53 - 63).

Finally, in the **FOLLOW-UP PHASE**, evaluative feedback and revisions to the programme were made from input gleaned from the questionnaires given to peer teachers, students and heads of participating schools, Chacko's Environmental Literacy questionnaire, the

Knowledge of Plants and the Environment questionnaire and the development of the booklet and the state of school gardens.

3.D. EVALUATION AND ASSESSMENT FOR ENVIRONMENTAL EDUCATION PROGRAMMES

Stake (1977) ascribes most problems of evaluation failure in curriculum development projects to poor funding and management, but also alludes to serious conceptual and communication problems. Stenhouse (1975) had, however, previously revealed that underlying flaws in the entire curriculum development and evaluation enterprise might be at the root of these problems. He concluded that evaluation should, as it were, lead development and be integrated with it. Then the conceptual distinction between development and evaluation is destroyed and the two merge as research. His idea of "research-based teaching" (p. 141) as critical curriculum development suggests that innovation should be viewed as reflective processes of re-constructive action (action research). If diverse intuitive, reflective and discursive critical processes (evaluation) have a central and integrated role in curriculum change, evaluation cannot simply be treated as external and rational processes to establish the value and effectiveness of a curriculum project. Evaluation thus came to be seen as reflective critical processes that give both meaning and direction to re-constructive action. This aspect is fundamental to this research and the reason why this project was of an evolving nature.

Environmental educational has shifted towards a participant centred approach to materials development and an action research orientation to research and evaluation (Lotz, 1995). This approach is evident in the present research in the development of the booklet and the evolving design of the intervention.

Lotz & Janse van Rensberg (1995) describe the various approaches to evaluation in environmental education:

- early approaches evaluated only specific products or outcomes of the programme (i.e. numbers or behaviours).They were usually conducted by experts.
- a later trend was for those who ran the environmental education courses to do their own evaluation perhaps in conjunction with an outside expert and to evaluate both the products and processes. This is the approach used in the present research.
- a third approach emerged from the critical social perspectives of environmental education. It makes no distinction between environmental education and evaluation, because it treats environmental education itself as a critical reflective process. This would have been the approach of choice for the current research, but this was not possible and because of distance and time constraints very little time could be spent in the schools observing the actual planting. This approach can be utilized when the

intervention is used in future where the facilitator is perhaps more involved at the schools observing each planting activity in order to record the time at which the action is carried out correctly and then effect the necessary changes in the intervention to accommodate this progress.

The implication for research is that environmental education becomes its own instrument of ongoing evaluation and development with students and teachers participating in directing their own learning. If continuous assessment is driven by the participants, then the evaluation becomes self-reflective, self-critical and empowering (Lotz & Janse van Rensberg, 1995). Evaluation should, as it were, lead development and be integrated with it. Then the conceptual distinction between development and evaluation is destroyed and the two merge as research (Stenhouse, 1975).

Continuous programme assessment is required that captures the perspective of all those involved, uses a variety of formal and informal strategies, focuses on the process and effects of the programme and feeds directly into programme improvement and evaluation

3.E.   SUMMATION

It was desired that the approach to environmental education followed in the current project approximate the situation where learning and teaching was an interpretive, reflective process. In other words the participants would continuously assess their practice as advocated by Stenhouse (1975), Lotz & Janse van Rensberg (1995) and Glover & Thomas (1999). Fullan's (1991) work provides a useful general framework for both understanding and affecting change. He stresses that "*change is a process, not an event".* This current research which was carried out over a period of time, researches the changes that the participants' undergo while an intervention is in progress. The monitoring of the participants' knowledge of plants before and after the intervention relied on pre- and post-test situations. The process of developing the school garden, formulating the booklet and observing the conducting of lessons, used guided workshops, questionnaires, photographs, videos and the observation matrix to obtain these results. This research does not illustrate the exact time the competency occurred but rather whether the competency was either evident or not at the end of the project. The value of the programme was measured by the feedback obtained from peer teachers, heads of schools, parents of participating learners and learners themselves in interviews and questionnaires.

The research methodology employs triangulation to substantiate results. For example a pre-test, "knowledge on plants" test and the "design a plant" activity was give to ascertain the participants plant knowledge initially. The method used to develop the school garden was planned after researching the literature which reviewed other gardening programmes such as the "Real" project, the "Growing" project, the "Lasers" project and the "Habitats and their

conservation" programme. Taking photographs at the different stages, as well as having the participants report on the actual hands-on planting of the material with their students undertook recording the process of developing the school garden.

The formulation of the booklet was deliberately and carefully planned e.g. the participants were asked to research the booklet by brainstorming the topic "plants", produce a mind map of what should be included as well as relevant activities and write a page on how they have gone about developing the booklet.

After the intervention some participants were videoed presenting lessons. This was done to assess their ability to teach in an outcomes-based fashion using plant material from the school garden. Hand in hand with the video went the observation matrices where the participants who where not presenting observed the lessons and critiqued them by using the "Science Observation Matrix".

In Chapter 4 the methods used in the preliminary study and the results and conclusions obtained are outlined and discussed.

CHAPTER 4

METHODS AND RESULTS OF THE PRELIMINARY STUDY

This chapter reports the knowledge, skills and attitudes regarding plants and the environment a specific group of teachers in South Africa possessed as investigated in a preliminary study. This preliminary study was conducted with 25 practicing foundation and intermediate phase teachers from Siyabuswa with the purpose of establishing the foundation for the intervention that would form the main part of this research. Grades 1 to 7 were represented in the group. The participants in the main study were drawn mainly from these participants. These results provide a reference level or baseline as a snapshot of the participants prior to the major part of the development intervention. The insight gained from these results assisted in the design of the main intervention, as well as contributing to the research questions

4.A. METHODOLOGY

The preliminary study consisted of an analysis of responses obtained from the participating teachers at a seven-hour biology workshop which 25 teachers from 17 different schools in Siyabuswa attended. These teachers had already been involved in a guided process of developing three small pamphlets of single experiments for elementary electricity, magnetism and chemistry and were enthusiastic about being given the chance to tackle something bigger. This biological workshop was conducted at the Siyabuswa SEIDET centre on the sixteenth of September 1999 to judge the teachers' level of professional development. The workshop contained three major clusters of activity:

i. A discussion of what characteristics a teacher who could achieve good class control needed

ii. A series of questions and activities designed as 11 worksheets which would give a clear picture of:

The participants' level of environmental literacy and understanding of the environment, environmental education and plants and be used to design the intervention of the main study

iii. The status quo of school gardens to see whether they needed improving and whether their products were being used in teaching.

i. Characteristics of a teacher with good classroom control

At the start of the workshop the article "Establishing A Network For Environmental Education – the Twelve Principles of Class Control (plus One) by Al Janulaw in "California Classroom

Science" - March 1999 (Appendix E), was read to the group. It was then discussed in the light of "what characteristics a teacher needed for good class control".

Janulaw (1999) found that if the curriculum is relevant and engages the pupils in activities that involve them in decision-making about and active participation in, the learning process then the need for discipline falls away because they enjoy the learning process. Question everything you do. If students do not see the relevance of the curriculum, maybe it is not relevant. Let the students teach you. Learn what motivates them by watching and listening. Then plan content-rich units that are in a style that works. Students who are given curricular opportunities that they consider interesting or, in their words, "fun" will provide the energy of twenty or thirty people pulling in the same direction. A powerful force indeed! This being the case the need for "class control" will disappear. Janulaw's thirteen characteristics are indicative of professional development which relates to Question 2 in the main study.

ii.   Environmental understanding of the group

In order to determine the group's botanical knowledge and understanding of the environment and related issues the participants were required to complete 11 activity sheets (see Appendix A - Question 4.1 – 4.11). This study reports on answers to the questions which were asked of the participants and the results would be used to design the intervention of the main study.

Questions 4.1-4.3 are precursors to Question 4 of the main research (what is the understanding of "environmental education" i.e. the environmental literacy level of the participants?):
• Brainstorm the environmental issues in your area. (Question 4.1 - Sheet 1)
• What do you understand by the phrase "environmental issues"? (Question 4.2A - Sheet 2A)
• What experience have you had in solving a local community environmental problem? (Question 4.2B - Sheet 2B)
• How is your school encouraging environmental education? (Question 4.3 - Sheet 3)

Question 4.4, 4.5 and 4.6 are linked to Question 1 of the main study:
• Draw a map of your own school grounds (Question 4.4 – Sheet 4)
• List the areas you feel should be included in your ideal school garden (Question 4.5 – Sheet 5)
• Taking the SEIDET centre garden as an example, brainstorm how you would improve it (Question 4.6 - Sheet 6)

Question 4.7 – 4.9 relate to Question 2 of the main study i.e. the participants' professional growth:

Are your school grounds being used as a learning resource? (Question 4.7 – Sheet 7)

- Brainstorm what you think students in your particular learning phase should know about plants (Question 4.8 - Sheet 8)

- What knowledge do you want your students to have regarding plants? (Question 4.9 – Sheet 9)

Question 4.10 relates to Question 1 of the main study:

- What skills do you want your students to have regarding plants? (Question 4.10 – Sheet 10)

Question 4.11 relates to Hypothesis 1 and Question 3 of the main study:

- What attitudes do you want your students to have regarding plants? (Question 4.11 – Sheet 11)

At the end of the day the teachers were asked if they would like to participate in the main study the following year.

4.B. ACTUAL PRELIMINARY WORKSHEETS WITH OBSERVATIONS AND RESULTS

What came out of discussing Janulaw's article (Appendix E)? The participants expressed the view that the curriculum must be relevant to the students. The environment that everyone lives in is relevant to him or her and perhaps we can use this as our starting point for all teaching which students will then consider interesting or "fun".

The teachers were then asked to brainstorm the environmental issues in their area and try to identify the root causes (Question 4.1 - Sheet 1). Questions 4.1-4.3 are precursors to Question 4 of the main research (what is the understanding of "environmental education" i.e. the environmental literacy level of the participants?).

COMPLETE QUESTION 4.1 - SHEET 1
Question 4.1 - Sheet 1 - Brainstorm environmental issues in your area

(15 answered Question 4.1 - Sheet 1)

TABLE 4.1. LOCAL ENVIRONMENTAL ISSUES

ENVIRONMENTAL ISSUES
School not integrated into culture
POLLUTION
Safety and security
LITTER
High unemployment causes crime
Overcrowding in schools
INSUFFICIENT WATER
IMPURE WATER
Juvenile delinquency
Lack of rent payments
Damaged roads
Electricity cuts
UNCONTROLLED VELD FIRES
SOIL EROSION
No camps for livestock
Roaming animals cause accidents
DESTRUCTION OF NATURAL FORESTS
OVERGRAZING
Illiteracy
Lack of refuse removal
School buildings not repaired
Violence, house breaking, theft
No recreational centres for the youth
Unhealthy diets
Lack of public libraries
Lack of transport
Shortage of teaching resources
Vandalism
Lack of adequate sewage disposal

When the teachers were asked to brainstorm the environmental issues in their area they came up with 29 issues (see Table 4.1). Only eight of these actually had to do with the natural environment: pollution, litter, insufficient water, impure water, uncontrolled veld fires, soil erosion, destruction of natural forests and overgrazing. The other issues related to social, political or economic factors such as vandalism, safety and security, high rate of unemployment resulting in crime and illiteracy (see Figure 2.2 – Loubser 1996A). The participants were then asked to decide for themselves whether they could consider themselves environmentally literate and environmentally active.

Definition of environmental literacy:

the ability to observe and interpret the relative healthiness of environmental systems and to take the appropriate action to maintain the state of these systems.

COMPLETE QUESTION 4.2A - SHEET 2A

Have you ever had any experience in solving a local community environmental problem? If yes, detail the problem and explain how you went about tackling it.

---

15 answered Question 4.2A - Sheet 2A and a summary of the answers follows:

TABLE 4.2. WAYS OF SOLVING LOCAL ENVIRONMENTAL ISSUES

SOLUTION TO LOCAL ENVIRONMENTAL PROBLEM	NUMBER
Some thought environmental problems e.g. lack of water and electricity, litter and vandalism	2
Litter – youth on Saturday had a clean-up – black plastic bags sponsored by "Ellerines" – truck	1
Water shortage – encouraged people to re-use dishwashing water to water their gardens or	1
Negotiate with local water service department to deliver water at certain points in the township	1
Roads in bad repair – husband and wife filled holes in front of their house with soil and	2
Dogs rummaged through dustbins – put heavy stones on top.	1
Water wastage – students asked not to drink from open tap – measured wasted water in a	1
Litter – teacher, neighbour and students picked up litter in the street.	1
Broken tap – teacher requested the principal to invite the parents to a school meeting to explain	1
Eroded roads were repaired by a load of soil being brought in and the donga levelled.	1
Vandalism – parents were brought in and each paid R5-00 for an electrical barbed wire fence to	1
Litter from students staying after school is cleaned up in the morning and burnt.	1
Illiteracy – adult classes held twice a week.	1
Educated adults on human rights by inviting speakers from Department of Justice.	1
Removal of refuse – neighbours collected all refuse and dumped it in a communal area away	1

COMPLETE QUESTION 4.2B - SHEET 2B

Explain how you would solve the following issue: You live in an area where you do not have access to basic water services. How would you go about making sure that each person has access to 25 litres per day?

---

11 answered the question and the answers were then analysed in terms of issue analysis.

Again when solving this issue the participants' answers should have included the following: problem, issue, players, positions, beliefs, values and solutions. The first two points, namely the **problem** and the **issue**, were supplied in the question i.e. the problem was a lack of water and the issue was to make sure that each person has access to 25 litres per day.

When identifying the **players** the following were mentioned:

TABLE 4.3. PLAYERS INVOLVED IN SOLVING LOCAL ENVIRONMENTAL ISSUES

PLAYERS	NUMBER
All people in area	1
Indunas	2
Local government	3
Unilateral decision made by the actual teacher	1
4 men to dig borehole	1
Organize lorry to store water	3
Send out notices for mass meeting	3

What were the **positions** of the stakeholders?

None of the participants managed to identify these positions and obviously did not realize that this was important if an issue was to be solved. This could also be the reason why so few players were identified, as the participants did not realize that it is essential to get suggestions from people with as many different view points as possible.

What were the **beliefs** of the stakeholders?

Not all participants approached this issue democratically but those that did, tried to find out what people's perception of the water shortage was. This was done in the following ways:

TABLE 4.4. METHODS USED TO DETERMINE STAKEHOLDERS' PERCEPTIONS OF LOCAL ENVIRONMENTAL ISSUES

METHODS	NUMBER
Discussion	1
Pamphlets to create awareness	3

What were the **values** of the stakeholders?

The establishment of the stakeholders' beliefs was also not achieved in this exercise. The ability to do this appears foreign to the participants. What was evident from their detailed approach to this problem was that the amount of 25 litres had to be monitored very strictly so that people did not take more than that that was due to them. This seemed to be a more important issue than realistically getting the water to the individual households.

What were the **solutions** to the problem?

The following were the various strategies mentioned to solve the problem of getting 25 litres to each person:

TABLE 4.5. METHODS USED TO SOLVE THE POOR DELIVERY OF WATER

METHOD	NUMBER
Collect money to buy machine to drill a borehole	1
Support local industry and buy water from donkey cart at 25c per 100	1
Each family pay R20-00 and this will enable the Induna to hire a	2
Educate the community on how to save water	4
During the rainy season collect as much water as possible for future use	1
Get men from community to dig borehole	1
Elect people to monitor the amount of water taken by each person	3
Ask big business to donate money to sink a borehole	1
Organize with Department of Water Affairs to supply a tanker that will be	2

From the above it is evident that "issues" is not something that the participants were familiar with and for them to see the lack of a school garden in the main study as an issue, could be difficult.

TABLE 4.6. THE DIFFERENT SCHOOLS IN THE PRELIMINARY STUDY

NUMBER	SCHOOL NAME
8	Ezwenilethu
4	Buhlebuzile
9	Kabenziwa
11	Vulindlela
6	Makopanong
10	Siyabuswa
5	Nkosiphile
17	Sibonelo
3	Thabana
16	Masuku
13	Sizamakwethu
12	Thembeka
1	Ramokgeletsane
2	Phutikwena
7	Mareleng
15	Sothhembani
14	Lungisani

School Sibonelo was represented in the preliminary study but not in the main study. Schools Ramokgeletsane, Mareleng, Ezwenilethu, Sothhembani, Phutikwena and Lungisani were represented in the main study but not in the preliminary study.

COMPLETE QUESTION 4.3 - SHEET 3

How is your school encouraging environmental education?

(15 answered Question 4.3 - Sheet 3 - 1 to 17 refer to different schools in the preliminary study- see Table 4.6)

TABLE 4.7. **THE METHODS THE DIFFERENT SCHOOLS USE TO ENCOURAGE ENVIRONMENTAL EDUCATION**

METHODS	SCHOOL							
Close tap tightly after using water	8	4	9	11	10	17	12	
Report leaking taps	8							
Pick up litter	8	4	9	9	11	6	3	12
Avoid causing veld fires	8							
Love and care for the environment	8	11	3	13				
Look after school property	8	17						
Report vandalism	8	17						
Close gate to prevent cows from entering	4							
Boys water planted trees	4	3						
Girls clean classrooms	4							
No smoking allowed on the school premises	4							
Ask students to bring a plant from home to plant at school	9							
Ask students to bring stones from home to stop erosion	9	12						
Ask community to stop catching birds	9							
Ask community to repair leaking taps	9							
Plant trees on Arbor Day	9	11	11	17	3	16	13	
Don't waste water when they water the flowers	9							
Involve students in campaigns on environmental issues	11	16	13					
Plant trees and grass to prevent soil erosion	11	11						
Have prizes for the best kept class environment	11							
Recycle tins, bottles, papers, plastic etc. to raise money	11	16						
Get the pupils to make posters to educate the community	11							
Give regular lessons on environmental education	11							
Repair small holes in the fence	11							
EE is not encouraged as the head sees it as a waste	6	6						
Do not waste water by irrigating where there are no plants	10							
Teach students about health	10							
Involve parents in school activities	5	17						

METHODS	SCHOOL							
Take students on educational tours	5							
Teach students how not to waste water	5							
Clean toilets	5							
Clean surroundings	17							
Plant beautiful flower gardens	17	3						
Encourage students to look after their pets	17							
Use facilities correctly-play on sports fields and not roads	17							
Discourage the chopping down of trees	17							
Use plants in demonstrations in other learning areas	3							
Plant trees and grass and flowers	16	13	12					
Put stones in footpath to prevent erosion	16							
Ensure crop rotation	16							
Avoid over grazing	16							
Encourage the use of contour ploughing	16							
Build water canals to direct excess water runoff	16							
Have a large vivarium to keep live animals	13							
Teach students how to combat pollution	13							
Don't climb trees as they may break them	12							

The participants were now encouraged to look at an issue very close to home, namely their school garden. They were asked what the status quo of their school gardens was. This could be an issue in which sustainability could be investigated. Question 4.4, 4.5 and 4.6 are linked to Question 1 of the main study.

They were asked to draw a map of their school grounds showing the buildings and the cultivated areas (not necessarily to scale).

> **COMPLETE QUESTION 4.4 - SHEET 4**
>
> **Draw a map of your school grounds showing the buildings and the planted up areas**

This was very poorly done even though large sheets of paper were provided. On discussion with the participants it became evident that they did not know how to represent the spatial arrangement of the school's infrastructure on paper. Their understanding of measurement was lacking. From their maps it appeared that the grounds were very neglected and the majority had mostly veld grass and vacant spaces. Some of them had established trees. One had well maintained lawn areas and lovely flowers (Kabenziwa Primary School – School 9) although the range of flowers was very limited. Only one had a vegetable garden that was operative (Mareleng Primary School – School 7), the others had vegetable gardens which were, however, unattended and going to seed. A reason given was that the fences were in very bad condition and the goats and cows came in and ate all the plants. Some stated that

there was a lack of sufficient water to maintain a vegetable garden. Another reason given was that the community stole the produce. This theft is not indicative of an honest community, as the fencing had probably been stolen as well. It appeared that the values of the neighbours had to be changed if the garden was to be resurrected. Also an intrinsic attitude of caring for property needed to be cultivated as the fences were probably in good condition at some stage but had been allowed to deteriorate over time. A culture of self-help needed to be instilled in the participants and hopefully they would pass it onto the community.

> **COMPLETE QUESTION 4.5 - SHEET 5**
> **List the garden/nature areas that you think should be included in your ideal school garden.**

The following have been extracted as areas that the group listed:

TABLE 4.8. **AREAS THAT COULD BE INCLUDED IN THE SCHOOL GARDEN**

AREA	TOTAL
Vegetable patch	10
Lawn	9
Rockery	3
Orchard	8
Parking	2
Grassed play ground – sports field	6
Pavement	1
Shelter	2
Flower garden	13
Fish pond	7
Nursery	4
Compost heap	6
Place where animals or plants kept	9

The following were listed as individual items that should be included:

TABLE 4.9. **INDIVIDUAL ITEMS THAT COULD BE INCLUDED IN THE SCHOOL GARDEN**

INDIVIDUAL ITEMS	NUMBER
Trees	10
Fencing	5
Gates	2
Jungle gym and swings	2
Taps	2
Animals like sheep, cattle and chickens	1
Statues	1
Road signs for road safety	1

The majority of these individual items were also seen to be extremely important in a school garden especially the trees and the fencing. Insecticides and gardening tools were not mentioned. The participants seemed to have a very good idea of what should be included in a school garden so why were there so few school gardens developed? The teachers mentioned the following aspects as those which hindered the formation of school gardens:

- lack of water (mentioned by the most participants)
- inadequate fencing (mentioned by the second most participants)
- vandalism and theft of plants
- no tools
- no funds to purchase plants
- no time to actually develop garden
- do not know what to plant
- do not know how to plant

COMPLETE QUESTION 4.6 - SHEET 6

PROBLEM: HOW CAN SCHOOL GARDENS BE IMPROVED?

Taking the SEIDET centre's garden as the sample, brainstorm how you would improve it

---

In order to determine if the participants could analyse the state of a garden they were confronted with the following scenario: "How would you improve the SEIDET centre's garden i.e. the garden of the workshop venue?" This garden was typical of many rural educational facilities. The ground was extremely hard and infertile. It was a dust bowl and almost barren with very few trees and no flowers. The trees present were Acacia karroos and they were all aggregated in one spot, far away from the educational buildings. The ground was very sparsely covered with veld grass and the soil was very poor and sandy. The buildings were in a state of disrepair and the fencing was dilapidated and full of holes. There was one tap close to the building (see Appendix F – Photos). The following were ways in which the participants thought the grounds could be improved:

TABLE 4.10. WAYS OF IMPROVING THE SCHOOL GARDEN

IMPROVEMENT	TOTAL
Fence	8
Plant trees	13
Divide the surroundings	5
Clear the surroundings of veld grass	8
Prepare the soil for planting trees, lawn and flowers	5
Make compost heap	6
Plant flowers	11
Plant vegetables	6
Plant lawn	12

IMPROVEMENT	TOTAL
Install gates	2
Acquire garden tools	3
Install extra water taps and irrigation	11
Plant fruit trees	6
Make a pond	7
Employ gardeners	3
Supply cage for vertebrates e.g. rats, rabbits, birds	1
Supply a cage for invertebrates e.g. locusts	1
Do a soil analysis	11
Build thatched shelters for visiting learners	1
Build carports	1
Erect lock up shed for tools	3
Make space for a nursery for plant propagation	2
Plant wind breakers	1
Pick up litter	1
Remove all unnecessary stones	1
Level the land	1
Draw a plan of the garden	3
Go and buy the plants	3

When the participants were asked to improve the SEIDET centre's grounds they were told that money was not an obstacle, nor was the acquisition of plants or equipment. On discussion with this group they came to the realization that they did not know how to start developing a garden nor what to plant in it. They also said that they did not know how to plant the actual plant material and that they knew very little about plants or gardening. Very few of them had their own gardens at home so this planting was not an experience that they had ever encountered. By their own admission their own education did not include hands-on activities involving planting. Only the teacher from Vulindlela Primary School had any logical plan for improving the SEIDET Centre grounds. If one person from the group had the ability to plan correctly, then the rest of the teachers should have been able to. This plan included the following steps: to improve the SEIDET Centre garden:

- test the soil in order to know what plants can be planted
- remove the unwanted weed, grass and shrubs to make way for paving where necessary
- make compost with the grass removed
- identify places to plant lawn, flowers and trees
- make provision for carports and thatched shelters for visiting learners
- start planting the lawn
- transplant seedlings to plant at various points

- make sure water is available to water the plants regularly

- have a lockup shed to place the tools in

- have some-one to care for the garden. If the school garden was being developed, the school children should take care of it themselves

- ENJOY THE GARDEN.

The last point was interesting. One would like to interpret this as showing that this teacher saw beyond all the hard work that went into establishing a garden and wanted it to be a haven to be enjoyed. If this value could be instilled in more people, they would want to have gardens where they could spend time relaxing. If this attitude could be taught to students, when they ultimately have homes of their own, they would want to establish a garden to relax in. This attitude would uplift the whole community and perhaps reduce poverty, vandalism and theft.

Question 4.7 – 4.9 relate to Question 2 of the main study i.e. the participants' professional growth. Question 4.7 - Sheet 7 (19 answered) returned the teachers to thinking about their own school grounds.

COMPLETE QUESTION 4.7 - SHEET 7

PROBLEM: CAN THE SCHOOL GARDEN BE USED IN THE LEARNING SITUATION?

Are your school grounds being used as a learning resource?

If so, state for which topic in the syllabus they are being used. If not, state why not.

TABLE 4.11. GARDEN RESOURCES USED IN THE LEARNING SITUATION

RESOURCE	TOPIC IN THE SYLLABUS	NUMBER
Soil	Air in soil	5
	Non-living and living organisms in the soil	2
	Types	3
	Uses of soil	1
	Filtration	1
Trees	To show shadow at midday	3
	To show the direction of the wind	4
	Useful plants	3
	Parts of a plant	1
	Different external structure of stem	1
	Different kinds	1
	Different types of leaves	1
	Give shade	1
Weeds	Unwanted plants - stinkblaar, blackjacks and burr weeds	3
Lawn	Prevents soil erosion	1
	Fibrous root system	1
	Seed production	1

RESOURCE	TOPIC IN THE SYLLABUS	NUMBER
	Vegetative reproduction	1
	Types of leaves	1
Flowers	Parts of a flower	3
	Pollination	2
	Uses of flowers	1
	Colours	2
	Angiosperms	1
	Give beauty	1
Leaves	Different types of leaves	2
	Different shapes of leaves	2
	Photosynthesis	1
	Vegetative reproduction	1
Stems	Monocotyledons and dicotyledons	1
	Underground stems – potato	1
	Vegetative reproduction	2
	Different types of stems	1
Roots	Different types of roots e.g. carrot and mealie	4
Seeds	Bean – dicotyledon	2
	Mealie – monocotyledon	2
	Dispersal – insects, birds	2
	Germination	3
Plants	General classification	1
	Biodiversity	1
	Different parts of the plant	1
	Wanted and unwanted plants	1
Shrubs	Parts of a plant	2
Vegetables	Root systems	1
	Wanted plants	2
	Use of water	1
Wild plants	Leaf shape and colour	1
Water	Uses of water	1
Small stones	Counting	1
Aloes	Xerophytic plants	1
Pine tree	Gymnosperms – cone bearing plant	1
Tortoise	Animal life	1
Lizard	Reptiles	1
Rats	Mammals	1
Aquarium	Fish and tadpoles	1
Fish in pond	Animals live in water	1

This sheet required the teachers to think about their own school grounds. They were asked whether their school grounds were being used as a learning resource? Although as many as 56 topics were mentioned that could be taught to their students, when it came to actual plant resources those listed were very general i.e. stems, leaves, roots, monocotyledons and dicotyledons (see Table 4.11). This exercise showed how limited these teachers' plant knowledge actually was. They had very little idea of specific plants that could be used to teach the different topics. The only ones that were actually mentioned by name were the "bean" and "mealie".

From the results it became apparent that environmental education and the utilization of their school garden did not play a prominent role in most schools in the preliminary sample. In fact, in one school, namely Makopanong Primary School (6), teaching activities in the school garden were actually discouraged as being a waste of time. It was hoped that the teachers would realize that the position of the head was important for the project to be successful and that his attitude needed to be changed. This school did participate in the main study and the intervention was able to change the head's attitude. Teachers in the school saw their lack of school garden as an issue and actually tried to solve it.

Other important aspects that arose from this question that did influence the main study were:
- teachers from only one school (3) actually used plants from their school garden in their teaching
- some schools saw the value of planting trees, grass and flowers (9 ,11, 17, 3, 16, 13, 12)
- quite a few schools participated in Arbor Day in which they were encouraged to plant trees (9, 11, 17, 3, 16, 13)
- four schools encouraged students to care for trees (4, 3, 17, 12)
- only three schools encouraged their students to conserve water (9, 10, 5)
- only one school (11) was doing anything about fixing the fence, yet it was a major cause of the lack of a school garden as the roaming domestic animals could not be kept off the school property.

Although research has shown that students prefer to study animals to plants (Yager & Tamir, 1993) only five teachers said they actually used live animal specimens in their teaching. Only one teacher used objects from the garden e.g. small stones in a subject other than general science i.e. mathematics. Again soil was used extensively in hands-on teaching. Trees and flowers were also used a lot but in a generic sense. Actual genus names were not mentioned which supports the assumption that the teachers did not know these names.

COMPLETE QUESTION 4.8 - SHEET 8

Brainstorm what you think pupils in your particular learning phase should know about plants remembering that learning should be relevant.

TABLE 4.12. **PLANT KNOWLEDGE RELEVANT TO THE DIFFERENT LEARNING PHASES**

Grade 2

GARDEN RESOURCE	REASON FOR INCLUSION
Trees	For shade and wind protection
Flowers	For beauty
Vegetables	For healthy food
Water	Needed by all these plants

Grade 4, 5 & 6

TOPIC
The importance of plants to man
Why it is important to take care of our plants
Is man dependent on plants and why?
How are weather patterns going to affect plants and what can be done about it?
The relationship between plants, man and animals
The external structure of a plant e.g. leaves, stems, roots, flowers, fruits and seeds
Different types of plants
Uses or importance of plants specifically their different parts – dyes, beadwork (seeds),
The different habitats of plants
Caring for plants
Seed or seedless plants
Pollination
Growing requirements for plants e.g. soil and water
Growing seasons
Plant taxonomy
Useful plants and weeds
Differences and similarities among plants
How to plant plants (3)
Different types of seeds (comparing skills)
Germination of seeds
Dispersal of seeds
Deciduous and evergreen trees
Coniferous trees
Differences between monocotyledons and dicotyledons with respect to roots, stems,
How to prune 1
How to water 1

The results indicated that the teachers were not informed about the different plant topics for the different grades (see Table 4.12). Teachers were required to teach what was relevant to their students, so Question 4.8 - Sheet 8 was also supposed to find out what the teachers thought important for their students to learn. Although not all the grades were covered in this question in the preliminary study, the results gave a fairly comprehensive picture. A closer scrutiny of the topics that the teachers thought were relevant revealed that except for three items, the rest were all knowledge and content bound. This could be the reason why teaching was still based on rote learning. Three topics showed promise for changing the style of teaching, namely: how to plant plants, how to prune plants and how to water plants. These were skills that required the students to actually perform a task if they were to correctly understand the concepts. If a syllabus of only knowledge acquisition were perpetuated then the students involved in the learning experience would probably end up possessing the same few skills as their teachers when their course was finished. What the preliminary study teachers thought should be learnt in the different grades and what had been prescribed in the actual syllabus (see Appendix B) did not appear to be very different.

COMPLETE QUESTION 4.9 - SHEET 9

Having completed Question 4.8 - Sheet 8 what KNOWLEDGE do you want your pupils to have regarding plants? Try to make a list linking a particular plant as a resource for enabling that knowledge to be imparted?

Ignoring the specific grades that the participants taught, the following is a composite list of knowledge topics and their resources that it was thought should be covered at school:

TABLE 4.13. PLANT KNOWLEDGE AND THE RELEVANT PLANT SPECIMENS

KNOWLEDGE	SPECIMEN
Leaf structure	Cabbage
Vegetative reproduction	grass, grapes, stem of flower
Medicinal plants and their uses	aloe, plantain
Edible plants (which can be eaten?)	figs, berries
Pruning	most fruit trees
Monocotyledons(grown for selling)	mealies (2)
Dicotyledons (grown for selling)	Beans, peanuts (2)
Flowering plants	?
	learn how to grow and sell
	grow garden to be used for photography
Trees and flowers	?
	make Botanical garden as a resource
Useful plants	fruit, vegetables, grass, trees, flowers
Habitat of plants	?, maize, wheat, oranges, grapes, apples

KNOWLEDGE	SPECIMEN
Seasonality	Winter – carrots; summer – mealies
Different parts of a tree	Peach, mulberry
Types of roots	grass, tree
Different parts of a flower	?, petunia
Comparison of seeds	bean (2), water lily, mealie
Seasonal changes in plants	red leaves – grape; yellow leaves –peach
Seasonal changes in plants	Shedding of leaves in winter – deciduous
Food storage in plants	roots – carrots, beetroots
	Leaves – cabbage, onion
	stem – potato
	Flower – cauliflower
	fruit – tomato, pumpkin
	seed – rice, peanuts
Shapes of leaves	thick – aloe; needle – pine
Xerophytes: function, habitat	Aloe
Hydrophytes: function, habitat	water lilies
Importance of plants	Vegetables (2), fruit
Functions of plants	trees (2)
Functions of the different parts of plants	Trees
Importance of water, air and soil to plants	Grass
Importance of plants to man and animals	Vegetables and trees
How to make compost	Leaves, waste and dung
Types of roots	?
Uses of plants	Food
Furniture (2) – Pine tree	
Wine	
Medicine	
Paper – Pine tree	
Decorations – Pine cones	
Juice – Marula	
Decorate yard – Jacaranda tree	
Wind breakers - Jacaranda tree	
Glue – gum trees	
Sugar – sugar cane	
Care of plants	?, lawn, flowers (2), vegetables (2) trees
Sowing of seeds	Bean
Names of plants	aloe, beetroot, Marula

From the results of what KNOWLEDGE the teachers wanted their students to have regarding plants, it became evident that the teachers' knowledge of plants was very superficial (see Table 4.13). Admittedly some of the participants used actual named plant material to teach a

specific plant topic especially in "uses of plants" and "food storage in plants" but these two topics hardly encompassed all that there was to know about plants at the intermediate phase. Some mentioned a plant topic that ought to be covered, but did not know which plant could be used to best illustrate the knowledge. Some of the topics listed were skills and not knowledge e.g. care of plants, making compost and pruning. There was scope to broaden the participants' plant knowledge through increasing their repertoire of actual plant varieties which would in turn, broaden the plant resource base used in their teaching. Through discussion with teachers in the preliminary group it became obvious that all the teachers saw the necessity in developing their school garden so that they could use its contents in their teaching. It also appeared that a tremendous amount of work needed to be done to educate teachers as to which specific plants could best be used to teach which particular plant topics. The participating teachers made it known that it was necessary to teach the following core of knowledge concerning plants to their students:

- all the parts of the plant as well as its inter-relatedness to the physical environment (temperature, air, water, soil, nutrients, gravity, energy)
- specific plants and their importance to the participants (economic)
- learning about these plants in a cross-curricular way (social).

Question 4.10 relates to Question 1 of the main study:

COMPLETE QUESTION 4.10 - SHEET 10

What SKILLS do you want your pupils to have regarding plants? Try to make a list linking particular plant as a resource for enabling those skills to be imparted?

Ignoring the specific grades that the participants taught, the following is a composite list of skills with their plant resources that the teachers stated should be covered at school:

TABLE 4.14. **PLANT SKILLS AND THE RELEVANT PLANT SPECIMENS**

SKILL	SPECIMEN
Woodwork	Marula tree
Making juice	Marula tree
How to plant trees	?
How to care for plants	?
How to make compost	?
How to experiment	?
How to observe	
How to draw plants	?
Give	Flowers
Understand	Trees
Discuss	
Know	?
Identify	?
Appreciate	?

In Question 4.10 - Sheet 10 the participants were specifically asked what skills they wanted their students to have regarding plants. They were also asked to link a particular plant as a resource for enabling that skill to be taught. This sheet was very poorly answered with only two participants answering the question (see Table 4.14). This could be because the rest had never contemplated skill acquisition relating to plants as an option in education. They especially did not relate to the issue of knowing how to actually plant and care for different plants as being something that could or should be taught at school. They were never taught these skills and as mentioned earlier, teachers tend to teach how and what they were taught. Most of the skills listed were scientific process skills. The lack of answering of this question led to the premise that the implementation of outcomes-based education, which will be covered in the next chapter, was of the utmost importance.

Question 4.11 relates to Hypothesis 1 and Question 3 of the main study.

COMPLETE QUESTION 4.11 - SHEET 11

What ATTITUDES do you want your pupils to have regarding plants? Make a list linking a particular plant as a resource for enabling those attitudes to be imparted?

Ignoring the specific grades that the participants taught, the following is a composite list of attitudes and the resources that the teachers stated should be covered at school:

TABLE 4.15. ATTITUDE TO PLANTS AND THE RELEVANT PLANT SPECIMENS

ATTITUDE	SPECIMEN
Love	? (2), flowers (5), grass, trees (2),
Acceptance	flowers (2), grass, trees (2), fruit
Positive attitudes	? (3), flowers, grass, trees (2), vegetables,
Negative attitudes	poisonous weeds
Uses of plants	furniture, food, beautify our homes
Appreciation	? (2), flowers, trees, fruit
Healthy attitude	vegetables, fruit
Happiness	?
Love the plants for their uses	food, shade, decoration
Observe the growing plant	?
Appreciate the effort growing them	Trees
Care for them	Trees, shrubs, all plants
Enjoy working in the garden	Flowers
Joy in watching plants grow	Flowers
Respect their surroundings	Flowers
~~Be responsible~~	~~Trees~~

ATTITUDE	SPECIMEN
Love of nature	different kinds of plants
Relevance to their lives	?
Instil an interest in plants	?
A willingness to learn more	?
The value of plants	? (4)

This questionnaire was also very poorly answered (see Table 4.15). Teachers have not been encouraged to express their feelings and so found it very difficult to write them down. Most of them translated the majority of questions into knowledge questions rather than handle them in the affective domain. This could have been a result of language barriers and the fact that these types of questions are foreign to teachers. This sheet was very enlightening because in only one instance was there any mention of negativity (poisonous plants). It is generally accepted that to be surrounded by plants and to work with plants is therapeutic, soothing and relaxing. This attitude was reflected qualitatively in this set of results.

4.C.   CONCLUSIONS

The preliminary study has shown that many learners find learning about plants with the current curriculum tedious, boring, difficult and irrelevant. Biology was seen by many students as the memorization of many unrelated facts, which had very little or no bearing on their lives. The emphasis in biology should not be on memorizing facts but on the understanding, interpretation and application of biological information. Fusco (2001) wrote that when young people said that biology was boring or not related to their lives or their future, he did not think that they meant the knowledge or content was useless but that the context for learning did not support their development.

OBE requires teachers need to have the necessary knowledge of plants, the skills to handle them and a positive attitude towards them, to teach about plants with enthusiasm. The preliminary study showed that these attributes were lacking in the participating teachers who were looked at as being representative of the majority of rural teachers in South Africa.

An analysis of all the preliminary sheets showed that although flowering plants formed a large part of many people's environment the knowledge, skills and attitudes related to them seemed very poor. There was definitely a need to investigate these aspects further and especially share with teachers the skills needed to choose, plant and nurture plants.

Another conclusion gleaned from the preliminary study was the fact the participating teachers did not have the necessary textual resource material describing the skills needed to develop a school garden. Curriculum 2005 has the requirement that teachers should develop resource

materials for themselves. Thus the main study was designed to include a project of developing this resource. It would involve the teachers creating a booklet which would present these skills in a logical manner. Also included in the booklet would be specific activities, relevant to the curriculum, designed by teachers. These activities needed to be outcomes-based. They also needed to be emulated in the classroom using material that could be found in the school garden. This booklet could then be used to teach a specific aspect from the curriculum for a particular grade from material collected in the school garden.

More research on the development of school gardens was justified and a sound basis for an intervention had been provided by the results of the preliminary study. This gave rise to the detailed process of development and research described in the following chapter.