

**EVALUATION OF THE USE OF RESOURCE KITS IN PROFESSIONAL  
DEVELOPMENT IN SCIENCE TEACHING**

**BY**

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**THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE  
REQUIREMENTS FOR THE DEGREE OF**

**MASTER OF EDUCATION  
(CURRICULUM STUDIES)**



**DEPARTMENT OF CURRICULUM STUDIES, FACULTY OF EDUCATION  
STELLENBOSCH UNIVERSITY**

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**MARCH 2009**

## **Declaration**

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Date: 4 March 2009

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## II ABSTRACT

The research was done in a period of curriculum transformation and reform in South Africa, a period during which teachers attended many interventions by service providers other than the education department to sharpen their skills. In this study, I investigate teacher professional development and professional development programmes using two case studies, MTN-SUNSTEP (Mobile Telecommunications Network – Stellenbosch University Schools Technology in Electronics Programme) and SWAP (Schools Water Project). These INSET programmes were intended to assist with the improvement of science teaching in terms of the new curricula suggested for the country.

The study proceeds by way of two case studies within an interpretive paradigm. The purpose of the study is to evaluate the two programmes based on the criteria developed through a literature review and to understand and give meaning to the process of teacher professional development that might have occurred in the programmes. This process is framed by my research question, “can resource kits enable professional development in science teaching”.

Data was collected at various stages by way of field notes, questionnaires, interviews and observations at workshops. Teachers generally found the processes useful but do indicate dissatisfaction with certain areas of the programmes. Issues that emerged from the study were that teacher development processes need to be organized over a long period, the development of teacher networks needs to be nurtured, and support at school level was essential to ensure implementation.

An important insight was that the research, once again, emphasized a key aspect of effective teacher development programmes. Effective programmes require a team consisting of three agents that bring their own expertise to the process namely, teachers, district officials and university staff. This team has to take into account the factors that ensure effective teacher professional development and should occur within the parameters of accepted professional development practices and learning support materials play an important role in supporting this process.

### III SAMEVATTING

Die navorsing het geskied tydens 'n periode van kurrikulum transformasie en hervorming in Suid Afrika. Onderwysers het gedurende die periode vele indiensopleidingsessies, aangebied deur diensverskaffers anders as die onderwys departement, bygewoon om hul onderrigvaardighede op te skerp. In die studie ondersoek ek professionele ontwikkeling van onderwysers sowel as professionele ontwikkelingsprogramme aangebied deur te fokus op twee programme naamlik, MTN-SUNSTEP (Mobile telecommunications Network - Stellenbosch Universteit Skole tegnologie in Elektronika Programme) en SWAP (Skole Water Projek). Hierdie indiensopleidingsprogramme was gerig op die verbetering van wetenskaponderrig in lyn met die voorgestelde nuwe kurrikula vir die land.

Die studie is gedoen aan die hand van twee gevallestudies gebed in 'n interpretatiewe paradigma. Die doel van die studie is gerig op die evaluasie van die twee programme aan die hand van kriteria ontwikkel na raadpleging van relevante literatuur en om langs die weg tot begrip te kom en betekenis te verleen aan die proses van professionele ontwikkeling van onderwysers wat tydens die programme kon plaasvind. Die proses is gerig deur my navorsingsvraag: 'Kan professionele ontwikkeling in wetenskap onderrig deur die gebruik bronne bemoontlik word'.

Data is op verskillende momente versamel deur die gebruik van veldnotas, vraelyste, en observasies tydens werksinkels. Onderwysers het die proses oor die algemeen as waardevol gevind maar tog hul ontevredenheid aangaande sekere fasette van die program bekend gemaak. Aspekte wat uit die studie na vore gekom het was onder andere dat ontwikkelingsprosesse vir onderwysers oor 'n lang periode moet geskied, dat die ontwikkeling van onderwysernetwerke bevorder moet word en dat ondersteuning op skoolvlak essensieel is vir die versekering van implementering.

'n Belangrike insig was dat die navorsing opnuut 'n kernbelangrike aspek omtrent effektiewe onderwysontwikkelingsprogramme beklemtoon het, naamlik dat vennootskappe bestaande uit onderwysers, distrik amptenare en universiteitspersoneel, elk met hul eie kundigheid essensieel is vir professionele ontwikkeling van onderwysers. Diesulke spanne moet verder die faktore wat effektiewe professionele ontwikkeling van onderwysers verseker, die raamwerk vir aanvaarde professionele ontwikkeling en die belangrikheid van leerondersteuningsmateriaal behoorlik verereken.

## IV ACKNOWLEDGEMENTS

The research process has reminded me, once again, that important journeys in my life have never only been through my own efforts. This thesis has been no exception and would not have reached this stage if I was not supported and sometimes, carried. I owe intellectual debt and gratitude to many people who have guided and influenced my work.

Firstly, to my supervisor, Dr. Chris Reddy, thank you for accepting me as a student at a very late stage of my research. Thank you for sharing your thoughts and guidance in changing the direction of the study. Without your support and encouragement, this would not have been possible. Chris, thank you for not giving up on me.

Dr. Faan Jordaan, thank you for your input into my research. Thank you to the MTN-SUNSTEP management team for their support and encouragement. A special thank you to the teachers and learners who very willingly gave up their time for interviews, questionnaires and observation sessions. You raised key issues and made the theories real.

Dr. Trevor van Louw, thank you for encouraging me to complete this study when I thought it was impossible. Your assistance with the translations and technical issues have been invaluable. To my colleagues and friends who always encouraged me, thank you for your input and support on this journey. Without you, I would have given up long ago.

A special thank you to my parents for your emotional support, understanding when I needed time to sit with my books and feeding me. Shamiema, thank your for being there.

Lastly, I wish to thank the Almighty for making this possible.

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# **CHAPTER ONE: RATIONALE FOR STUDY**

## **1.1 INTRODUCTION AND BACKGROUND TO THE STUDY**

The study evaluates the use of resource kits in science teaching and reflects on the challenges and possibilities highlighted by two programmes using resource kits in science teaching. The implementation of these programmes in schools occur at a time of curriculum change in South Africa with the new constitution of South Africa providing the base of curriculum transformation and development.

The White Paper on Education and Training , Department of Education (1995:10) states, that in South Africa presently the lack of human and material resources in the majority of schools has contributed to the learners not choosing science and mathematics as subjects from grade 10 to grade 12. Thus, their access to careers that require mathematics and science as a foundation is denied.

It is recognized by government that effective science and technology education is essential for the economic and social development of the country (Department of Education 1995:13; Department of Arts, Culture, Science and Technology 1996:11) and as such it was vital to transform our education system.

“It is generally agreed that if South Africa is going to reduce poverty and unemployment, and all their negative side effects, it must become competitive in the global economy” (Arnott, Kubeka, Rice and Hall, 1997:5).

Kahn and Rollnick (1993) describe that prior to 1994, science and mathematics education for black students was of a very poor quality. Resources both physical and human were limited. Schools had no electricity, no toilets, water, poor infrastructure, no text –books or teaching and learning resources. Under-qualified or unqualified teachers were the

order of the day. Teachers had to cope with large classes. The discriminatory education policy of the apartheid government resulted in chaos in black education.

With the election of a democratic government in 1994, education, a basic human right, had to be transformed to reflect the principles of equity, democracy, transparency. One national system of education and training was developed to serve the needs of the people (White Paper Education and Training, 1995).

The new national curriculum transforms teaching and learning within a new qualifications system formulated by the South African Qualifications Authority. It is directed towards achieving a democratic, unified, globally competitive country with literate, creative and critical citizens that participate and share in the growth of the country.

This is a reflection of the vision in the preamble of the South African Constitution, (1996:1), which states that through the constitution we wish to

“Improve the quality of life for all citizens and free the potential of each person.”

It is echoed in the Report to United Nations Educational, Scientific and Cultural Organization (UNESCO) of the International Commission on Education for the Twenty – first Century: Learning: The Treasure Within (1998:19)

“Education is at the heart of both personal and community development; its mission is to enable each of us, without exception, to develop all our talents to the full and to realize our creative potential, including responsibility for our own lives and the achievement of our personal aims.”

In education, South Africa has excelled in developing a governance system based on local and community participation in schools through school governing bodies consisting of teachers, parents, learners and relevant stakeholders; norms and standards for school

funding; professional development of teachers and a National Qualifications Framework which integrates the mobility of learners in the education system. The vision for education is encapsulated in the critical and developmental outcomes incorporated in Curriculum 2005 which were inspired by the Constitution and the democratic process (Cross, Mungadi and Rouhani, 2002:171).

Curriculum 2005 identifies eight learning areas in the general education band (GET) from grades one to nine. Learning areas were developed to break down the traditional barriers of subjects; to allow for integration within and across the disciplines as well as for organizing the core curriculum. The traditional subjects are part of the eight learning areas: Natural Sciences; Mathematical Literacy Mathematical Sciences; Arts and Culture; Language, Literacy and Communication; Life Orientation; Human and Social Sciences; Technology and Economic and Management Sciences (Cross, Mungadi, Rouhani, 2002:179). In the further education band (FET), from grades 10 to 12, the outcomes are organized in thirty -three subjects, of which the physical sciences and life sciences are two subjects.

Within this new competency- based framework, aimed at what learners know and can do at the end of the learning process, new knowledge and concepts are introduced which will be relevant, localized and integrated with developing skills and attitudes to prepare the learner for life and work.

To implement the changes in the curriculum meant changes in the teaching and learning process. How teachers teach, what they teach and how they assess has to change to ensure quality in education (Lotz 1997:3; Taylor, 1999:108).

Teaching and learning is shifted from traditional transmission to learner -centred methodologies. In learner-centred methodology, learners take control of their learning. Learners are active, creative and self disciplined. They regulate their own learning through group and independent activities (Taylor, 1999: 108). A range of teaching methods can be used to ensure that learners demonstrate the outcomes.

In curriculum 2005, assessment criteria provided evidence that learners had achieved the outcome. Range statements indicated depth and scope of the learners' learning (DOE, 1997:16). Performance indicators gave details of the expected performance of learners. Learning programmes were sets of activities with which learners interact to achieve the outcomes (DOE, 1997: 11). Content and assessment standards were not specified but suggested in the GET band.

The adaptation of curriculum 2005 was based on shortcomings highlighted by the Policy Review Committee appointed by the Department of National Education (Cross, Mungadi and Rouhani, 2002: 183). The shortcomings highlighted were amongst others, lack of alignment between curriculum and assessment policy; inadequate orientation training and development of teachers; follow – up support not being available; policy overload and limited transfer of learning into the classroom; learning support materials which are variable in quality, often unavailable and not sufficiently used in the classroom and shortages of personnel and resources to implement and support Curriculum 2005 (Cross, Mungadi and Rouhani, 2002:184).

Based on the recommendation of the review committee, the Revised National Curriculum Statement specified the learning outcomes and content for each phase. It specified the outcomes per grade, assessment standards per grade and the content per phase. In the FET band, content is specified per grade. In this band the new national curriculum was and will be implemented in grade10 in 2006, grade 11 in 2007 and grade 12 in 2008 (DOE, 1997).

According to policy teachers were to develop their teaching and learning materials, to use a combination of text books and to fulfil their role of being 'interpreters and designers of learning programmes and materials (Norms and Standards for Educators Policy Statement DOE: 2000).

Assessment of learners occurs through various assessment strategies and techniques using a variety of assessment tools. Evidence of learning can be collected through portfolios which would show whether the outcome has been attained (Lotz: 1997).

## **1.2 SCIENCE TEACHING POST 1994**

In a study, to determine the factors that influenced the students to study engineering, conducted by the Dean of Engineering offices at Stellenbosch University, Appendix A page 200, of first year engineering students, it was found that from a sample of five hundred students approximately three hundred and fifty (70%) stated that a science project positively influenced them in their choice (Appendix A). This was closely followed by the influence of their science and mathematics educator. From this study, it becomes clear that science interventions and motivated teachers influence learners in their choice of subjects and careers.

This is supported by a study done by Woolnough across six countries - England, Australia, Canada, China, Japan and Portugal. In the six countries, the main reason learners chose careers in science and technology was the quality of the science teaching at the school. Motivated, enthusiastic and confident teachers motivate and encourage their learners to choose these careers (Woolnough, 1994; Arnott and Kubeka, 1997).

According to the reports and studies undertaken, a shortage of mathematics and science teachers exist in the profession. Mathematics and science teachers generally have very little knowledge of their subject, their pedagogy is poor and they have very little practical experience. A large portion of mathematics and science teachers have very little training in mathematics or science as a field of expertise. Their qualifications have mostly been obtained through teaching diplomas (Arnott and Kubeka, 1997).

Arnott et al. (1997:1) conclude that a large proportion of science educators at school level do not have the necessary academic qualifications to teach science and mathematics. They are therefore too insecure to depart from text- books and rely on the traditional

transmission method to teach science and mathematics. A lack of innovative resources in the classroom increases the alienation of learners from the subject.

The study also revealed that a large number of science teachers have very little experience in their profession. A large number leave the profession after two years. Forty two percent of science teachers across seven provinces (Western Cape and Eastern Cape did not participate in the study) have been teaching science for less than two years; 65 % for less than five years. The attrition rate of teachers teaching science is higher than other subjects, as more opportunities for employment are open to them (Arnott and Kubeka, 1997).

In the current context of science teaching in South Africa, the study: Evaluation of the use of resource kits in enabling teacher professional development in science teaching is an important one. Successful professional development programmes in science teaching could make a difference in the classroom.

### **1.3 MTN-SUNSTEP**

MTN - SUNSTEP (Mobile Telephone Networks and the University of Stellenbosch Schools Technology and Electronics Programme) introduces Intermediate and Senior Phase teachers and learners to electronics and is based at the University of Stellenbosch.

The programme uses electronics as a vehicle to stimulate an interest in technology with “the aim that participants will eventually decide to pursue careers in electronics, or technology in general”, (MTN-SUNSTEP Brochure, 1998).

Electronics can be described as the

“Study, application and development of devices controlling the motion of electrons.” (Hartmann-Petersen and Gerrans, 2001)

In 2001 when the study started, electronics was not a compulsory in the school science curriculum. Although not explicitly stated, this programme works mainly with teachers.

#### **1.4 SWAP (SCHOOLS WATER ANALYSIS PROJECT)**

In 1992, Professor Danie Schreuder established the schools water analysis project (SWAP) at the University of Stellenbosch under the auspices of the Environmental Education Programme (EEPUS).

Schreuder (1995a:8) states that SWAP

[...]is an example of an initiative based on the principles of wide participation, critical reflection and social construction of knowledge; the development of an environmental ethic, political literacy, and innovative teaching strategies.

SWAP is a water quality monitoring resource that was developed from the Global Rivers Environmental Education Network (GREEN) kits in America. It includes basic scientific tests as well as other data collecting techniques that can be used for rivers and catchment areas in general.

The case study for the research of the SWAP kits was a partnership programme involving the Shuttleworth Foundation, Stellenbosch University and the Education Management and Developmental Centre, Metropole South of the Western Cape Education Department represented by Fadli Wagiet, a natural science curriculum advisor. The focus of the 2004 programme was the intermediate phase teachers of primary schools.

#### **1.5 THE RESEARCH PURPOSE**

Within this context, the two programmes were implemented. Initially I became involved in MTN-SUNSTEP to introduce my learners to interesting applications of science and to make teaching and learning more fun for the learners and myself. I was involved in



MTN- SUNSTEP programme as a high school science teacher in 1998- 2000. I attended workshops, introduced the electronic kits into the classroom as part of the curriculum and my learners built applications for the kits. I questioned whether the programme contributed to my understanding of electronics and later agreed to evaluate the resource kit as part of my studies. I became aware of the SWAP programme as part of my duties as a curriculum advisor in the district.

The purpose of the study is to evaluate the use of resource kits in the process of professional development in science teaching, to discuss and reflect on the challenges and possibilities that are created during these processes.

Janse Van Rensburg and Le Roux (1998: Part V) have developed the indicators that will be used as part of a mixed model of indicators to measure the success of professional development of teachers. These have been adapted for the study:

- Did teachers develop new understandings of the knowledge areas embedded in environmental education and electronics;
- Were there any changes in their approach to teaching environmental education, electronics and resource –based learning programmes;
- Were teachers better equipped to teach in the content areas and did their ability to teach improve: this could include assessment strategies, teaching styles, resources, curriculum and the use of technology;
- Were they more confident in the classroom in terms of using resources and teaching;
- Did they develop teacher networks and learn from each other in terms of teaching, methodology, content knowledge and resources and;
- Did they develop or adapt resources of the programme to contextualize the resources for their classes.

These indicators are in line with Guskey's levels of evaluation of professional development (2002:45), as outlined below, where success of the intervention is determined by the success of attainment of the five levels of evaluation.

- Level 1: Participants' (teachers') reactions to both SWAP and MTN-SUNSTEP process and resource kits
- Level 2: Participants' learning during the programme process
- Level 3: Organisational support and change of the teachers
- Level 4: Participants' use of new knowledge and skills in the classroom and during the programme
- Level 5: Student learning outcomes

The other models that will be used to evaluate the effectiveness of the programmes are Bell and Gilbert (1994) and Garet, Porter, Desimone, Birman and Yoon (2001). This will be discussed in the literature review.

The research process in the MTN-SUNSTEP case study included teacher questionnaires, observations of teacher workshops and informal teacher interviews. In the SWAP case study, it included workshop reports, teacher questionnaires and programme reports. This is discussed in Chapter 3.

## **1.6 STRUCTURE OF THE THESIS**

The thesis consists of six chapters.

### **Chapter 1: Rationale for the study**

The first chapter deals with the rationale and context of the study. The research study is discussed.

## **Chapter 2: Literature Overview**

Chapter two reviews the literature to gain a deeper understanding of the context both nationally and internationally. A conceptual framework is developed to give meaning to the research. Teacher professional development is unpacked and resource kits as learning support material are reviewed.

## **Chapter 3: Research Design**

Chapter three provides the conceptual framework within which the research is addressed and the methodology of the research process is outlined. The research techniques used for the evaluating are: teacher questionnaires, observation of teacher workshops and reports. Semi – structured interviews were conducted with teachers and the programme coordinator.

## **Chapter 4: Data Report**

The data report deals with the goals and objectives of the programmes, the resource kits, and teachers' responses to the processes of the programmes. The data is presented in the form of tables, descriptions and photographs.

## **Chapter 5: Discussion of Data**

The findings of the research study as outlined in chapter four are discussed and analysed within the conceptual framework described in Chapter two. The criteria identified for the evaluation are the parameters within which the analysis occurs.

## **Chapter 6: Concluding comments and recommendations for further research**

This chapter summarises the data report and the analysis. Recommendations are made in terms of the study.

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1 INTRODUCTION**

In order to discuss and make meaning of the study: Evaluation of the use of resource kits in teacher professional development in science teaching, I will evaluate the process of teacher professional development and the use of resources in enabling teacher professional development through two programmes, MTN – SUNSTEP and SWAP.

I would like to explore the literature on teacher professional development, science teaching and teacher professional development in science teaching. I will explore the definition and factors affecting professional development, examine the literature on the process of professional development, learning support materials, its role in professional development and report on support programmes implemented in schools. In this way, I will construct my theoretical framework that will serve as the conceptual lens for the study.

The study is an evaluation of the process of teacher professional development using two case studies. The theoretical framework of the study will include the factors of Garet, Porter, Desimone, Birman and Yoon (2001) as the concluding tool, the Bell and Gilbert model (1994) for teacher professional, Janse van Rensburg and Le Roux (1998: Part V) and Guskey's critical levels of evaluation (2002) to evaluate the process of the SWAP and MTN- SUNSTEP programmes. Different models will be used as a theoretical framework as one model would not be able to illuminate different areas of the study. Multiple lenses have been selected as it will allow for rich discussion and interpretation of the data.

## **2.2 PROFESSIONAL DEVELOPMENT**

### **2.2.1 IN SEARCH OF A DEFINITION**

Much research has been done in this field of study. Literature defines teacher professional development in many ways (Reddy, 2004:139). The development of a definition is important as it sets the parameters for the field of study. Critique can then be developed within these parameters (Evans, 2002: 124). Very few leading researchers in the field have ventured to put forth a definition. Many researchers work in the field and have contributed toward the accumulation of knowledge about the development of teachers (Evans, 2002: 124).

The terms, teacher development, professional development and in-service training are used interchangeably. Fullan and Hargreaves (1992) state:

“Our overarching conclusion is that teacher development must be conceptualized much more than it has been.”

Definitions of teacher development are almost entirely absent from the literature. Fullan and Hargreaves state in a footnote (1992: 8-9)

“We will not attempt to define the term teacher development at this stage of the chapter. As it will become clear we use both to refer to specific developments through in-service or staff development, as well as to more thorough advances in teachers’ sense of purpose, instructional skills and the ability to work with colleagues.”

Darling –Hammond (1994) offers no definition of teacher development or professional development. Leithwood’s (1992: 87) description of teacher development incorporates three dimensions: development of professional expertise, psychological development and career – cycle development. There is still much to be discovered about teacher development process and conceptual coherence will facilitate the discovery.

Day (1999:4) represents a definition of professional development which according to Evans (2002: 128) could be a definition of teacher development:

“It is the process by which, alone and with others, teachers review, renew and extend their commitment as change agents to the moral purposes of teaching; and by which they acquire critically the knowledge, skills, planning and practice with children, young people and colleagues through each phase of their teaching lives.”

Evans (2002: 131) looks at a definition of the concept of teacher development and the process of teacher development by evaluating the existing literature and developing her own definition as: “the process whereby teachers’ professionalism and/or professionalism may be considered to be enhanced.”

She interprets teachers as involving all who carry out professional, recognised teaching roles, including pre- school teachers and teachers in the post compulsory education sector. She accepts Hoyle’s (1975) separation of the terms professionalism and professionalism. Professionalism as being the status –related parts of teachers work and after due analysis and consideration defines professionalism as: an ideologically -, attitudinally-, intellectually- and epistemologically-based stance on the part of the individual, in relation to the practice of the profession to which he/she belongs, and which influences his/her professional practice.’

Professional development has many definitions in literature. Professional development covers all forms of learning undertaken by experienced teachers from courses to private readings to job shadowing (Craft, 1996). Billings (1977: 22, in Bell 1991: 4) used the term to describe moving teachers forward in knowledge and skills.

In- service teacher training (Inset) has many definitions and a composite one is difficult to develop (Reddy 2004: 139). According to Bagwandeem and Louw (1993:19) Inset includes all the experiences that a teacher undergo to expand his/her professional or

personal education. Holly and McLoughlin (1989) define Inset as events or processes designed to allow teachers new learning or development opportunities.

These definitions overlap and it is often difficult to distinguish between them. Like Craft (1996) and Reddy (1994), I will use the terms interchangeably to mean *all positive professional learning that teachers experience after their pre- service training*.

### **2.2.2 MODELS FOR PROFESSIONAL DEVELOPMENT**

One of the models for the evaluation of the effectiveness of the process of teacher professional development that I have chosen to use as part of my conceptual lens is the Bell and Gilbert model developed from a three year study in New Zealand. This model is a comprehensive one and deals with the aspects of teacher professional development as discussed and critiqued in most of the literature, namely the personal, professional and social development of the teacher. Although, these aspects of teacher development are discussed in various models, Bell and Gilbert differentiates these aspects into levels so that teacher development can be assessed on nine levels, giving a greater range and scope for discussion and interpretation. The model emphasizes personal development as crucial to teacher development as teachers can only take responsibility for their own learning if they recognize their strengths and weaknesses. Clarke and Peter (1993) refer to the:

- Personal domain: attitudes, beliefs, knowledge;
- External domain: Support and information provided;
- Domain of practice: professional experimentation and;
- Domain of consequence: observable or measurable student learning.

I did not choose this model as one of my conceptual models as the study did not deal with the learners – the domain of consequence: observable or measurable student learning.

The two models both have the three stages of teacher development, namely, personal, professional and social domain, but Clarke and Peter (1993) discusses and critiques student learning as part of teacher professional development and the highest level of achievement of success of teacher professional development.

Indicators for measurement of success of in-service interventions that focus on professional development of teachers have been developed by Janse Van Rensburg and Le Roux (1998: Part V). The indicators were developed with participants in a participatory course in Environmental Education. The participants were collaborators in the evaluation of the course and co-constructed the indicators. The indicators are:

- New understandings;
- Changing approaches to work;
- Improved job skills;
- Increased confidence in the work environment;
- Developing networks and learning from each other;
- Developing material resources for teaching and learning.

These indicators are broad and generic but will be adapted to be used as part of the conceptual lens as they were developed by teachers for teachers. This will be discussed later in the chapter. The indicators would be used as part of the theoretical framework for the study.

The Bell and Gilbert model is based on a three- year research programme on teacher development in New Zealand. The science teachers were developing their teaching to incorporate learners' thinking and the constructivist view of learning. The main finding was that teacher development involved personal, professional and social development of the teacher. This is aligned with the Clarke and Peter model (1993) as well as the indicators of Janse van Rensburg and Le Roux (1998: Part V). These levels of teacher development are also inherent to Guskey's model of evaluation of teacher professional development (2002:46-51).

Teacher development can be viewed as teacher learning: a purposeful inquiry or investigation on an aspect of their teaching, rather than teachers changing because of an outside agent. Through the process of learning, teachers develop their beliefs and ideas



on what it means to be a teacher, reflect on their classroom practice and develop an awareness of their feeling and attitudes about the change process. Teachers learn about professional development, the change process and their process of learning.

The Bell and Gilbert model for teacher development consists of three aspects which are divided into three integrated and interdependent levels. Professional development on one level affects the development of the other levels (TABLE 2.1). This is echoed by Daloglu (2004: 689 - 690), who states that if the four domains of the teachers' world, as identified by Clarke and Peter (1993), are addressed in the programme, teacher change in one domain leads to a change in the other.

**TABLE 2.1 STAGES OF TEACHER DEVELOPMENT: BELL AND GILBERT (1994)**

	<b>Personal development</b>	<b>Professional development</b>	<b>Social development</b>
<b>Level 1</b>	Recognising and accepting an aspect of teaching as a problem	Trying new activities in the classroom	Feeling that isolation is a problem
<b>Level 2</b>	Dealing with the issues	Developing ideas and classroom practice	Valuing collaboration at different levels
<b>Level 3</b>	Feeling empowered	Initiating other professional development activities	Initiating networks and collaborative ways of working

Adapted from Bell and Gilbert (1994)

In the study, support, feedback and reflection are identified by teachers as being essential to their development (Bell and Gilbert, 1994). The teacher development programme focussed on new teaching activities and pedagogical practices (being a teacher).

Discussions related to learning, science and the curriculum flowed from these two foci.

According to Bell and Gilbert, teacher development can be seen as consisting of two aspects: the introduction of new theoretical ideas and new teaching strategies. Both are embedded in the three aspects of teacher development: professional, personal and social.

The study demonstrated that though teachers attended the same programme, they had differing starting points in the development process and achieved different outcomes. Personal development is an important part of teacher development without which the other aspects of development is not possible. The pace of personal development affected the pace of professional and social development. Personal, in this context, means affective development (Bell and Gilbert, 1994: 495). This is echoed by Clarke and Peter (1993) in the discussion of the personal domain of teacher development. In the indicators of Janse van Rensburg and Le Roux (1998: Part V), personal development is indicated by increased teacher confidence in the work environment.

Social development is an integral aspect of teacher development (Bell and Gilbert (1994), Daloglu (2004), Janse Van Rensburg and Le Roux (1998: Part V). It involves working with teachers in new ways, discussing the teaching and learning process and developing teacher networks. This is a focused discussion and not left to chance.

In the Bell and Gilbert study, the teachers preferred to be given a range of activities which they could choose to practice over a period and not to be compelled to teach a particular activity. They appreciated the opportunity to manage the risk involved in their teaching. Teachers contributed to the discussions, were supported, guided and given feedback through this process, 'the desired teacher development was not achieved by trying to force the teachers to change' (Bell and Gilbert, 1994: 496). Teachers needed to be convinced about the need for change and to be part of determining the direction of the change before they would engage in learning (Bell and Gilbert, 1994). Time was also a factor in trying to reach all levels of development.

According to Guskey (2002), evaluation has become an important aspect of professional development as policy makers and investors ask whether it is making a difference. A simple definition of evaluation is the 'systematic investigation of merit or worth' (Joint Committee on Standards for Education Evaluation, 1994: 3). Evaluation is a thoughtful

and intentional process whereby data is collected, analysed through appropriate techniques, and judged.

Guskey (2002) has developed critical levels of evaluation for professional development which become progressively more complex and are interdependent.

### **Level 1: Participants' Reaction**

The first level of evaluation looks at participants' reaction to the professional development activity. This type of information is easy to collect and the data is usually gathered through completion of questionnaires at the end of the activity. Questions usually include teachers' response to the activity. For example, did they like the facilitator? What were the strengths of the activity? What could be improved? Did the participants learn anything? Did it add value? Did they like the tea? Was the room comfortable? The data refers to the teachers' response immediately after the workshop. This evaluation can help with the improvement of the activity in terms of logistics and delivery.

### **Level 2: Participants' Learning**

At this level the participants' knowledge and skills gained during the activity is assessed. This can be done through simple testing or through the development of resources by the participants, the critique of the resources, simulations of classroom practice, diagnosis, case studies, demonstrations, etc.

This type of evaluation is normally done at the end of a workshop. The outcomes of the activity have to be explicit at the outset of the activity and can be used to improve the content, format and organization of the activity.

### **Level 3: Organisational Support and Change**

At this level of evaluation, the context within which the professional development activities will be implemented and change to occur, is examined and the necessary support for this implementation provided.

This requires that district and school policies be examined to ensure that the change and type of development is possible. It requires that support mechanisms for the teacher be accessible. Organisational support and change is a crucial factor in professional development and can hamper implementation.

At this level of evaluation, the focus is the organisations' character and success. Were the changes that were encouraged through the activity aligned with the mission of the school, district and national policies? Was the individual supported through this process? Was enough support available? Was successes acknowledged at different levels and shared?

Gathering information can be done through questionnaires, interviews, studying records of schools and through various other sources. The information could be used to improve organisational support.

### **Level 4: Participants use of new knowledge and skills**

At this level, the participants' use of new knowledge and skills is analysed. Did the professional activity make a difference? Is the teacher implementing in the classroom to affect teaching and learning?

This type of evaluation can only be conducted after the activity has been completed and over a period. Data can be collected through portfolios but the best form of data gathering would be observations either directly or through audio visuals. Journals and questionnaires are also effective methods for gathering data.

This level of evaluation looks at the implementation of the activity in teaching and learning and requires a time lapse after the completion of the activity.

### **Level 5: Student Learning Outcomes**

At this level of evaluation, improvement in students' knowledge and skills are assessed based on the professional developmental activity. This would be part of the objectives of the activity.

Data about the intended as well as the unintended outcomes should be collected. This type of data collection would assess the cognitive abilities of students and would involve pre and posttests, students' portfolios, grades, as well as students' affective development such as students' levels of interaction, classroom behaviour, motivation, study habits and self concept.

Data can be collected through questionnaires, interviews with students, parents, teachers and administrators of schools as well as school records and portfolios. This type of evaluation assesses the improvement of all aspects of the programme; its implementation and support. This level of evaluation was not included in the study due to the focus on teachers.

Veenman and Van Tulder (1994:304) emphasizes that in order to verify and use student learning outcomes, causal links must be demonstrated between the learners' progress and the knowledge and the skills offered in the development programme. This was not the focus of the study.

These levels of evaluation can determine the effectiveness of professional development activities. The collection and analysis of the data can improve programmes. In the complex context of a school it is impossible to state that a professional activity would be solely responsible for improving teaching and learning in the classroom. There are many variables that affect the teaching and learning in the dynamic, changing and complex

environment of the classroom and school. If the objectives of the programme are clarified at the beginning of the process, it is easier to evaluate the activity and collect evidence through various methods.

The implications of this model of evaluation are firstly, that all the levels are important. The information provided by all levels is essential for the improvement of the professional development activities. Monitoring effectiveness at one level does not indicate and ensure success at the other levels, although success at one level can make success at the other levels easier. Secondly, it takes time and planning to achieve the five levels and breakdowns can occur at any stage. Thirdly, planning for professional development to improve students' performance has to happen from level five to level one. The objectives for student improvement have to be clear and measurable. This will then determine the type of activities, the time and effort needed for the activity.

Evaluation of professional development provides the evidence for us to decide between poor professional development activities and good ones. Furthermore, it provides the necessary evidence for enhancement of professional development programmes (Guskey, 2002).

In a study done in America, a national evaluation of the Eisenhower Professional Development Programme: a funding programme that supports professional development, it was possible to examine the factors that influence teacher development as identified in literature, and in the reports of teachers on changes in their knowledge, skills and classroom teaching practice (Garet, Porter, Desimone, Birman and Yoon, 2001: 918).

According to Garet et al, there are two types of factors: structural and core that influence teacher development.

## **Structural factors**

- (a) Type of activity: Workshops would be the most common form of professional development. A workshop would be a structured activity that would be conducted outside the classroom. It involves an expert or specialist and participants who attend in a scheduled time. This type of activity is most criticised in literature as having very little effect on teachers practice (Louckes – Horsley, Hewson, Love, & Stiles, 1998). Another type of activity would be “reform” types of professional development which include coaching, mentoring and study groups (Garet et al, 2001: 920). Reform activities occur during normal teaching times and can make better connections with classroom teaching and may be better able to change teachers practice (Fullan and Hargreaves, 1992).
  
- (b) Duration of activity: The duration of professional development would have an important influence on teacher learning. The longer the time spent on the activity the greater would be the impact on teaching practice. The amount of time spent as well as the span of time would influence this process (Garet et al, 2001: 922).
  
- (c) Collective participation: Professional development activities are designed for groups of teachers from the same school, grade or department. The potential advantages are that teachers from the same school and grade can communicate and support each other; they can share the same resources and discuss students from the same school. In addition, when teachers leave the school the professional culture at the school is easier to maintain (Garet et al, 2001).

## **Core factors**

- (a) Focusing on content: Studies have found that professional development that focuses on specific content and how learners learn the content have a greater

effect on student achievement than professional development activities that concentrate on general pedagogy. (Cohen and Hill, 1998)

- (b) Promoting active learning: This occurs when teachers are actively engaged in the professional development activities through discussion and debates, planning and practice (Loucks-Horsley, Hewson, Love and Stiles, 1998). Active learning can be observation of experienced teachers, being observed teaching, planning how new curriculum material and teaching methodologies will be used in the classroom, assessing learners work, presenting and leading discussions and publishing articles. (Darling – Hammond, 1997)
- (c) Fostering coherence: This involves professional activities being part of a coherent programme for teacher development. It must be consistent with teachers' objectives for professional development by building up on the existing activities in which teachers have participated. The activities have to be aligned to the national curriculum in terms of standards, assessments and content. If the activities are aligned, they can contribute to an improvement in teaching practice (Grant, Petersen, and Shojgreen-Downer, 1996).

Fostering professional communication with other teachers can enhance professional development. There is evidence that teachers involved in change who network with each other remain motivated.

The results of the study show that the type of activity has an influence on the duration, with reform activities involving more time than traditional activities. It indicates that reform activities have slightly more positive outcomes because more time is allocated to these activities.

Time span and duration has a positive influence on opportunities for active learning and for coherence. The study indicates that both time span and contact hours are important.



All three of the core factors have a positive influence on enhanced knowledge and skills. Activities that have a greater emphasis on content, are connected to teachers' experience, standards, assessments and communication with other teachers are more likely to produce enhanced knowledge and skills. Teachers confident of their content knowledge and skills are more likely to change their teaching practice (Garet et al 2001: 933 – 934).

The results of the study provide empirical data on ways of improving professional development. Focus has to be on duration, collective participation and core features. Type of activity is not as important (Garet et al, 2001: 936). The results also support the importance of collective participation and coherence of professional development activities.

I will use these three different models for identifying and evaluating the levels of professional development that occurred in the two programmes. These indicators provide a conceptual lens through which professional development can be evaluated regarding their effectiveness, usefulness and value to the participants. In the study, this mix of indicators will be used to gauge whether or not professional development has been enabled through the processes of the SWAP and MTN-SUNSTEP programmes. The process of the programmes and the use of the resource kits in enabling professional development in science teaching will be evaluated.

I included an overview on science professional development programmes in South Africa as well as internationally to gain insights into the processes of professional development, the challenges as well as the possibilities that arise. The overview supports the selection of the models and indicators I will use in my study.

A study done in Korea by Cho (2002), studies the effects of a science –technology-society (STS) in-service programme designed to change teachers awareness and practice of STS/constructivist approaches. The study focussed on students' understanding and changes in perception of the constructivist learning environment. The programme was

developed to achieve teacher oriented teaching in a social context, developing STS units and their use in the classroom.

The Iowa Chautauqua Program (ICP) was developed as a professional development model for in-service science training in Iowa and other states as well as Japan, Spain and Taiwan.

This model provides teachers with support throughout the year. It starts with a two-week workshop for teacher leaders in the June vacation; followed by a three- week workshop for teachers in the regions. The workshop includes methodology, curriculum alignment and assessment. This is followed by a five- day trial period of the materials at the schools. The materials are then adapted to suit their needs for a teaching unit. The research is set up with pre-assessment, videotaping and post assessments.

Studies of this process indicate that teachers gained confidence in teaching science, their understanding of the nature of science and technology improved. Their understanding of the concepts and processes in science improved as well as their ability to develop strategies to use the methodology.

Korea introduced a new approach in their national curriculum, the Science-Technology-Society Approach. At that time, teachers had little experience and exposure to teaching science in a social context. Most in-service training concentrated on science content, methodology and new trends in science education. Very little material was available for teachers to teach the STS units.

The in-service program was a new attempt to introduce the new methodology and approach. This model was used to encourage teachers to network and exchange ideas with peers and university researchers. Teachers had opportunities to work together, to reflect upon their teaching, share resources and create a larger bank of resources for their

use. The achievement of the programme reflected in the learners' test scores. Their basic understanding science concepts improved as well as their application of these concepts.

The study showed that teachers' ability to identify learners' ideas and social issues, their understanding of the educational goals and assessment issues, applying new trends and research in science in their current teaching and their co-operation in the process improved. This model for teacher professional development echoes Bell and Gilbert (1994) as it includes the development of the personal, professional and social aspects at different levels. The programme created the opportunity for the development at all the levels with teachers developing their own resources, taking responsibility for their teaching and developing networks. The success of the programme can also be measured using the indicators of JanseVan Rensburg and Le Roux (1998: Part V), teachers developed new ways of teaching science, developed new materials and developed teacher networks to support each other. In my opinion, the programme was successful as it was developed using professional development approach and objectives. It was done over a period, was needs based and focussed on both content and methodology.

An evaluation of the Natal Primary Science Project (PSP), a national programme was conducted by Jim Taylor, Carmel McNaught, Rob O'Donohue, Menaka Padayachee, Dianne Raubenheimer, Ruth Vilakazi and Nathi Mhlongo in 2001. The programme is actively involved with primary school science teachers. The evaluation focuses on school science education, teacher development, in-service activities and curriculum development. In the context of teacher development, a set of essential elements are implemented. These elements are: materials and resources, teacher in-service training, coping strategies, teacher participation, curriculum development and evaluation. The successes of the programme: teachers are actively organising their science committees, are involved in science competitions, Olympiads, excursions and biological gardens, are networking with each other to share resources and are leaders in organizations. Some teachers are presenting their innovations at seminars and conferences.

The indicators of JanseVan Rensburg and Le Roux (1998: Part V), can be used to determine the success of the programme: teachers formed networks to learn from each other; new understandings of the content and greater teacher confidence were developed as they could present their findings at conferences. Using the Bell and Gilbert Model (1994) to evaluate the programme, indicates that opportunities for social , professional and personal development were essential to the programme.

A case study of the micro-scale primary science system (MPSS) evaluates the implementation of the system (MPSS) as a teacher support resource in four primary schools. The evaluation was part of a national South African intervention programme which equipped four hundred schools in four provinces with the MPSS kit. The MPSS is a low cost system for teaching and learning science through practical work at primary schools (grades 4 -7). The research study included clinical interviews, written questionnaires and qualitative analysis of the classroom sessions.

The National Department of Education implemented the primary schools micro science programme in four provinces, North West, Northern Cape, Eastern Cape and Kwazulu Natal. The programme consisted of a two phase training component. In the first phase, twenty eight education development officers (EDOs) from the four provinces were trained over a period of five days at the University of Witwatersrand. The EDOs were involved to ensure support after the training. The second phase was training four hundred teachers, one hundred from each of the provinces. Both the EDO and the teacher workshops promoted ownership of the programme. This should have ensured continuity by emphasizing self-sufficiency and the development of the skills and structures. The teachers received kits, chemicals and printed resources to use in their schools.

During the training, teachers were highly motivated and enthusiastic about the implementation of the programme. From the responses, ninety nine percent responded that the workshop was valuable, one hundred percent was confident that they would use the kits in their classrooms and ninety nine percent felt confident they would be able to

train other teachers at their schools. The EDOs were enthusiastic about the programme, impressed with the quality of the teacher workshops and the micro science equipment.

The school visits to collect data occurred six months after the training workshops. Teachers were requested to teach the three states of matter using the micro science equipment. The lessons were videotaped.

Six months after the implementation of the programme, the four teachers involved in the research had not used the equipment extensively in their teaching. They stated that they needed more class time to use the equipment. The school timetable did not make allowances for this.

The implementation of the micro science programme was hampered by many factors: The changing environment created by the implementation of Curriculum 2005 (DOE, 1997); the cascade model for teacher training; the programme was not prioritized by the provincial department; it did not receive the required support from the provincial officials and the teachers and; the teachers could not strategise to overcome the logistical, policy and organisational issues as well as their confusion over the implementation of OBE.

It is possible that the challenges could have been overcome by training EDOs for the programme or more support from the EDOs. The support of the EDOs in subsequent workshops and in the classroom was an important factor in the continued use of the equipment. (Nakedi,)

As stated by Taylor and Vinjevold (1999), government needs to appreciate the magnitude of the challenges and realities of teacher development and training:

...reform initiatives aimed at revitalizing teacher education and classroom practices must not only create a new ideological orientation consonant with the goals of the new South Africa. They also need to get to grips with

what is likely to be a far more intractable problem: the massive upgrading and scaffolding of teachers' conceptual knowledge and skills.

When one uses the indicators of the three models to evaluate the programme, the programme did not fully develop the three aspects of teacher development as identified by the research. Opportunities for social networks were not created, teachers did not feel empowered, and they might not have recognised that aspects of their teaching were problematic. They did get support for their professional development, and their approach to their teaching did not change. In my interpretation, teachers were not given enough time to reflect on their practices, their mindset and attitude to teaching. . Both at school level and at the workshops, the support for the programme and the teachers were lacking.

Studies has shown that short term INSET programmes in support of curriculum reform do not easily change the teaching and learning in the classroom.(Adler and Reed, 2002) Teachers need consistent support from an experienced mentor with a focus on the understanding of concepts and process skill development. Follow -up workshops to support teachers to work innovatively with the equipment was essential. (Nakedi).

An important component for success in educational reform is in -service education (Lappan 2000 and Yager 2000). In science education reform, science teachers should participate in lifelong learning where teachers play a role in the process of development of professional development programmes and activities. This experience should be intellectually stimulating rather than just a technical exercise for specific skills and should take into account the context of the school.

## **2.3 PROFESSIONAL DEVELOPMENT IN SCIENCE TEACHING**

### **2.3.1 WHAT IS SCIENCE TEACHING?**

Science teaching is a complex process (Loucks-Horsley, Love, Mundry, Stiles, and Hewson, 2003; Monk and Osborne, 2000). Teaching is about organising and shaping learning experiences for learners (Loucks-Horsley et al., 2003 :37; Monk, 2000 :5). With curriculum reform and new demands placed on teacher in terms of delivery of the curriculum and reaching high standards, teaching concepts in depth and to all learners has to be re-examined (Loucks-Horsley et al., 2003:38). To deliver quality education conforming to the principles of the curriculum requires that teachers know their content areas, understand how learners learn, and have a wide range of teaching strategies to facilitate learning (National Council of Teachers of Mathematics, 2000; National Research Council, 2001). They must be skilled at assessing learners and using the assessment information to make daily teaching decisions. Professional development should focus on supporting the improvement of their skills in these areas (Loucks-Horsley et al., 2003:38).

The function of teaching is to facilitate learning. For effective teaching to have occurred learning has to take place. Teachers have to make learning achievable for learners. Effective teaching involves continuous assessment of learners, choosing appropriate learning activities based on the assessment, and re-assessing to gain information on the teaching and learning process and to determine the next activity (Black and Williams, 1998). Self- assessment is a necessary part of this process. This implies that teachers need a good understanding of their subject matter, be able to understand what they can learn from assessing learners work and their thinking, and be knowledgeable about teaching, learning and assessment strategies. This has implications for quality professional development (Loucks-Horsley et al., 2003:38).

As stated by Loucks-Horsley et al., (2003), the present view of the teaching profession demanding specialized knowledge of the field, is in contrast with the traditional view of teachers as technicians, who apply a body of knowledge produced by others (Loucks-

Horsley et al., 2003:39). This involves knowledge of the subject matter, the learners and of teaching as well as assessment strategies. Fernandez-Balboa and Stiehl (1995), refer to this knowledge as pedagogical content knowledge meaning, how to teach specific content in science. Developing this pedagogy of content knowledge demands a sound understanding of the subject matter (Loucks-Horsley et al., 2003: 40).

Teachers recognize that much of their knowledge is based on their practice and their complex knowledge particularly of how learners learn, influences their teaching (Loucks-Horsley et al., 2003: 40). This implies that teachers need opportunities to engage with themselves and other teachers on these issues, Ball and Cohen (1999).

Teaching is complex because the process of learning is complex (Monk, 2000:5; Loucks-Horsley et al., 2003:41). Teachers have the responsibility to ensure that all learners learn. They have to ensure that the learning environment is safe, where learners' ideas and input is valued and respected and where the learners can explore and learn. They have to respond to their learners and ensure equal access to equitable teaching for all learners (Loucks-Horsley et al., 2003:42).

### **2.3.2 THE NATURE OF SCHOOL SCIENCE**

Changes in society have resulted in changing expectations of the school. The impact of science and technology on everyday life has served to highlight the role of science in the curriculum. According to Bennett (2003), who concentrates her research in the United Kingdom, these issues are common to many countries. Debates on the access of learners to science education, the relevance of the science curriculum and its preparation for later life, abound (Bennett, 2003: 14; Loucks-Horsley et al., 2003: 42).

Today in South Africa, learners follow a compulsory science curriculum from grades one to nine. The school science programme contains aspects of biology, earth science, physical sciences, space science and chemistry (DOE, 2002). This trend exists in many countries (Bennett 2003:14). The questions asked by the science education community



are: What to teach? How to teach? What to assess? In South Africa, some of the answers were provided by the introduction of the National Curriculum Statement, a curriculum that specified the subjects to be studied in compulsory schooling (Department of Education, 2000).

In science teaching, attempts are made to incorporate the methods of scientists into the science classroom, to allow learners to engage in scientific inquiry through science investigations. This involves the science processes of observing, predicting, hypothesizing, measuring, testing, explaining and evaluating. These processes allow science learners to make informed decisions and understand the nature of science and its impact on their lives (Loucks-Horsley et al., 2003: 43).

Bennett's (2003) account of science education in the 1990s in the United Kingdom (UK) resonates with current science education practices in South Africa. This decade was about raising standards in the UK.

‘The decade was one characterized by increasing centralized control, increasing curriculum prescription and increasing accountability’ (Bennett, 2003: 18).

The curriculum materials for the 1990s in the UK have attempted to cover the assessment requirements and curriculum specifications. Most resources related science ideas to the learners' everyday life. Curriculum materials relied less on recommendations of research into the learners' understanding or misunderstanding of scientific ideas. In the 1990s, more work was done on assessment, practical work and investigations (Bennett, 2003: 19).

However in the UK at present, the structure and content of the science curriculum is once again under scrutiny as the ‘science for all’ principle has not yielded more involvement of learners in science after the compulsory phase. Millar and Osborne in *Beyond 2000* (1998) has presented a vision of a core school science curriculum where learners are educated about science rather than for science. This places less emphasis on scientific

theories and concepts and more on application of science and decision- making processes involving science. The learners who wish to specialize in science would choose to study additional modules on traditional science content.

### **2.3.2.1 SCIENCE LEARNING**

Science teaching and learning are intertwined and when considering good science teaching practices, we need to examine the learner and the learning of science (Monk, 2000:5).

According to Leach and Scott (2000:43), science learning is about coming to understand, and being able to use the conceptual tools of the science community. The learner is involved in making sense of scientific views. Learning occurs in a context of everyday applications and ways of thinking of the phenomena under study (Leach and Scott 2000:43).

### **2.3.2.2 CONSTRUCTIVIST APPROACH TO TEACHING AND LEARNING**

Constructivist view of learning emphasises the active role of the learner and the relationship between the existing (old) knowledge and the ‘new’ knowledge (Leach and Scott, 2000). As an experienced science teacher, I am aware that science learning can create difficulties. The learning outcomes after teaching are often disappointing in terms of what learners understand, how much they can apply, what they remember and what skills they have acquired (Leach and Scott 2000: 44).

The scientific view and explanations often comes across as counterintuitive to the common sense explanation of the phenomena. The differences between the everyday and the scientific view can be called the learning demand (Leach and Scott, 2000). This challenges the learner in internalizing and understanding the scientific view of the phenomena. The learning demand helps the teacher to understand the learning steps necessary in making sense of the scientific view and helps the teacher to identify the difficulties that the learner might experience in the process of accepting the scientific

viewpoint. The learning demands of learners are not always identified using the traditional approaches of breaking the subject matter into clear logical steps. (Leach and Scott 2000: 47)

Designing teaching strategies is not only about learning demand but also the subject matter and its interrelated concepts. Research shows that learning and teaching does not occur at the same pace. Learners who follow a carefully designed teaching scheme do not necessarily understand the scientific view. Learners can learn in smaller steps resulting in their thinking being more advanced than before but will not necessarily understand the scientific view (Leach and Scott 2000: 48).

### **2.3.2.3 THE CONTEXT BASED APPROACH TO TEACHING AND LEARNING**

The last twenty years has seen the development of curriculum and curriculum materials, both locally and nationally, which uses contexts and applications as a point of departure for developing understanding of scientific ideas and concepts. This type of approach to teaching and learning is often described as ‘context –based’, ‘applications-led’ or using the ‘Science-Technology- Society’ links (Bennett, 2003: 100).

This approach should not be confused with the ‘relevance’ approach. Both approaches highlight the links with schools science and everyday life. The difference in approach is the point at which the links are made. In the ‘context-based approach’ the links are made at the start of the topic and is used to develop the scientific idea. In the ‘relevance’ approach the scientific concept is first taught and thereafter links are made with everyday life (Bennett 2003:102).

Bennett (2003: 102) raises three factors that contributed to the adoption of a context-based approach: firstly, the irrelevance of the materials used in the classroom for the learners, secondly, the small numbers of learners who choose to do science, particularly physical sciences at a post – compulsory level and thirdly, the concern over the science courses offered to non-science specialists. The origins of the context -based approach in

classroom practices come from teachers' desire to make lessons interesting for the learners. Informal evidence shows that most teachers determine the success of their lessons by the learners' interaction with the materials (Bennett, 2003: 102).

Bennett (2003) writes that researchers have argued for the motivating effects of context-based teaching and the use of the context-based approach is now widespread. Context-based learning can have several meanings:

At its broadest, it means the social and cultural environment in which the student, teacher and institution are situated..... A narrower view of context might focus on an application of a physics theory for the purposes of illumination and reinforcement (Whitelegg and Parry, 1999:68).

Very little evaluation of the context-based approach has been undertaken but as the use of the approach has become widespread, an increasing interest in its effects has been noted (Bennett, 2003: 113). The majority of context-based materials have been developed for high school learners. Research shows that this approach helps learners to make the links between science and their everyday life. Evidence also suggests this approach enables learners to learn science concepts, at least as effectively as those following courses with more conventional approaches.

Research into this approach has provided valuable information on curriculum innovation and its implications for teaching practice. It provided concrete examples of materials which research indicates should increase learners' interest in science and help them see the links between science and society. In some cases, it also developed a better understanding of particular science ideas than more traditional approaches (Bennett, 2003:121).

The research indicates some of the disadvantages of this approach. Some learners view the interesting and enjoyable activities they are involved in as 'not really' about science. A number of key ideas in science appear to be poorly grasped, irrespective of approach used

in their teaching. The interest and enjoyment in science lessons do not appear to translate into a widespread desire to study the subject further (Bennett, 2003: 121).

## **2.4 RESOURCE KITS**

I have included a literature review of the role of learning support materials, as resource kits are an integral part of SWAP and MTN-SUNSTEP. The study evaluates the role of resource kits in enabling teacher professional development. Resource kits are defined as learning resource materials as discussed 2.4.1.

### **2.4.1 THE ROLE OF LEARNING SUPPORT MATERIALS**

The term materials and resources are used interchangeably and refer to worksheets, resource kits, science kits, computer programmes, games, text- books, teacher guideline documents, posters, overhead transparencies, slides and resource boxes (Russo and Lotz – Sisitka, 2003:15). Materials are defined as “any systematic description of the techniques and activities to be used in classroom teaching (Brown, 1995: 139). Adler (et al, 2002) states that teachers as critical practitioners use different kinds of resources to enhance the teaching and learning environment for the learners. Based on these definitions of materials and resources, I will therefore use the terms interchangeably.

The design and production of learning support materials are an integral part of curriculum development. Well- designed resources can promote and enhance ‘good’ teaching and learning. These resources play a major role in teaching and learning as “teachers often come to depend on them for some or all of their content and pedagogical content knowledge” (Kesidou and Roseman 2002: 522). The materials provide a framework for guiding and supporting teachers and the learning process. It provides teachers with a framework for planning and implementing the learning programme (Russo and Lotz – Sisitka (2003:15).

There are two approaches to the development of learning support materials. This can be ‘top down’, ‘expert driven’ and ‘package –centred’ where the expert decides what would be developed and how it would be used (Russo and Lotz-Sisitka, 2003). The term RDDA (Research, design, disseminate and adopt) has been coined for this model that emphasizes the role of the expert (Robottom in Russo and Lotz-Sisitka, 2003). Materials are developed by experts, distributed to teachers, schools, district offices and communities where they are implemented by teachers and learners. This type of approach demonstrates a lack of consultation and expects teachers to follow a fixed set of ideas that does not take the teaching and learning context into account (Russo and Lotz-Sisitka, 2003).

The other model is participatory where teachers form part of the development process. This method currently has greater acceptance and prominence (Russo and Lotz, 2003:9-10). Several advantages to this model have been highlighted. Teachers are more involved with the process and develop a better understanding of the issues. Teachers would develop a greater sense of ownership of the materials. Materials are developed “*with* people rather than *for* target groups”. Materials would be used more extensively as teachers have a better understanding of their use. It would be easier to contextualize these resources for both learners and teachers (Russo and Lotz, 2003:30).

However, this model has drawbacks as it is time -consuming and has implications for the quality, purpose and use of the materials (Russo and Lotz, 2003:10). Because of these implications, an approach that combines the role of the expert with teacher participation has emerged (Russo and Lotz, 2003: 11).

Learning support materials are not developed in a vacuum, but are designed for particular situations and contexts. The context of learning guides the choice of information and the type of resources for material development (Russo and Lotz, 2003).

Russo and Lotz (2003), argue that material development processes often do not consider the manner in which materials will be incorporated into the classroom. They support their

argument with the tendency that exists to ‘commodify’ and ‘trivialise’ the learning support material. The learning support materials are treated as ‘objects’ or ‘commodities’ and their integration into the teaching and learning process is neglected. A lack of reflection occurs on the role of learning materials in the learning process, how learning occurs and how support material is integral in this process. Russo and Lotz, (2003:11-13), advocate the research- based learning approach. This involves adapting the materials to the context and ongoing reflexive research on how learning support materials support the learning process.

An evaluation of middle grades science text- books and stand- alone units which formed part of a study called Project 2061, focused on identifying materials that supported learners in learning key concepts through the quality of instruction of the text, found that none of the science texts evaluated by Project 2061 was rated satisfactory. This was based on criteria of how learners learn. The stand-alone units developed by the Department of Education in Michigan, based on research of how learners learn, were rated much higher than text- books. This indicates that good science material can be developed (Roseman et al., 1999:2). The evaluation was based on categories that incorporated the need for science text to be able to serve the learners’ requirements as well as the instructional needs of teachers.

Eisner (1990:65-66) emphasises that materials’ development should enable teachers to develop resources that meet five criteria:

- The activities should develop skills, ideas and perceptions that are educationally sound;
- The activities should stimulate higher order critical thinking and be intellectually challenging;
- The resource content should be visually stimulating and should not rely on text only;
- The content and concepts should be integrated and help learners make connections to other areas;

- Teachers should be given options of activities through the materials, for example enhanced activities.

Teachers have opposing views on resources; some prefer that resources are prescribed and that they make very little decisions. Others prefer to develop and /or adapt the materials themselves. Curriculum materials are indispensable tools that allow teachers to best work with learners. These materials provide the framework for the science programme. The materials are based on the best thinking in the field and allow teachers to make the best decisions about their learners' learning (Kesidou and Roseman, 2002:523)

A study done by Remillard (2000), to examine whether and how reform –orientated mathematics textbooks could contribute to the learning of teachers based on case studies, suggests that 'materials most likely to foster teacher learning are those that engage teachers in the learning' (Remillard, 2000: 331 in *The Elementary School Journal*). Current research on the use of curriculum materials has shown that teachers' beliefs and knowledge about the process of learning, teaching and their understanding of content will influence their decisions about what and how to teach, more so than text books (Putnam, 1992; Remillard, 1992). These results suggest that changing instruction will require learning by teachers. Because teacher learning is necessary in curriculum change, curriculum reformers has relied more on teacher development than on curriculum materials (Remillard, 2000).

This study emphasises the need for well -designed curricular guidance (Brown, 1995). Teachers have to interact with texts in new ways that was not demanded in the old curriculum. Teachers need opportunities to learn to use text to assist in the construction of their classroom curriculum. Reformed curriculum materials will only significantly affect teaching if support is provided for the use of the materials (Remillard, 2000: 347).



Professional development should help teachers play a more active role in curriculum development processes. Material and teacher development should be a coordinated and coherent strategy and not be at cross -purposes to each other (Remillard, 2000:347).

Teacher and curriculum development occur in a school context. Their effect on the teaching and learning process is determined by the school context (Hargreaves, 1994: Jackson, 1986, Sarason, 1982). Therefore, the adoption of curriculum materials that assist in the change process must occur within a school and district context supportive of teachers as curriculum developers (Remillard, 2000:348).

These views of the role of learning support materials in professional development, as well as the process of professional development, is echoed in a study done by Daloglu (2004). The teacher development programme focused on establishing a materials' bank for English language teachers at a private school in Turkey. The programme aimed to encourage teacher change through growth and learning, to address school based needs and to provide overall quality improvement.

The in- service professional development programme aimed to improve the quality of the instructional materials, a need identified by the teachers and their learners. Materials are defined as “any systematic description of the techniques and activities to be used in classroom teaching (Brown, 1995: 139).”

Considering the pivotal role of materials, the quality of the materials used in the classroom can improve the quality of the teaching while achieving the curriculum goals (Daloglu, 2004: 681).

Based on the questionnaire and interviews, teachers found the year- long program more effective than a ‘one-shot’ workshop, the program addressed a need that was identified by the participants, the materials developed could be used immediately and teachers could benefit concretely. The programme was context- driven as it addressed an institutional

need and the participants were involved in this context. It allowed for the development of a learning community and teachers could network, share, collaborate and communicate with each other. Teachers reported that they had become more aware of the quality of their teaching; their participation in the program had contributed to the improvement in the quality of the materials and the quality of the overall instruction. Teacher became more confident and capable in developing professionally. They were more willing to take ownership of their own professional development. The length of the programme and the administrative support provided during the programme were factors that contributed to the success of the programme. These findings are echoed in the research of Garet et al (2001), Janse Van Rensburg (1998) and Guskey (2002).

The study provides evidence that for teachers to change and learn through professional development, change has to be identified with learning (Clarke and Hollingsworth, 2002). For example, if teachers can design materials that they can immediately use in class and see the impact on the learners, they believe that they have learned and changed.

Teacher development programmes which directly address the needs of the institution are viewed to be more effective. If the four domains of the teachers' world, as identified by Clarke and Peter (1993), are addressed in the programme, teacher change in one domain leads to a change in the other (Daloglu, 2004: 689 - 690). In this programme, learning resource materials was the vehicle for enabling teacher professional development.

A summary of factors that determine the success of learning support materials as developed through the literature review are:

- The activities should develop skills, ideas and perceptions that are educationally sound ( Eisner, 1990:65-66);
- The activities should stimulate higher order critical thinking and be intellectually challenging ( Eisner, 1990:65-66);
- The resource content should be visually stimulating and should not rely on text only ( Eisner, 1990:65-66);

- The content and concepts should be integrated and help learners make connections to other areas ( Eisner, 1990:65-66);
- Teachers should be given options of activities through the materials, for example, enhanced activities ( Eisner, 1990:65-66);
- Activities should be context driven – in terms of school and district (Russo and Lotz, 2003:11-13; Remillard, 2000:348; Hargreaves, 1994)) ;
- Resources should support the learning process (Russo and Lotz, 2003:11-13);
- Resources should engage teachers in the learning (Remillard, 2000:331);
- Implementation of the resource should be a supported process (Remillard, 2000:347);
- Teachers should be able to use the resource immediately in the classroom (Clarke and Hollingsworth, 2002);
- Impact on learners must be immediately visible to sustain the change for teachers (Clarke and Hollingsworth, 2002; Daloglu, 2004: 689 - 690);
- District should support the resource to ensure curriculum alignment and teacher acceptance of the resource (Remillard, 2000:348).

The overview of the literature indicates that in the programmes reviewed, the indicators that I chose as my theoretical construct are used to determine the success of the Inset programmes. The research shows that the programmes reviewed contained elements of the indicators of the mix of models, Bell and Gilbert (1994), Janse Van Rensburg and Le Roux (1998), Guskey (2002) and (Garet et al, 2001). These elements ensure the success of teacher professional development.

Based on the research, I chose the indicators in these models as my conceptual lens for the process of teacher professional development as well as the factors that determine the success of learning resource materials indicated by the literature review. This mixed model or multiple lenses will be used to evaluate the use of resource kits in the teacher professional development process.

## **2.5 CASE STUDIES**

### **2.5.1 CASE STUDY 1: MTN – SUNSTEP KITS**

#### **The history of the programme**

I decided to accept the offer of Etienne Botha, the MTN SUNSTEP programme manager, to evaluate of the programme. At that stage, I was excited, motivated and questioning whether the programme was making a difference in the teaching and learning process. In 1999, MTN – SUNSTEP was the only programme that introduced electronics to teachers and learners at schools in a sustainable way. At that time, I was a physical science teacher at Spine Road High in Mitchells Plain, who had participated in their programme and introduced the resource kits in my classroom curriculum.

MTN – SUNSTEP (University of Stellenbosch Schools Technology and Electronics Programme) is a joint venture between the University of Stellenbosch and MTN (Mobile Telephone Networks) to introduce learners in grades 7, 8 and 9 to electronics, basic electricity concepts and to provide support in the classroom.

The programme was started in 1996 when the University of Stellenbosch Satellite Project (SUNSAT) invited 1 500 schools to submit ideas for an experiment which could be placed on the SUNSAT satellite. Only four schools responded to the invitation. This highlighted the need to promote science, mathematics and technology awareness with teachers and learners. MTN-SUNSTEP was thus born, a joint programme of the Department of Electrical and Electronic Engineering, the Centre of Education Development at the University of Stellenbosch and MTN. The project was initially managed by Etienne Botha and the programme coordinator, Miranda Myburgh who later became the programme manager when Etienne emigrated. The programme collaborates with the curriculum advisors of Western Cape Education Department to remain aligned to policy requirements of the national curriculum.

The programme was launched in August 1996, working mainly with schools from disadvantaged areas. A pilot school programme was started in 1996 with eight schools from disadvantaged areas. This initiative aimed to make science and technology more accessible to teachers and learners and to promote a positive attitude towards science and technology. During 1997, the programme was extended to KwaZulu Natal and Gauteng.

MTN was the main sponsor for the programme and pledged R2 m over a period of five years. The University of Stellenbosch provides the institutional and organisational base. For the duration of the sponsorship, the objective was to reach a minimum of fifteen thousand learners per year. This would be made possible through teacher development workshops.

The mission statement of SUNSTEP as stated in a later brochure:

SUNSTEP wants to broaden the base of future scientists, engineers and technicians in South Africa by stimulating teachers and learners' interests in electrical and electronic fields.

The goals of the programme are to:

- Promote technological awareness amongst teachers and learners, especially in disadvantaged communities;
- Develop a fresh approach to science and technology education;
- Remove the mystique surrounding science and technology;
- Stimulate discussion and thought on technological issues;
- Improve the technological capability of learners and;
- Encourage participants to consider pursuing careers in science and technology.

Ms. Miranda Myburgh , the programme coordinator and later to become the programme manager, is convinced that SUNSTEP contributes to making science and technology

accessible to thousands of learners. This is illustrated by an extract from the SUNSTEP literature,

“When the children initially receive their kits, you can see that they are unsure of themselves, but once they have successfully assembled their own electronic timer or burglar alarm, they spontaneously bubble over with pride and enthusiasm. It is wonderful to observe how much self – confidence learners acquire in a matter of two to three hours and how motivated and excited they become about electronics.”

(MTN – SUNSTEP Brochure, 1998)

The SUNSTEP team has developed various electronic (resource) kits. Teachers are encouraged to use the kits in their classrooms to illustrate important scientific concepts and to link them to other teaching and learning opportunities. Learners are taught to assemble the kits as a means of bridging the gap between scientific knowledge and real life applications. The electronic kits consist of a circuit board, components and worksheets.

The components are identified and matched with their symbols. The working of the components is explained and observed in the circuit. In this way, teachers and learners gain a great deal of practical and theoretical knowledge while having fun at the same time. To encourage participation in the programme, a prize is awarded to the learner from each participating school who finds the most creative practical application for the kit.

The first phase of the programme involves the technical orientation of teachers. Teachers are invited to a three- hour workshop on a specific electronic kit at the University of Stellenbosch in the SUNSTEP laboratory. The workshops occur in the afternoon and teachers can attend as many workshops as they wish. During the workshop, the resource kit is explained and assembled using the instruction worksheet. The facilitator presents a thirty –minute presentation. Teachers then complete their kits with the facilitator assisting on an individual level.

“In this way teachers are equipped with the necessary skills so that they are able to teach the junior secondary learners to assemble the electronic kits while providing them with the basic facts on electronics. Teachers receive high priority, since they have a crucial role to play in improving the standard of science and mathematics education in schools throughout the country” (MTN-SUNSTEP Brochure, 1998).

One of the criteria for the selection of the schools, is the enthusiasm and commitment of the teachers.

In the second phase of the programme, schools purchase the kits for the learners and these are assembled in the classroom. Schools purchase the equipment required to assemble these kits. Teachers are encouraged to work with the simpler kits initially. They then teach their learners to assemble the resource kits in the classroom or at the school science clubs. Learners are taught to assemble the kits as a way of bridging the gap between scientific knowledge and real life application.

The programme field worker supports teachers in the classroom by being accessible telephonically. A technology laboratory has been established at Stellenbosch University, and teachers are invited to bring their learners to the laboratory to complete the kits. In 2001, the field worker was available to assist with workshops at the schools.

In the third phase of the programme, learners are encouraged by their teachers to use their kits in real- life applications by building models. The models are judged by the teachers and the SUNSTEP team in a school competition. A prize is awarded to the learner from each participating school for the most creative and practical application of the model. The models are entered into a provincial competition. The submission of models in the provincial competition is a criterion for determining the success of the programme and a ‘good school’. Yearly prizes are awarded to outstanding teachers on the programme.

The programme has undergone various changes in the last few years. A new programme manager and coordinator were appointed in 2000 when the study started.

### **MTN – SUNSTEP resource kits**

Initially the programme team developed resources for three modules. This consisted of worksheets for building the kits, the motherboard and its components.

In 1997, the modules included generic learning outcomes:

- Demonstration of understanding of electricity as a energy form;
- Identifying specific electronic components to the kits;
- Demonstration of a basic knowledge of electronics;
- Demonstration of the use of the correct electronic terminology;
- Ability to solder the components on the printed circuit board;
- Ability to do simple electrical calculations;
- Be able to demonstrate an understanding of the operation of the semiconductor diode;
- Be able to demonstrate an understanding of the operation of a transistor and;
- An understanding of the importance of the transistor to modern electronics.

At the end of each of the three modules, questions were provided to assess whether the outcomes were achieved. These outcomes did not appear on the later editions of the worksheets. These were redeveloped and packaged in a friendlier A3 format.

The worksheet of the resource consisted of an A3 page. This included the description of the kit, components, circuit diagram and function of each of the components as well as the method of construction, troubleshooting hints, functioning and applications of the kit.



The MTN-SUNSTEP kits available:

1. The transistor – Module 1 ( developed in 1997)
2. Electronic timer – Module 2 ( developed in 1997)
3. Burglar alarm – Module 3 ( developed in 1997)
4. Lights on alarm
5. Choice mate
6. Morse code trainer or communicator
7. Pet trainer
8. Electronic organ
9. L.E.D. ( Light – Emitting Diode) Flasher

### **The Transistor - Module 1**

In this module, the transistor is examined both theoretically and practically. The notes explain the functioning of the kit. The transistor determines the amount of current that flows through the circuit. Semiconductors are discussed as well as N-type and P-type semiconductors. Instructions are provided to solder the components on the printed circuit board.

### **The Electronic Timer – Module 2**

This module examines resistors and capacitors, its functioning and application. Resistors control current flow. The notes explain the determination of the value of resistance. In the notes, the capacity of the capacitor to store electricity and its discharge is explained. These components are soldered to the circuit board using the notes and the printed circuit board.

### **The Burglar alarm – Module 3**

The burglar alarm was a very popular kit for both teachers and learners. It is an example of a multivibrator circuit. A tone generated through the piezo buzzer is controlled by one of the transistors in the circuit. This is done through a link which is normally switched on, but when broken allows a current to flow through the buzzer. It allows the multivibrator

to operate and the L.E.D's to flash alternatively. If the link is closed, the buzzer will be switched off.

### **Lights on alarm**

This is a multivibrator circuit with a loudspeaker to warn motorists of the state of their headlights when leaving their vehicles.

### **Choice mate**

This multivibrator circuit allows the user to answer yes or no, by holding down or letting go of the switch.

### **Morse code trainer/ communicator**

This simple multivibrator includes a loudspeaker to train a user to learn Morse code language by hearing it when a button is pressed. A L.E.D provides visual communication of the signal.

### **Pet trainer**

This multivibrator circuit can be used to train animals to respond to specific sounds. The tone generated through the loudspeaker is varied through the light dependant resistor. This varied pitch can assist in the training of animals.

### **Electronic organ**

A multivibrator circuit with a loudspeaker included in its design. The tone generated by the loudspeaker creates sounds so that an octave can be heard.

### **L.E.D Flasher**

The multivibrator circuit shows how electrolytic capacitors are charged and discharged. This switches the transistor on and off alternatively which causes the L.E.D to flash.

## **Conclusion**

In my opinion, from the literature, MTN-SUNSTEP was not developed with clear teacher professional development indicators as guidelines. These are implicit in the objectives of the programme. Although the resource kits are emphasised, the success of the programme was dependant on teacher involvement. Based on the literature review this should have been explicit. In the study the programme is evaluated on teacher professional development indicators.

### **2.5.2 CASE STUDY 2: THE SCHOOLS WATER PROJECT (SWAP)**

#### **The history of SWAP**

In 1992, Professor Danie Schreuder established the schools water analysis project (SWAP) at the University of Stellenbosch under the auspices of the Environmental Education Programme (EEPUS). The project started in Stellenbosch but later spread to Delta Park and Rand Water in Gauteng, Kwazulu Natal and other provinces. Initially the project was funded by the Water Research commission and Juta. SWAP materials were developed for both senior and junior school phases at that time but the focus of the 2004 project was on intermediate phase of primary schools.

SWAP is developed as a water quality monitoring resource in America. The kit includes basic scientific tests as well as other data collecting techniques that can be used for rivers and catchment areas in general. The kits also include a teacher guidebook and A1 poster size proformas (labs) for data recording.

Since the inception of Outcomes Based Education (OBE) philosophy and methodology for teaching and learning, the SWAP activities have been revised and reintroduced as a tool for teachers and learners in Environmental Education and OBE. This has worked really well and teachers have regularly requested workshops. A partnership was also established between EEPUS and the Cape Metropolitan Council (CMC) to establish SWAP activities at various sites in the peninsula. The SWAP kits provided the resource

material to train teachers in environmental education processes. It was a learner-centred resource for learners at various locations, with follow up classroom sessions. Due to financial constraints, this partnership was severed.

SWAP kits and activities have proved to be a useful tool for understanding the concept ‘environment’, an underlying principle in environmental education, which is a focus in the National Curriculum Statement. These resource kits allow learners to have hands –on experience in the environment about the environment. The kits make it possible for learners to conduct tests, gather data about the conditions of the rivers or catchment and make judgements about the quality of water. This could lead to debates and encourage learners and teachers to respond to issues related to water quality. The resource kits also allow learners to develop knowledge and skills related to basic scientific tests and expose them to the process of scientific investigations.

The SWAP activities are aligned to the objectives of the environmental education in the United Nations Education, Science and Cultural Organisation – United Nations Environment Project guide for educators. These objectives are:-

- Awareness : To help social groups and individuals ( teachers) acquire an awareness and sensitivity to the total environment and its allied problems;
- Attitude : To help social groups and individuals acquire a set of values and feelings of concern for the environment and the motivation for actively participating in environment improvement and protection;
- Knowledge: To help social groups and individuals gain a variety of experiences in and acquire a basic understanding of the environment and its associated problems;
- Skills: to help social groups and individuals to acquire the skills for identifying and responding to environmental problems and risks;
- Participation: To help social groups and individuals with an opportunity to be actively involved at all levels in working toward resolution of environmental problems.

## **SWAP Process**

The case study for my research of SWAP was a partnership programme involving the Shuttleworth Foundation, Stellenbosch University and the Education Management and Developmental Centre, Metropole South of the Western Cape Education Department represented by Fadli Wagiet. In this partnership, the curriculum advisor provided the curriculum expertise and ensured that the resource was aligned to the curriculum, provincial and national imperatives for science education. The university provided the expertise in terms of teacher professional development of teachers and resource materials. The teachers ensured that the understanding of their school contexts and classroom expertise were embedded in the project. These factors are echoed in the indicators for teacher professional development outlined previously.

The aims of the project as stated in the funding proposal for the period March 2003-March 2004 was ‘to develop environmental literacy through active learning involving scientific enquiry based on user friendly science testing procedures. Further, to enable professional development in teachers in primary schools and to provide assistance for interpretation and implementation of national curriculum initiatives in terms of the National Environmental Education Programme.’

The target audience of this aspect of SWAP was primary school teachers and learners (grades 4-6) in the Cape Peninsula (Eerste River catchment). The programme was later extended to other schools in the peninsula.

The measurable outcomes of the programme was based on professional development indicators which included improved understanding of local environmental issues , skills related to water quality monitoring, improved environmental literacy, improved science testing skills , community involvement and action plans.

Eighteen schools became involved in the programme and formed three clusters. The clusters were supported by two field workers, responsible for organising workshops, meetings, training and support for teachers, liaising with the district and the university coordinator.

### **The SWAP resource kit**

The SWAP kit consists of seven laboratories that each investigates a different aspect that indicates the rivers' health. The seven laboratories are:-

Room 1: The Historical Research Lab

Room 2: The Catchment Area and Health Risk Lab

Room 3: The Water Life Lab

Room 4: The Oxy-Bac Lab

Room 5: The pH Lab

Room 6: The Nitrate Lab

Room 7: The Turbid Lab

The 8<sup>th</sup> poster is completed when the results of the seven experiments are reviewed at the end of the project.

### **The water life laboratory**

The water life laboratory allows the investigator to judge the quality of the river water. The participants find different living creatures which they classify using the bug dial provided in the kit. The creatures are replaced in the water. Each creature is graded on a pollution scale using the pollution classification able.

### **The turbidity lab**

In this test, the students investigate the turbidity of the river water using the turbidity disk and completing the worksheet. A beaker, bottle or glass of the water is tested through observation and placing the disk in the water sample.

### **The nitrate test**

The nitrate test allows the investigator to test the levels of nitrates in the water and to judge the levels of pollution in the water. In this test, the nitrate stick is placed in the water sample and colour is compared to the colour -code table provided.

### **The catchment and health risk lab**

In this test, the health risk of the water is tested. A sample of the water is tested to determine whether the water is fit for drinking purposes of humans and animals.

### **The programme process**

The teachers' training occurred over three days; the dates were negotiated with the teachers involved. On the first day, the teachers were introduced to the SWAP kits and the use of the resource in supporting teaching and learning in the classroom. The teachers were introduced to water as a key resource and the importance of water quality in a healthy environment. The links between the resource and the curriculum were highlighted and used to explain the science outcomes and assessment standards. On the second day, the discussion of the kits continued as well as the reporting procedures. On the third day, the teachers visited a water source to practically apply the testing procedures of the resource and to complete the report on their findings. Each of the schools that participated received five kits for classroom use. The field workers accompanied the teachers and learners on one river visit to support the teacher. On average sixty six teachers from eighteen schools participated in the programme.

From the report dated July 2004, many teachers indicated that the workshops provided them with an opportunity to exchange ideas and discuss their practice with other teachers. They could develop relationships with other teachers who share similar contexts.

The factors mentioned by teachers are in line with the indicators for measurement of success of in-service interventions which focus on professional development of teachers. These indicators were part of the objectives of the programme. The indicators of Janse

Van Rensburg and Le Roux (1998: Part V), developed with participants on their project have been adapted to suit SWAP needs and are listed below:

- Did teachers develop new understandings of the knowledge areas embedded in SWAP;
- Were there any changes in their approach to teaching environmental education and resource –based learning programmes;
- Were teachers better equipped to teach in the content areas and did their ability to teach improve: this could include assessment strategies, teaching styles, resources, curriculum and the use of technology;
- Were they more confident in the classroom;
- Did they develop teacher networks and learn from each other in terms of teaching, methodology, content knowledge and resources and;
- Did they develop or adapt resources of the programme to contextualize the resources for their classes.

During the reflection sessions, these factors were highlighted by teachers and seemed to have been achieved through the programme process. From the final report of the programme by Chris Reddy, the reasons for the achievement of the outcomes as indicated by the focus group discussions and the teacher questionnaires were:

- The alignment with the professional development indicators of Janse Van Rensburg and Le Roux (1998);
- The SWAP resource: It was easy to use, aligned to the curriculum, OBE friendly and adaptable to the context of the school;
- Support: The support provided by the project partners and fieldworkers motivated teachers;
- Organisation : The project was well organised, good refreshments and expertise provided by the partners contributed towards the teachers confidence and interest;
- Official nature of project: The project was endorsed by the EMDC and this initially encouraged some teachers to participate.



SWAP provides information to teachers and learners that allow them to assess, interpret and analyse the data gathered through the tests and investigations. It allows the learners and teachers to explore and understand their findings, contextualize it and make sense of the information using the kit itself and not having to research an external source.

The kit allows teachers and learners to discuss social, political and environmental factors that influence the chemical, biological or physical nature of the water quality.

The different laboratories function as independent units and their value to the teaching and learning process is the integration of the units to allow for a coherent and interdependent flow of information. This demonstrates the interdependence of the rivers and the environment as a whole and allows for the flexibility and adaptability of the resource. The teacher can decide what aspects to use based on his/her context.

Through discussion and analysis of the results of the tests, learners and teachers may come to a better understanding and awareness of local environmental issues related to water quality.

## **2.6 CONCLUSION**

In this chapter, I presented different concepts and ideas of teacher professional development and Inset. I reviewed science teaching and learning and the role of resource kits in science teaching and teacher professional development. I presented indicators and models from current literature to develop a theoretical framework and conceptual lens to evaluate effective teacher development. This information will be used to assess the case studies in Chapters four and five.

The following chapter outlines the theoretical planning and execution of the study: the methods used; the paradigms for the interpretation of the data and the different aspects considered in choosing the research design for this study.

## **CHAPTER 3:RESEARCH METHODOLOGY**

### **3.1 INTRODUCTION**

This chapter outlines the conceptual framework for the research design and the methodology that is to address the research. This study is an evaluation research of two professional development programmes, linked to SWAP and MTN-SUNSTEP as described in Chapters 1 and 2. The chapter includes the theoretical underpinning of the research study, the instruments that were developed and used in the research, the sample design, techniques and the criteria used to select the sample size.

### **3.2 RESEARCH DESIGN**

Initially the study was constructed by the programme manager of MTN-SUNSTEP as an outcome evaluation case study that follows a non-equivalent comparison group design with focus on learner acquisition of learning skills, appropriate monitoring of learner progress and learner awareness of electronics. Much later in the study, I changed the focus of the study. Unlike the ideal research process, I did most things in a haphazard, uncoordinated and messy fashion. In 2006, after struggling with programme evaluation for six years, in discussion with my new supervisor, Dr. Chris Reddy, we changed the focus of the evaluation study to professional development in science teaching using two programmes as case studies, SWAP and MTN-SUNSTEP.

The study evaluates the use of resources kits which could include other forms of learning support in the process of professional development. This was a welcoming change as it rejuvenated me. The study was an extension of my field of work. I was excited to read the literature on these issues and to be able to anchor some of my experiences through research.

I was still struggling with the research design but was encouraged to continue to read in the field and to start working again. Durrheim (2006) understands design as a .....

“strategic framework, a plan that guides research activity to ensure that sound conclusions are reached.” A research design should provide a plan so that the research question is answered through the research process.

“The purpose of research design is to assist us in obtaining answers to critical and meaningful questions.” (Oppenheim, 1966:7)

Durrheim and Terre Blanche (2006) state that the researcher makes design decisions along four dimensions the:

- purpose of the research;
- theoretical paradigm informing the research;
- context or situation within which the research is done; and
- research techniques employed to collect and analyse the data.

They conclude that the multiple considerations derived from these four areas must be integrated into a coherent research design in a manner that will maximize the validity of the findings.

### **3.2.1 THE PURPOSE OF THE STUDY**

The purpose of the study is discussed extensively in Chapter 1. To summarise, the study evaluates the use of resource kits in professional development. This is discussed through a mix of indicators, some of which are: Did the teachers involved in the programmes develop new understandings in environmental education and electronics? Were there any changes in their teaching approaches to environmental education, electronics and resource –based learning programmes? After participating in the programme were teachers better equipped to teach in these content areas? Was there an improvement in their job skills? Were they more confident in their approach to their teaching? Did they develop teacher networks? Did they develop or adapt resources to suit their context?

The main unit of analysis (Durrheim, 2006) is teachers in both the programmes. The object of analysis was changed from the start of the study. Initially, it would have been

learners and the resource kits in the MTN-SUNSTEP programme. This would have implications for the instruments and data collection used in the study. The goal of the research would be evaluation.

I will be applying a mix of indicators to determine the success of these programmes. To summarise: This is an evaluation of two programmes by way of case studies as a research methodology.

### **3.2.2 THE THEORETICAL PARADIGM/METHODOLOGY**

The conceptual framework for the research is underpinned by the paradigm that I am comfortable with. I had great difficulties conducting research that I would not consider to be “useful” and that gathers dust on a bookshelf. This was one of my first comments to my supervisor.

This is a simple illustration of the importance of a research paradigm. Intuitively I knew that I would not enjoy my research if it did not resonate with my worldview. I support the argument of Durrheim and Terre Blanche (2006) that encourages an awareness of your personal paradigm but you need to research and select the paradigm that best fits your research question. These two paradigms might not always be in harmony with each other. There is evidence that choosing an evaluator involves matching the style and values of the programme to the style and values of the evaluator (Potter, 2006).

#### **3.2.2.1 TOWARDS A DEFINITION OF PARADIGM**

“A paradigm is a worldview built on implicit assumptions, accepted definitions, comfortable habits, values defended as truths and beliefs projected as reality. As such paradigms are deeply embedded in the socialization of adherents and practitioners.” Patton (1997: 267) Kuhn (1970) states that the key point about a paradigm is that it is a source of guidance (way of knowing) for conducting and evaluating research that is consensual within a particular scientific discipline.

Durrheim (2006) echoes that paradigms are all encompassing systems of interrelated practice and thinking that define for researchers the nature of their enquiry. This occurs along three dimensions: ontology, epistemology and methodology.

Ontology specifies the nature of the reality to be studied and what is known about it. In this study, I am specifying the nature of professional development, science teaching, learning support resources and how these support, interact and link with each other in the context of the research.

Epistemology specifies the nature of the relationship between the researcher and what can be known. This dimension would investigate my relationship and interaction with the body of knowledge, teachers, learners and the knowledge produced by the way of the interactions.

Methodology specifies how the researcher will practically study whatever she believes can be known. The process of conducting the research is the focus. How did I interact with the teachers? Did I use interviews or questionnaires? What was the level of my involvement in the process? (Durrheim, 2006)

These three dimensions and the choice the researcher makes will define the dimensions of the paradigm within which the researcher will operate. This could be in the positivist, interpretive, or constructionist paradigm (Durrheim, 2006). This will be further discussed in the next section.

The following quote from Durrheim and Terre Blanche (2006:3), deepens my understanding of paradigm:

[ .....]but the background knowledge against which they made sense of their observations. Background knowledge tells us what exists, how to understand it and most concretely, how to study it.

The search for a paradigm or a combination of paradigms that would fit both my world view, MTN-SUNSTEP and SWAP programme specifications was the challenge. It was possible that the search for a paradigm best suited to the study “has been replaced, at the level of methods, by a paradigm of choices.” (Patton, 1997:297) Durrheim (2006) explains that paradigms often coexist and because different paradigms exist simultaneously, it is possible to draw on more than one paradigm. In this study, I selected the interpretive paradigm as it best suited the research question.

### **3.2.2.2 EVALUATION RESEARCH**

In this section I will interrogate the term ‘evaluation research’ and describe the type of evaluation that best suits my study.

Evaluation research, sometimes referred to as programme evaluation refers to a research purpose rather than a specific research method. The purpose is to *evaluate* social interventions. (Babbie and Mouton 2001:334). A social intervention could be any social programme and is understood to be any kind of organized activity (Potter, 2006:410). In this study, I will be evaluating two classroom based education programmes.

Well known researcher on evaluation research Leonard Rutman states that ‘programme evaluation entails the use of scientific methods to measure the implementation and outcomes of programs for decision –making purposes’ (Rutman, 1984:10). ‘Programme refers to any intervention or set of activities mounted to achieve external objectives.’

Rossi and Freeman (1993) define evaluation research as ‘the systematic application of social research procedures for assessing the conceptualization, design, implementation and utility of social intervention programmes.’ In their definition of programme evaluation, Rossi and Freeman (1993) states that it is in the domain of social sciences research and utilizes the full range of social sciences methods in assessing or evaluating social intervention programmes. Babbi and Mouton, (2001: 335) explain that the areas of

the programme that are evaluated are the conceptualization, design, implementation and utility of the programme.

### **3.2.2.3 DEFINING PROGRAMME EVALUATION**

The function of programme evaluation research is to determine whether social programmes are needed, effective and likely to be used. Since the early 1990s, there has been a growing recognition in South Africa that programme evaluation is necessary for accountability. The process of evaluation is an essential part of the development of social programmes. (Potter, 2006)

Programme evaluation is the systematic collection of data about the activities, characteristics and outcomes of programmes. This enables the evaluator to judge programmes, improve the effectiveness and inform decisions about future programming. Programme evaluation does not only examine whether the programme has attained its goals, but also evaluates the implementation, processes, consequences and long term impacts (Patton, 1997:23). It includes systemic data collection that is dependant on the nature of the study rather than only applying social science methods.

Programme evaluation occurs for various reasons. Michael Patton has suggested that the purpose of evaluation is to: make judgements; improve programmes and generate knowledge (Patton 1997; Potter 2006). Judgement –orientated evaluation assesses the value of the social intervention. Patton (1997) states that judgement - orientated evaluation follow a pattern. One (a) selects criteria of value (b) sets standards for performance (for example outcomes) (c) measures performance and (d) synthesises results into a judgement. (Patton 1997:68)

Improvement –orientated evaluations are formative evaluations where progress is monitored. Questions for improvement of the programme are asked to give feedback to stakeholders and to check whether implementation is on track (Babbi and Mouton, 2001:339).

Knowledge –orientated evaluations generate new knowledge, improving our understanding of the mechanisms of programmes and of changes in the behaviour of people (Babbi and Mouton, 2001: 339).

To summarise, Potter (2006) states that:

‘Although programme evaluation is not the sort of activity that one can get exactly ‘right’, it is exhilarating to know that this is not just research for its own sake, but research that makes a difference.’

#### **3.2.2.4 THE GOALS AND OBJECTIVES OF PROGRAMME EVALUATION**

The effectiveness of a programme is judged by the attainment of the goals of the programme. Goal clarification is very important for the evaluator to formulate part of the evaluation question. Goals are seldom clear, specific and measurable and are frequently unrealistic. For evaluation purposes, goals have to be clarified to make them meaningful and measurable. Evaluators have to work closely with stakeholders to clarify and unpack the goals and objectives (Patton, 1997: 150 –152). In this study, the stakeholders are the programme managers, the administrators, sponsors, teachers, school principals, parents, and learners.

Goals are broad and encompass the purpose and aims of the programme. Objectives are specific and describe the measurable outcomes of the programme. They are indicators of the effectiveness of the programme and the parameters of the goals. Sometimes goals can be outdated or stakeholders have different goals (Weiss, 1998). The evaluator has to decide in negotiation with stakeholders which programme goals and objectives should be evaluated to produce the most useful results to improve the programme. The most important goal is not necessarily the most useful goal to evaluate. (Patton, 1997: 170)



Official goals are not the only sources that evaluators can use to define outcomes. The evaluator should search for the hidden goal of the programme and express her own interpretation of the importance of the goals. Allowing the evaluator to define the programme goals could also affect the use of the evaluation study by the stakeholders (Weiss, 1998).

“Goals provide direction for action and evaluation, but only for those who share in the values expressed by the goals.” (Patton, 1997:174)

According to Patton, a common error made by novice evaluators is to assume that the commitment to use and monitoring goals exists when an evaluation is requested. These commitments have to be engendered if they are not present or reinforced throughout the evaluation process. (Patton, 1997: 37)

In terms of the evaluation, standards and expectations for comparing evidence have to be determined. A judgement has to be made. Criteria for judgement can be based on the goals of the programme or on the expectation of other stakeholders in the programme. The objectives of the programme managers can be criteria for judgement. (Weiss, 1998)

An important task for the evaluator would be to clarify the goals and the objectives with the stakeholders. In terms of this study, the evaluation was developed with the programme manager and officer. Other stakeholders were not consulted in this process. The questionnaires are based on the vision, goals and objectives of the programmes.

### 3.2.3 CONCLUSION

According to Potter (2006:426) and Patton, (1997) no single approach to programme evaluation is advised. Evaluators decide on an appropriate methodology to fit the requirements of the programme, rather than one approach or model.

Making a decision on the type of evaluation for my study has not been easy. The SUNSTEP case study started during the programme implementation in schools. This study evaluates the design, implementation and utility of the programme.

In this case study, the programme was initiated to improve the technological capacity of teachers and learners, promote technological awareness amongst teachers and learners, improve the position of science amongst disadvantaged learners and encourage learners to pursue careers not only in mathematics and science but also electronics.

In the second case study, SWAP, the research was conducted after the completion of the programme. In this study, evaluation of the design, implementation and the use of the program was researched

According to Babbi and Mouton (2001), timing of the evaluation is one of the most important factors in deciding the type of evaluation that will be conducted. I am persuaded by the literature that my study is an outcomes- based evaluation in the interpretive paradigm. The purpose of the evaluation is the improvement of the programmes and the generation of knowledge about the role of science kits in professional development through interrogating the processes of the programmes.

I will use the conceptual model of social programmes developed by Babbi and Mouton, (2001: 343), as a guide to assist in identifying the aspects of the two programmes that should be evaluated. Refer to the diagram of the model (TABLE 3.1).

Based on the model, aspects that need to be discussed and evaluated would be (i) the goals; (ii) target group; (iii) measurable outcomes; (iv) programme components; (v) human resource base; (vi) stakeholders and (vii) context of the programmes.

(i) Goals; (ii) target group and (iii) measurable outcomes

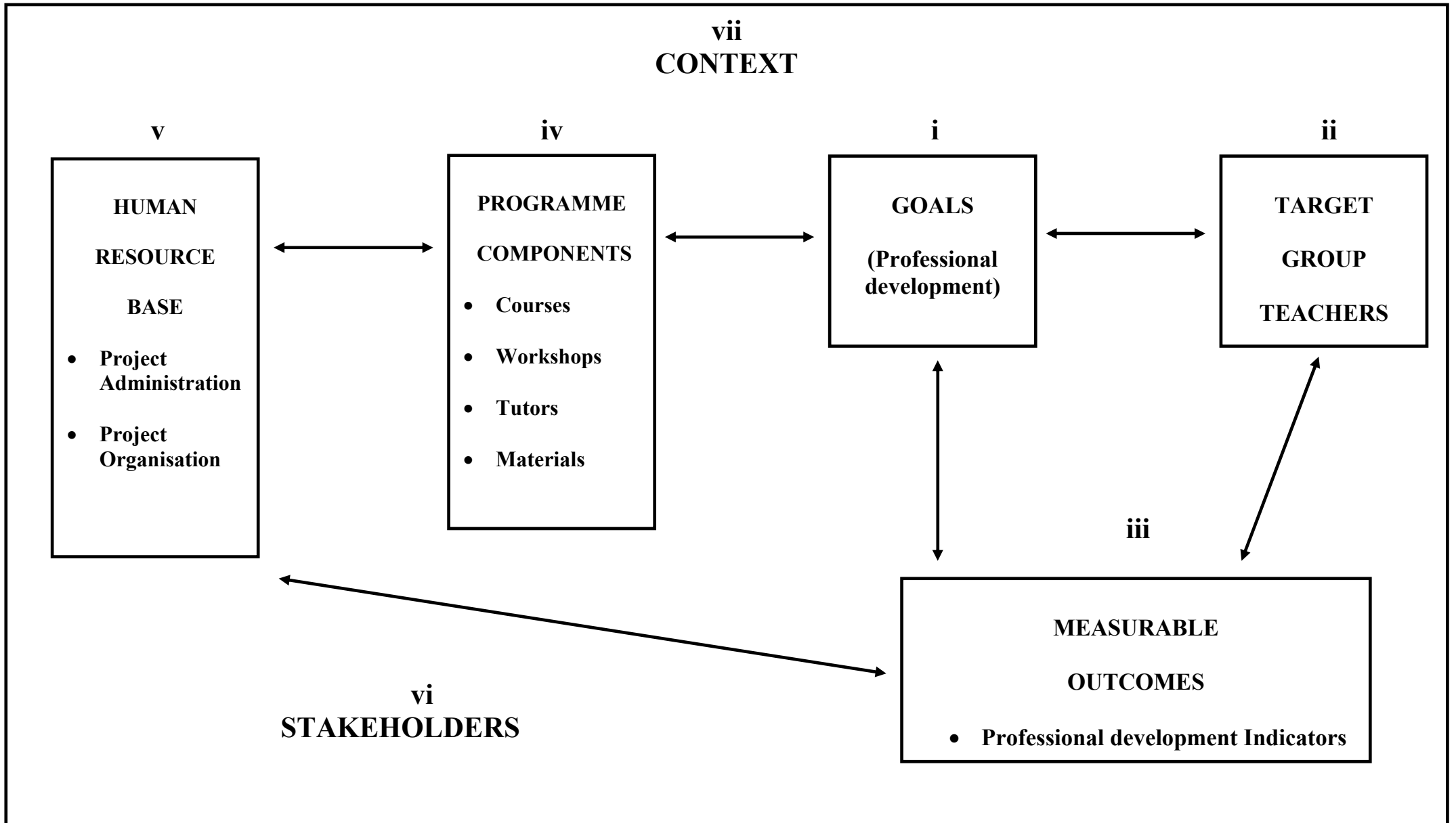
There is a symbiotic relationship between programme goals and the target group as the programme is conceptualized to address the needs of the target group (Babbi and Mouton, 2001). The perceived or real needs of the target group would determine the goals of the programme. Goals ought to be translated into measurable outcomes (Babbi and Mouton, 2001).

In the MTN-SUNSTEP case study, the goals are defined in brochures and have been reiterated in interviews with the programme manager and coordinator. The target group or beneficiaries are the teachers and the learners. The explicit measures of success in the programme and the measurable goal would be teachers teaching the kits in the classroom and the applications of the kits learners design and build. Most of the goals in the programme are generalized statements that are difficult to measure, for example, whether the learners have acquired an awareness of electronics. The underlying measure of success would be the number of teachers that participate in the teacher workshops at Stellenbosch University.

In the SWAP programme the goal was explicit and measurable. The main aim of the programme was the professional development of teachers with regard to science teaching. The measurable outcomes were listed: new approaches to work, development of new networks, improved understanding of the local environment, and better understanding of context-based work. The programme targeted teachers.

TABLE 3.1: A CONCEPTUAL MODEL OF SOCIAL PROGRAMMES ADAPTED FROM BABBI AND MOUTON (2001)

**A CONCEPTUAL MODEL OF SOCIAL PROGRAMMES** Adapted from Babbi and Mouton 2001: 343



(iv) Programme components

The programme components refer to those mechanisms and means that make the attainment of the goals possible. In MTN-SUNSTEP, the programme components would encompass the teacher workshops at the University of Stellenbosch, the instruction booklet, the electronic kit and two facilitators to offer support to participating teachers. In the SWAP programme, the programme components would be teacher workshops, SWAP kits, learning support booklets, two facilitators Andre and Vanessa to support teachers, EMDC South, focus group meetings, questionnaires and programme manager, Dr. Chris Reddy who was actively involved in the programme.

The question that should be asked is: Will the programme components listed produce the desired outcomes? As indicated in the diagram, the programme components are directly linked to the goals and the human resource base. The goals would determine the components which would determine the success of the programmes.

(v) Human resource base

The human resource base refers to the individuals who manage the programme and includes the programme administration. This would be the programme manager and coordinator in MTN SUNSTEP. In the SWAP programme, it would be the manager, Dr. Chris Reddy and Fadli Wagiet from EMDC South. Issues which are to be considered are the abilities, competencies and personality styles of management (Babbi and Mouton, 2001: 344).

(vi) Stakeholders

Stakeholders are other groups of people that might have a direct or indirect interest in the programme. In both MTN-SUNSTEP and SWAP, the stakeholders include the funders, MTN (MTN-SUNSTEP), Shuttleworth (SWAP), University of Stellenbosch, competing service providers, teachers, learners, principals, education departments, teacher unions,

parent bodies and other community structures. All these stakeholders have an interest in the eventual results of the evaluation (Babbi and Mouton, 2001:345).

(vii) Context

The context of the programme can be a deciding factor in its success or failure. This can include the broader socio-political context, geographical location as well as the timing of programme implementation. In both MTN-SUNSTEP and SWAP programmes the context is South African classrooms in disadvantaged areas, at a time of curriculum innovation and change in South Africa.

### **3.3 CASE STUDIES**

The study proceeds by way of two case studies in the interpretive paradigm. I decided that case study research would be best suited to the study as it is an evaluation research of two programmes. Guba and Lincoln (1981:375 in Merriam 1998:39) conclude that case study model is the best reporting form for evaluations. It provides thick description, is grounded, holistic and life-like, simplifies data to be considered by the reader, illuminates meanings, and can communicate tacit knowledge. But more than anything else this type of case study weighs information to produce judgement. Judging according to Merriam (1998:39) and Patton (1997), is the final and ultimate act of evaluation.

Merriam (1998:19) explains that case study research is conducted to find out about the process rather than the outcomes. It is contextual research that seeks to discover rather than confirm. Aptly described by Durrheim (2006):

“[ .....]to imagine and try to understand text in their context.”

The researcher selects a case study design because of the nature of the research problem and the questions being asked (Merriam, 1998:41). The case study offers the means of investigating complex social units consisting of multiple variables that could potentially

be important in understanding the phenomenon. She defines a case study as an intensive description and analysis of a bounded system such as an individual, programme, event, group, intervention or community (Merriam 1998:19).

Merriam (1998:41) explains that the case study design has proven to be useful for studying educational innovations, for evaluating programmes and informing policy. Furthermore, case studies are particularly useful if you are interested in the process, for example, describing the context and population of the study, discovering the extent to which the programmes has been implemented or providing immediate feedback of a formative type (Merriam, 1998: 33). These elements were part of my study and determined my choice of a case study design.

In this research study, a case study will be defined as an intensive description and analysis of a bounded system: the programmes, SWAP and MTN-SUNSTEP. Each programme will be represented as a unique case. Merriam (1998:27) presents a test to assist in deciding whether something is a case study: a system can be called bounded if there is a 'limit to the number of people involved who could be interviewed or a finite amount of time for observations.'

In a case study, you rarely focus on everything and everyone. Usually the researcher investigates a core group but stays aware of the people on the periphery. In the MTN – SUNSTEP programme, I selected the teachers to interview as they would provide a rich source of information. In the SWAP programme the teachers were invited to participate in the questionnaire.

My research question: whether teachers experienced any learning by being involved in the SWAP and MTN-SUNSTEP programmes, interrogates teachers' interaction with the resource and the construction of their meaning during and after the process. I believe the data can most effectively be explained through case studies. Yin (1994) explains that case study is a design that is particularly suited to study situations where it is impossible to separate the phenomenon's variables (professional development) from their context (the

schools). In schools teaching and learning is inseparable from the schools' context: principals, peers, politics, policies, district influence to mention a few. In terms of the study, the case study model would provide a rich source of information that could provide the insights to enable an understanding of the processes and to make judgements.

Case studies do have limitations, as discussed in Potter (2006). The validity of the information might be problematic, causal links are difficult to test and generalizations cannot be made from single case studies. A very real danger in qualitative case studies is the limitations of the researcher's sensitivity and integrity.

In this design, the researcher is the primary instrument to collect and analyse data. The researcher's knowledge and attitude will determine the quality of the data collected (Potter, 2006). During my research process, I was constantly aware of my influence on data gathering and the quality of the interviews. My dithering about the nature of my question and the appropriate approach would have influenced these processes.

The case studies in my study involved two programmes, MTN-SUNSTEP and SWAP which can be regarded as bounded case studies. Each case study had its own particular context, physical location, people, background and experience of teachers, intensity of the programme that was implemented at schools and teachers' differing interest in the programmes. All these variables would influence the intensity of the learning that occurred. The cases were to a large extent sample groups and detailed descriptions of the context were not part of the study as such. Teacher professional development in each sample group formed the central part of the study and was the "object" of the data analysis. Evaluation and interpretation of the professional development was done in terms of propositional and documented knowledge based on the data and discussion of other studies. The case studies are not compared but are viewed as professional processes using different resources in different contexts. It is the professional development processes that are under scrutiny in the particular cases.



Case studies provide in depth understanding of the process of the programme and provide reliable information for improvement of the programme (Patton, 1997: 289). As part of the MTN-SUNSTEP case study I visited four high schools, Glendale, Spine Road, Rylands, Rocklands and Belville South Primary chosen by the programme manager. These schools were not representative of the sixty- four schools participating in the MTN-SUNSTEP programme in 2001. Based on the data, the study is descriptive and does not intend to make generalizations beyond the sample.

The criteria for the selection of the schools in the study was (1) their participation or non-participation in the three phases of the programme (2) my proximity to the schools and time constraints that I would experience when conducting the research and (3) the schools were located in disadvantaged areas and the enrolment was predominantly disadvantaged students. At the time of the study, very few black schools were participating in the programme.

The SWAP programme was conducted with the teachers in their school context. This is a primary school programme .The study was broadened to include the SWAP programme to obtain a ‘thick description’ of the nature of professional development and the role of learning support materials in scaffolding this process. It was felt that the data collected in the MTN-SUNSTEP would not suffice and that the study needed to be broader and less narrow in focus. The research question was then adapted to focus on professional development of teachers. Durrheim (2006) echoes that interpretive researchers do not distinguish between different phases of the research, but may reformulate their research question as a result of new material they have collected, or change their sampling strategy in response to new findings. This occurred in my study.

### **3.4 THE CONTEXT**

Research always takes place in a specific context. In this research the impact of context on human and social behaviour is emphasized and an attempt is made to study the programmes within a school context (Durrheim, 2006 : 53). The context of the research is

teaching and learning in a science classroom within a South African school. To understand this study and the broader issues related to the study, I consulted readings about professional development in science teaching globally. This allowed me to compare and further contextualize the South African classroom.

These programmes were implemented at a time of curriculum change and transformation in South Africa. Transformation in education was a priority. I needed to gain insight into science teaching and professional development prior to the transformation process to enhance my understanding of the context within which professional development would occur. The MTN – SUNSTEP programme was envisaged to be part of the transformation of the science and technology curriculum, as electronics, a new field, would be included in the national curriculum. SWAP would be implemented in environmental education, which was a new content area in the life sciences curriculum. Both these programmes are defined as learning support resources in Chapter 2. The study is placed in this broad context with the programmes representing the case studies.

### **3.5 RESEARCH TECHNIQUES – METHODS**

As discussed previously in this chapter, I am conducting this study as an interpretive researcher using interpretive evaluation design. I am comfortable with the choice of paradigm as it strengthens the coherence between the research design and the research investigation. In addition, the nature of my journey in trying to conduct and complete this study has made this the best possible option.

The term ‘techniques’ is sometimes interchangeably used with the term ‘methods’. Hitchcock and Hughes (1995:20) describe techniques as ‘ways of proceeding in the gathering and collection of data.’ It describes the manner in which data will be collected and produced.

There is no one best way to conduct an interpretive evaluation. The majority of interpretative evaluation designs assume that different programme stakeholders have

different perspectives on the programme and its development. These differences are based on different value positions and ideologies. Understanding the stakeholder perspectives is important in understanding the programme (Potter, 2006:415).

Initially interpretative evaluation involves interaction of the evaluator with the stakeholders. This initially involves a visit or series of visits to the programme, followed by interviews with various stakeholders. Group meetings and focus groups can be included. The purpose would be to inform various stakeholders about the evaluation and consult them about the design. . The stakeholders could suggest possible questions for research and sources for data that could be included. . The evaluation design is thus responsive to the needs of various programme stakeholders (Potter, 2006: 415). At the start of the MTN – SUNSTEP study I had numerous meetings with the programme manager to determine the nature of the question researched. As a teacher who had and was participating in the programme, I had questions of my own which influenced the research question.

Interpretive research emphasizes data in context. The researcher wants to make sense of phenomena as they occur in the real world and to study them in their real setting (Durrheim 2006: 287). Interpretive research emphasizes rich experiential data. The research has to be designed to produce this type of data (Durrheim, 2006: 48).

Interpretive research favours observation and interviewing methods of data collection. These methods allow for rich and detailed observations of a few cases. It permits the researcher to build up an understanding of phenomena through observing particular instances of the phenomena as it plays itself out in context (Durrheim, 2006: 52).

In qualitative research, the researcher is the instrument of observation. Data are collected either by interviews or observations and human behaviour is recorded in contexts of interacting (Durrheim, 2006:51). These particular observations are categorized into themes and a more general picture of the phenomena being researched is built up of particulars. (Durrheim, 2006: 51)

This study is framed as bounded case studies within an interpretive paradigm. Firstly, the programmes are researched as two separate case studies, the teachers both at the workshops and at the schools in the MTN-SUNSTEP case study and the teachers in the SWAP case study. In conducting the research using case studies, I was constantly aware of the words of Merriam, (1998:21) that the researcher must be sensitive to the location, people, overt and covert agendas and non-verbal behaviour of the stakeholders among other things.

The different methods of data production included:

#### MTN-SUNSTEP PROGRAMME

- Informal meetings with the programme manager, Etienne: This assisted in developing the research question but no notes of this is available.
- Field notes of MTN- SUNSTEP teacher workshop: These were taken while the workshop was conducted by the facilitator and consists of my observations.
- Short recorded unstructured interviews of the MTN-SUNSTEP workshop participants while they were completing their kits
- Written teacher questionnaires of their processes in the MTN-SUNSTEP workshops. These questionnaires were handed out at the end of the workshop and teachers were not compelled to complete them.
- Transcripts of the teachers' interviews: The interviews were conducted informally while the teachers were busy or at the end of the workshops.
- Long unstructured interview with one of the teachers: This interview was conducted at the school at the end of the period.
- Field notes of classroom observations: These occurred at three of the five schools visited.
- Field notes of interview with the programme coordinator : This was conducted at Stellenbosch University
- Field notes of the email interview with the programme manager: This interview was conducted via email as I could not meet the manager due to time constraints.

## SWAP PROGRAMME

- Teacher questionnaire: This occurred at the end of the process. A meeting was organized for participating schools at which the questionnaire was completed. In the cases where teachers could not attend, the questionnaires were hand delivered and collected.
- Report of the SWAP process.

### 3.5.1 INSTRUMENTS

I conducted random probabilistic sampling of teacher workshops. This was mainly due to my time constraints. As a teacher, I could not possibly attend all the MTN – SUNSTEP workshops in Stellenbosch, but chose to attend four workshops. Questionnaires, observations and interviews were used as my instruments of data collection. This was in line with the interpretive paradigm.

Information gathered through observations, interviews and questionnaires has limitations as the data can sometimes be inaccurate accounts of events or behaviour. It cannot indicate a causal relationship but shows relationships between the variables. The data becomes reliable and valid when the interviewer and interviewee share common assumptions and perceptions about the meaning and construction of the instrument.

A self – completion questionnaire was handed to each teacher at the workshop. This was completed at the end of the workshop. At the teacher workshops, I chose to be a non-participatory observer and only interacted with the teachers during the interviews of teachers randomly selected. I compiled field notes of the proceedings of the workshops and attempted to remain as unobtrusive as possible. At this stage of data gathering, I was sensitive to the context, the facilitators, teachers and the non-verbal behaviour of the stakeholders.

In the classroom observations, I was a non- participatory observer and interacted with the learners and teachers only during introductions, unstructured and semi-structured interviews and farewell sessions. I attempted to be a student in the classroom and did not

interact with the teacher while the lesson was in progress. At this stage, I was appointed as a curriculum advisor and tried to maintain my role as researcher. I compiled field notes and cassette recordings of the proceedings.

Questionnaires and interviews were used as a method of data collection. At the teacher workshops at the MTN-SUNSTEP laboratory in Stellenbosch, semi-structured interviews were randomly conducted with willing participants. This was recorded on cassette. Teachers also completed the teacher questionnaire.

At one of the schools a semi-structured interview was conducted with the teacher. An interview was conducted with the programme coordinator.

I conducted classroom observations to observe the completion of the electronic kits. The observations were non-participative. I was unable to attend all the teaching sessions of the resource kit at the school but set up a programme with the teachers and attended one to three sessions at a school.

### **3.6 VALIDITY AND RELIABILITY**

In qualitative research, validity is defined as the degree to which the researcher can produce observations that are believable to herself, the subjects being studied and the eventual reader of the study. (Durrheim, 2006:90) Researchers should ask themselves if their research is designed to give valid and believable conclusions or whether the conclusions could be explained by other factors the researcher had not taken into account (Durrheim, 2006:38)

The credibility of qualitative research is established through the process of the research. The researcher continually searched for discrepant evidence to the hypothesis she was developing as a means of producing a 'rich and credible account'. One of the ways of doing this was through triangulation, employing different research methodologies, quantitative and qualitative, to show whether discrepancies were present (Durrheim, 2006: 91).

### **3.7 TRIANGULATION**

Triangulation is the use several sources of data collection to establish the validity of the study. Conclusions can be verified using different methods resulting in a coherent and meaningful study (Neuman, 1997). These include the recordings of the interviews, the observations sessions and the questionnaires. This verification is part of the design process.

Durrheim and Terre Blanche, (2006:287) explains that triangulation means collecting information in a many different ways and from as many diverse sources as possible. This enables the researcher to ‘home in’ on a better understanding of a phenomenon by approaching it from different angles.

In terms of my study, two case studies were chosen to produce detailed observations from believable diverse sources. This data would be analysed to attempt to explain the contextual variables that determine successful professional development.

### **3.7 ANALYSIS**

The analysis of data will be done by way of various models for professional development which offer indicators for professional development. The nature of the programmes and process which framed the professional development will be probed and analysed as part of the indicators. These include the work of Bell and Gilbert (1994), Janse Van Rensburg and Le Roux (1998), Guskey (2002) and Garet et al (2001). These were discussed and explained in Chapter 2 and will not be elaborated on here. The various models are used and serve as indicators for the processes in this study as they cover the different aspects this study touched on and therefore provides what I consider to be a broad and comprehensive analytical basis for the work.

## **CHAPTER 4: DATA PRESENTATION**

### **4.1 INTRODUCTION**

In this chapter, I present the data developed during the research process. The research process took place over a period of six – seven years in various locations. The process is divided into two separate case studies, which were run independently. The data is presented independently for each case study but no comparisons are made as part of the final analysis and discussion of data in this study.

Case study 1, focuses on the presentation and implementation of the MTN-SUNSTEP electronics kit for teachers. I present the background to the development of the kit as well as the process by which teachers were introduced and trained in the use of the kit. Teacher responses to the programme process and the use of the kits are then presented.

In case study 2, I focus on the resource, the SWAP kit, the process and how the teachers were introduced and trained to use the resource, their responses to and their experience of using the resource is again the object of the investigation. The implementation of the whole process is documented and teacher responses by way of a questionnaire are presented as qualitative data.

### **4.2 CASE STUDY 1: MTN-SUNSTEP**

#### **4.2.1 INTRODUCTION**

I started the study in 2000. At that time, my research study: The evaluation of the impact of the MTN-SUNSTEP electronic kit on the teaching and learning of science was developed. The object of analysis was the learner. After discussions with the programme manager and my supervisor, I developed a teacher questionnaire, a learner questionnaire and a pre and posttest as instruments to collect data to analyze the question.



In 2001, during the process of data gathering, I observed four teacher workshops at the MTN-SUNSTEP electronics laboratory in Stellenbosch and administered the teacher questionnaire. I collected the questionnaire from the teachers on the same day. I interviewed the teachers at the workshops and helped some of the teachers with assembling their kits. These interviews were informal and unstructured.

In August of 2001, I was seconded to the education department as a curriculum advisor for physical science for the Cape Town Region. Initially I thought that I would have more time available for the collection of the data, as it was my field of work. Little did I know. I was seconded on the 1 August; on the 9<sup>th</sup> I facilitated my first workshop with 60 teachers on Grade 8, CATS and EATS in Natural Science. In August, I co-facilitated four to six Grade six NCS Natural Science workshops. In September, I co-facilitated four to six grade 8 -9 Natural Science workshops. My studies consisted of WCED and national policy documents and my personal research on the pertinent issues. From October - November of that year, I conducted face moderation at approximately one hundred schools. My time was spent driving from school to school moderating the Grade 12 physical science continuous assessment marks.

During this period, the management of the programme changed. In 2002, I did classroom observations at two schools. This was difficult as the schools were now in a different district to the district in which I worked. Although my research would contribute to my professional development, I had difficulty finding the time. The education department was implementing new policies, for example, new curriculum and moderation policy. Teachers needed to be trained!

My supervisor hardly saw me. In 2003, I requested an interview with the programme manager and programme coordinator. I did a personal interview with the programme coordinator and an electronic interview with the programme manager. I also relied on brochures of the programme as my sources of data as well as annual reports. I had collected my data for this case study by 2003.

In 2004, with discontinuation staring me in the face, I started writing a draft copy of chapters 1, 2 and 3. This I presented to my supervisor. At the end of 2005, my supervisor resigned and I was again in trouble. I would not be allowed to continue.

Considering all my options, I decided that I wanted to complete my studies. I applied for a new supervisor. After many changes in the course of my studies, programme management, my career, supervisor, my research question changed. When I started the study, I was idealistic and wanted my study to be meaningful and not gather dust on a bookshelf. By 2006, all I wanted was to complete. My research study changed to, *evaluation of the use of resource kits in teacher professional development in science teaching. An exploration of the challenges and possibilities presented.*

The study focuses on the evaluation of teacher professional development with the two programmes, MTN-SUNSTEP and SWAP. The object of analysis was the teacher. This was more suited to my present context and field of work as a physical science curriculum advisor. The second case study, the SWAP programme was added to the study. With the assistance of my supervisor, I developed a questionnaire, arranged a meeting with the teachers and started collecting the data.

#### **4.2.2 PRESENTATION OF DATA**

In this section of the chapter, I present my data on the MTN-SUNSTEP case study. I have organised the data into different categories to facilitate the analysis, interpretation and make sense of the information. The categories are:

1. Why the programme was developed, what it intended and how it was developed?
2. What teachers felt about the workshops and the resources?

## **1. Why the programme was developed, what it intended and how it was developed?**

These are parts of two interviews conducted with the programme manager and coordinator. The interview with the programme coordinator occurred at University of Stellenbosch and the programme manager via email. The programme manager was not available for a personal interview. The programme coordinator is a qualified industrial artist who worked as a journalist before she joined MTN-SUNSTEP.

All the questions and answers pertain to the period 2000 – 2002.

### **• Why was the programme developed?**

#### **Why was SUNSTEP initiated?**

Manager: In 1997, when the Electrical and Electronics Engineering Department partook in the SUNSAT project, a competition was launched to encourage schools to participate in the event.

Due to a very poor reaction from the schools, the Electrical and Electronics Engineering Department decided that they needed to initiate a project, which would reach out to schools and make teachers and learners aware of Engineering as a subject choice.

### **• What the programme intended?**

In the year 2001, what were the goals and objectives of the programme (for the teachers and learners)?

Manager: Goals for 2001:

- Align MTN-SUNSTEP with Education Department
- Reach 200 teachers in the Western Cape
- Develop electricity as another section
- Reach 6 000 learners in the Western Cape
- Broaden the base of schools in Khayelitsha

- Building a rainbow nation

**What was the vision of the programme ?**

Manager: It was an awareness programme to inform teachers and learners about Technology.

**What was the programme trying to achieve with the (a) teachers) and (b) learners?**

Manager: Train teachers to have a basic understanding of technology and be able to present workshops themselves in order to reach more learners.

**If the programme were successful, how would the teachers and learners be different after participating in the programme?**

Manager: Teachers would have the competence to present their own workshops in classes and learners would be able to make a more informed career choice.

**What kind of changes did you want to see in the teachers and learners?**

Manager: Sunstep wanted to see competent teachers and learners who could make an informed career choice, including the field of electronics and electricity.

**Was the aim of the programme about motivating learners and/or teachers and having fun or/and about the understanding of electronics, the components, the kits and the concepts involved?**

Manager: The main aim was to motivate teachers to understand technology and for their learners to receive hands on experience thereof.

### **What was the goal of the programme?**

Coordinator: The programme initially started with basic principles of electricity for Technology teachers. Electronic kits were not part of the programme.

Technology was incorporated into the curriculum in 2000. Teachers from different learning areas and subjects had to teach the learning area with very little in-service training

Teacher training developed from electricity to electronics. The workshops vary in levels of difficulty. Teachers decide which workshop to attend. Teachers reflect verbally and informally on the workshops. The technology curriculum specialist at WCED head office gives feedback.

### **What are/were the objectives of the programme in the period 2000 – 2002?**

Coordinator: To provide electronic teacher training for teachers that have to be re-skilled to teach technology;  
To develop electricity concepts;  
Keeping abreast with technology developments;  
In 2003 lessons in electronics to be available via the computer from grades 6 – 9;  
Three teacher centres were used for workshops in 2003, Sunzone, West Coast Winelands and Worcester;  
Learners that participated in the programme are traced via Careerstep, one of the projects of MTN-SUNSTEP.

### **What are the outcomes of the programme?**

Coordinator: Teacher training – teachers are more comfortable with electronics in the classroom as there was very little support from the department in this area.

Support for teachers in electronics

Teachers could measure their success via the competition

Number of teachers doing the workshops has increased since the introduction of technology in the curriculum.

Knew about existing problems and what teachers could expect when introducing technology.

Encourage learners to study mathematics and science. Feedback is a problem and it is difficult to trace learners. Forms are being sent to school to attempt to trace learners that have been on the programme.

### **Were the objectives of the programme achieved?**

Coordinator: I would have liked to do more workshops with teachers over a longer period.

Teachers have become very innovative. Some teachers initially had no knowledge of electricity.

- **How it was developed?**

### **How was the programme initiated?**

Manager: Etienne Botha, Ms Miranda Myburgh and Prof Schoonwinkel visited all stakeholders from the WCED from the top down; as well as stakeholders at other tertiary institutions and Stellenbosch university who might even remotely do something that contributes to what we wanted to do or where we might be able to contribute. We visited Peninsula Technikon, UWC, RAU, Stellenbosch University Education Faculty, Marketing and

Communication, Learning programmes assisting students to adhere to the mathematics and science “vereistes”, IMSTUS, Protech, and Ort -Step (now called Ort Tech). Once we had the blessing of all, we targeted schools where there was structure, infra structure and discipline, where teachers and learners wanted to succeed and started training those teachers in the burglar alarm kit.

The development of the new kits, a factor which contributed to the success of MTN-SUNSTEP, including the multiboard printed circuit board developed by Kevin Matthew, expanded the range of the MTN-SUNSTEP kits dramatically. This also reduced the cost of the printed circuit board, since bulk orders were possible. Mr. Henry Chamberlain and Mr. Leon Korki developed another kit, the cordless microphone.

Ms Semmelink, Senior Curriculum Planner for Technology of the Western Cape Education Department was supportive of MTN-SUNSTEP during a visit to her earlier in the year. She said that non governmental organizations and programmes like MTN-SUNSTEP were needed.

MTN-SUNSTEP was advised to partner with Mr. W Mercuur to provide in-service training for Technology educators during holidays. MTN-SUNSTEP was to be at the next SAASTE meeting.

Prof. A. Schoonwinkel suggested that MTN-SUNSTEP move closer to the Education Department.

Some educators had a fear of Technology due:

- To a lack of knowledge
- To scarcity of good textbooks
- To lack of equipment
- To lack of budgeting for technology
- To lack of training for technology

#### Accomplishments:

- Successful meetings with Education Department
- 17 Curriculum advisors trained in WP
- Educators trained in Western Province – 199
- Learners reached in Western Province – 3 052
- Electricity introduced
- Schools visited

#### **How was success evaluated?**

Manager: Workshops for teachers were organized through the curriculum advisors of various Education Management and Development Centres. Many teachers attended and the success can be measured by the acceptance and gratitude of the Education Department for the input of the programme.

#### **How are teachers interacting with the resource?**

Coordinator: Teachers want the worksheets translated to Afrikaans. Some IsiXhosa speaking teachers have a problem with their eyes and soldering. Some teachers struggle with the fine motor skills required to complete the kits. Each stand now has a helping hand lens.

In 2002 teachers and Osman Sadick, the technology curriculum advisor of Metropole South, informally evaluated the kits via a workshop. The kits were found to be acceptable. Osman is on the steering committee.

#### **How was the programme implemented? (Period 2000 – 2002)**

Coordinator: The first part of the process is the teacher workshops followed by the implementation in the classroom by the teacher. Learners attend



workshops at the University of Stellenbosch due to the lack of equipment at some schools. The programme now has toolboxes, which schools borrow on requests. Wouterien follows up and gives ideas on projects and the design brief and this culminates in the building of the model.

The teachers who attend the workshops do not all implement the programme at their respective schools. It is assumed that if the model was built the programme was implemented at the school. It was very difficult to determine whether the programme was implemented. The purchasing of the kits was not an indication that the programme was implemented. Judging the models does not indicate whether the learners have built it in the classroom.

Ulrich, the technical assistant, or I attend to any technical queries. Either, the support is via the telephone or a school visit. Ulrich and I are also available to do lessons with learners at the schools. This is dependant on time constraints and personal safety issues.

The project culminates in a competition where the best model is selected from participating schools.

### **Did teachers reflect on the process of implementation?**

Coordinator: I contacted teachers telephonically. Reflection occurred with curriculum advisors. The teacher did not complete an evaluation report at the end of the workshop. The reflection sheet was not handed to teachers at the workshops.

### **How were the resources developed?**

Coordinator: The Head of the Architectural Planning Department at University of Stellenbosch who enjoys electronics developed the resources. He is the

patent holder of the kits and has designed circuit diagrams and multi boards that could be used for electricity. My husband and I develop the worksheets. The worksheets instruction manual uses instruction language.

**How do you think the learners perceived the programme? Was there any feedback?**

Coordinator: I work with learners at learner workshops requested by teachers. In my opinion, the learners enjoy themselves and enjoy working with their hands. .

**Did internal evaluation of the programme take place? (Who participated?)**

Coordinator: MTN evaluated the programme.  
Wouterien continuously evaluates the programme. Evaluation takes place at and annual workshop and two steering committee meetings.

**How has the programme changed since 2002?**

Coordinator: The teacher training sessions has changed from two- day sessions for science teachers to a series of workshops for technology teachers. These teachers have very little science background and technology training. Initially the kits used to part of the science club activities, now it is part of the curricular activities in the classroom.  
Computers are used in the workshop.  
Teacher demand for the workshops has increased due to curriculum demands.  
The workshops start with basic electricity due the lack of conceptual knowledge in this area.

I rearranged the data from the two interviews to fit the categories used for analysis. The data gathered in this section will be analysed and interpreted to provide information on the programme.

The data below was gathered from the teacher questionnaires and reflect the numbers as on the questionnaire.

## **2. What teachers felt about the workshop? (How teachers experienced the workshops?)**

Teachers attended the workshops at the MTN-SUNSTEP Electronics laboratory at the University of Stellenbosch. Workshops started at 14h30 and ended at 17h30. Some participants completed the electronic kit at 16h00 and left. I attended four workshops in 2001, to observe the process and gave each teacher a questionnaire to complete voluntarily.

The workshops I attended were

- (a) the cordless microphone on the 7 May 2001
- (b) the burglar alarm on the 8 May 2001
- (c) the pet trainer on the 24 April 2001
- (d) the radio microphone on the 27 February 2001

The workshops start with a 20 – 30 minute presentation on the kit by the facilitator. In three of the workshops, there was one facilitator and two in the fourth one. The teachers who attended the workshops taught different subjects and learning areas.

To facilitate analysis and interpretation, the questions from the teachers' questionnaire have been categorized. In this section, data is collected from the questionnaires, my observation notes from two teacher workshops, the interview with one of the teachers at one of the schools in the case study and the transcripts of the informal interviews with teachers at the workshops. Thirty-seven teachers returned the questionnaire. I have maintained the same numbering of the questions on the questionnaires in the presentation of the data.

**1. What subjects or learning areas are you teaching presently?**

Economics and Management Sciences, Life Orientation, Arts and Culture, Home Economics, Woodwork, Technology, History, Biology, Mathematics, Natural Science, Afrikaans, Human and Social Sciences, Literacy and Technical Drawing

The teachers teach across a variety of subjects and learning areas. Teachers from the senior phase attended the workshops.

**2. Have you attended any other MTN-SUNSTEP workshop? Please state the workshop.**

In the cordless microphone workshop, five teachers had not attended any other workshop and two had attended at least one other workshop.

In the burglar alarm workshop ten teachers had not attended any other workshop and three had attended at least one other workshop. One teacher did not answer this question.

In the pet trainer workshop, two had not attended any other workshop and one had attended three other workshops.

In the radio microphone workshop, two had not attended any other workshop and thirteen had attended at least one other workshop. One participant did not answer the question.

From the data, the workshops consisted of a mixed ability group of teachers. In each of the workshops some of the teachers had never attended an electronics workshop before and some had attended at least one other workshop. One of the teachers had attended three workshops.

**3. Have you attended any other course or workshops in electronics? State the course.**

Thirty- two teachers had not attended any other electronics course, one teacher was self-taught, one had attended the Technology 2005 project and one had completed an ORTSTEP course. Two participants did not answer this question.

From the data it is evident that the majority of the teachers had never attended an electronics course before.

**4. State your reasons for attending this workshop.**

Twenty- four teachers responded to this question by stating that they were interested in learning about electronics and teaching it to their learners as part of the technology course. Ten teachers responded by stating that they were interested in gathering information and experience in technology. One teacher was invited by another school and one teacher stated that SUNSTEP had ‘conducted a workshop for my learners that aroused my interest in electronics.’ One teacher was part of the Technology project school. Two teachers did not respond to the question.

Most of the teachers attended the workshop to learn new skills so that they could implement electronics in teaching and learning.

**5. Does the time, venue and duration suit your needs.**

Thirty-two teachers were happy with the time, three teachers were not happy with the time and one teacher did not respond. All the teachers were fine with the duration of the workshop.

Nine teachers responded that the venue was too far. These teachers taught in Khayelitscha, Nyanga and Mitchell’s Plain. Twenty six teachers were happy with the

venue and one did not respond. Most of the teachers did not have a problem with the time. Nine teachers replied that the venue was too far.

**6. Has your time been well spent attending this workshop? Has it been an empowering experience?**

Thirty-one teachers thought their time was well spent. 'Absolut wonderlik'  
"Very empowering, a wonderful learning experience and I leave with much more technological skills than what I had walked in."

**7. What did you have difficulties with during the workshop?**

Fifteen teachers responded that they had no difficulties. One teacher responded that the terminology was difficult. One teacher responded that the whole activity was a challenge as it is a new field. Four teachers had a problem with working out the codes and identifying the colours of the resistors. One teacher had difficulty with understanding resistors and capacitors. One teacher was a bit nervous and one could not stop shaking. . Two teachers wanted a third hand. One teacher responded that the writing was too small on some components. One teacher had a problem with soldering. One teacher had a problem with the different components, as he was not acquainted with it. Seven teachers did not respond.

Most of the teachers had difficulties during the workshop. The type of difficulties cited:-

- Terminology
- New field
- Codes and colours of resistors
- Understanding resistors and capacitors
- Nervous and hand shaking
- Not enough third hands
- Writing on components too small
- Soldering
- Working with components for the first time

**8. Please rate presentation, support and the material resources of the workshop. Use a scale of 1 to 5. One indicates weak and five means it needs no improvement. Please explain your rating.**

Eighteen teachers rated the presentation 5. One explained that difficult terms were made easy. One said that the tutors knew their content.

Seventeen rated the presentation 4, without any explanations. Three teachers rated the presentation 3. One explanation was the language. Part of the presentation was done in Afrikaans. One teacher did not respond. The overwhelming majority of the teachers were satisfied with the workshops and the ratings imply that it needed no improvement.

Teachers responded that needed to improve because the presentation was done in Afrikaans.

Twenty-six teachers rated the support 5, with no explanations. Nine teachers rated the support 4. One explanation given was that the facilitator came immediately when you called. Two teachers rated the support 3. One teacher did not respond.

The majority of the teachers were satisfied with the support during the workshops.

Thirty-three teachers rated the material resources 5. One explanation given was that all the material was there when you needed it. One participant did not respond. The majority of the teachers were satisfied with the material resources during the workshop.

**10. How do you think this workshop can be improved?**

Two teachers requested that the groups be smaller (approximately 14 teachers in the workshop). Three teachers responded that there should be more assistance in the workshop. Three teachers responded that the components needed more explanation. One participant wanted more outcome-based information. One teacher responded that the workshops needed no improvement. Two teachers responded that the workshops could occur centrally, for example at the school. Two teachers wanted the workshops in the

morning. Sixteen teachers did not respond. Two teachers wanted more workshops and two teachers felt that it was their first time and could not comment.

The improvements of workshops as stated by teachers:

- Smaller groups
- More assistance
- More explanations
- More outcome-based information
- Workshops at school
- Morning workshops
- More workshops

The following data is an extract from an interview with a teacher from one of the schools in the case study. I interviewed the teacher at the end of my observation session in the classroom. The teacher willingly participated and made time to do the interview. This was an unstructured interview. This part of the interview highlights the teacher's view of the workshop he had attended.

Akeda: Any other recommendations?

T1: I sat on the course on Monday pass. I was the only experienced teacher with the group. I think they must really work on transferring the information. The guy, what's his name, Ulrich is not a trained teacher and they should train him to explain the kit in an educational manner. . He did fairly well but I felt he could have better. Doing (trails off).....

Akeda: When you left the workshop, did you understand how the kit worked or did you still have to go home and study?

T1: Some of it ja

T1: I cannot compare myself to other teachers who have come for the first time. Teachers, who had seen a resistor for the first time, and handled it, therefore, it is an unfair comparison.



Akeda: Did you understand?

T1: Not when I left the workshop. You have to go back and read the stuff to completely and fully understand how capacitors influence the sound generation and all that.

The teacher highlighted his frustration with being the only experienced teacher in the group. The teacher also highlights that he had problems understanding the concepts because of the facilitation and teaching style. He adds that the facilitator is not a teacher and that he requires more training to explain the kit to teachers.

My reading of the interview and my observation of the teacher also shows that the teacher did not fully understand how the kit functions at the end of the workshop but still had to study.

The following data was gathered at two of the teacher workshops at the SUNSTEP electronics laboratory at Stellenbosch University. These field notes are my interpretation of my observations of the workshops.

Field notes on educator workshop: 27 February 2001: 14h30 – 17h30

TABLE 4.1: INFORMATION ON CORDLESS MICROPHONE WORKSHOP

<i>Venue</i>	MTN-SUNSTEP
Presenter	2 facilitators present for the workshop
Language of facilitation	English and Afrikaans
Number of teachers	19
Number of male teachers	13
Number of female teachers	6

The workshop started at 2.45 pm. The facilitators explained the electronic kit to teachers for twenty minutes in Afrikaans and English, but Afrikaans was favoured by the

facilitators. Teachers asked a few questions on the values of the capacitors and resistors. The facilitator wrote the capacitor code on the board. Teachers then started the assembly of the kit at 3.15 pm. Teachers were at different competence levels, some attending an electronic kit workshop for the first time, while others had already attended a workshop or two.

Each teacher assembled their own kit except for one pair where the male teacher did most of the soldering and assembly. The class was quite big. Everybody was very industrious and some teachers were reluctant to talk to me. Others on the other hand were eager to communicate. Initially the class was quiet with many questions addressed to the facilitators. The teachers who were more confident spoke easily, other who were attending for the first time were concentrating and seemed more diffident and nervous.

#### **Quotes and information from teachers (transcript from short unstructured interviews with teachers)**

Teacher 1: “It is the first time and I find it challenging. It will be exciting and motivating for the students. It will be applied in Technology learning Area. Will start with the burglar alarm as less complicated for the grade 7s and assemble the cordless microphone in grade 8 in the Natural science class.”

Teacher 2: “At Xola High the teacher teaches large classes with 5 soldering irons. The teacher was comfortable with the presentation, language and the instruction manual for the workshop. He has been attending workshops since 1998. He will start a Technology Club in the afternoons to train student facilitators for classroom practice and assist with language as the he cannot speak isiXhosa.”

Teacher 3: “Belvue Primary was sharing as the teacher was attending for the first time.”

The cordless microphone enables one to speak into the radio tuned to the correct frequency. It can be used for concerts, each child uses their own pc board, but also their own radio and each radio has to be set to a different frequency. Two learners can also speak into each other's radios. The sensitivity of the microphone is affected by decreasing the resistance 1K5. The facilitator explained this.

Teachers had a problem with the values of the capacitors. Everybody was very excited to complete the kit and was amazed when it worked. The kit was tested using the radio. Hearing one's voice on radio is quite exciting. The class ended at 5.30pm. Some teachers had completed earlier. The teachers that were struggling a bit because it was their first workshop completed in the allotted time.

In the workshop, teachers do not pay for the kit. This kit was complicated, as teachers had to calculate the values for the capacitors and resistors using colour codes. I was assisting two of the teachers who were struggling.

Field notes for Teacher Workshop: 8 May 2001: 14h00 – 17h30

TABLE 4.2: INFORMATION ON BURGLAR ALARM WORKSHOP

Venue	MTN-SUNSTEP
Presenter	Ulrich
Language of facilitation	English and Afrikaans
Number of teachers	27
Number of male teachers	21
Number of female teachers	6
Number of teachers participating for the first time	7
Number of learners	3

Ulrich does a thirty minute presentation on the working of the electronic kit. Then teachers used the worksheet to build the board.

At first, teachers were quiet and tentative. They were concentrating on their notes and finding the values of the resistors. Approximately four teachers arrived at 3.30 pm. Most teachers arrived by 3pm, at 2.45 only six participants were present. The teachers, who could not solder, did not mention this.

Most of the teachers left the workshops very happy and most had completed their kits, which they took home with them. Light refreshments were provided for the teachers. The teachers did not immediately evaluate the workshops.

- **How did the teachers experience the materials?**

1. **Do you have the resources available to implement this project at school?  
How will this be overcome?**

Twenty- seven schools do not have the resources immediately available. Five schools have the resources available. The schools that do not have resources will use school funds or obtain donations to buy the equipment.

2. **What would prevent the implementation of this programme at school?**

Difficulties that most teachers experience:

- The purchasing of the equipment and the kits
- Large classes
- Overcrowding and not much space in the classroom
- Assistance in the classroom
- Burglaries at the school.
- Learners' inability to follow instructions.

**3. Would you implement this programme at school? Why would you implement the programme?**

Thirty- four teachers would implement the project because the learners are interested and would benefit. “To bring the world of electronics to the learners.” Two teachers did not respond. The overwhelming majority of the teachers would implement the programme at their schools.

**4. How can the electronics kits be incorporated in the subject or learning area?**

Eighteen teachers responded that it could form part of electronics in the Technology learning Area. Three teachers felt it could be part of Natural Sciences. One responded that it could be used in Mathematics in calculations. Four teachers responded that it could be part of crafts in entrepreneurship.

**4.2.3 CONCLUSION**

This data will be analyzed using the data collected from the interviews, the teacher questionnaires and the field notes. The interpretation will be guided by the literature review related to professional development programmes.

### **4.3 CASE STUDY 2: SWAP**

The SWAP kit was implemented as a partnership programme in EMDC South as discussed in Chapter 2. The findings from the data presented below will be used to evaluate both the programme and the resource.

#### **4.3.1 INTRODUCTION**

In 2006, my supervisor suggested that I change the focus of my research question to teacher professional development. The SWAP kit was added as a separate and independent case study. I collected the data in November 2006 after meeting with some of the teachers that were involved with the programme. The programme had been implemented in schools between March and May 2004. I had not been part of this process. The questionnaire was hand delivered to schools in November 2006 and collected at the school in December 2006. The programme manager and facilitators wrote the reports.

The SWAP programme was a partnership between the University of Stellenbosch, WCED (EMDC South) and Shuttleworth, the funder. In the planning stages of the programme two meetings were held with Fadli Wagiet, the life sciences curriculum advisor. Teachers were introduced to the programme in two planning meetings and invited to participate. Three days of training on the kit and methodology was provided for each of the clusters. Six schools participated in each cluster. Teachers attended an afternoon workshop engaging with the curriculum alignment of the resource. A river visit was organized for teachers to familiarise themselves with the resource before it was taught in the classroom. Two facilitators, the programme manager and the curriculum advisor attached to the district, provided support. The facilitators also assisted the teachers with one river visit per school.

## **4.3.2 PRESENTATION OF DATA**

The data is based on an interim programme report of the programme activities in July 2004.

### **4.3.2.1 MISSION STATEMENT OF SWAP**

The Revised National Curriculum Statement (RNCS) requires implementation of learner centred approaches to teaching and learning and emphasises environment as a focus. Preliminary research indicated a possible lack of capacity in many teachers and also a lack of learning support materials to enable or assist teachers with implementation of these approaches. With the SWAP partnership programme we aimed to help teachers to understand curriculum statements, assist with better understanding of the construct environment and also provide learning support material for science education that promotes active learning in science at school level.

The process is structured around a partnership programme involving the Shuttleworth Foundation, Stellenbosch University and the Western Cape Education Department, more specifically the EMDC South represented by Fadli Wagiet. Most of the participating schools are located in the area served by and under the jurisdiction of this EMDC. Mr. Fadli Wagiet provides curriculum expertise and ensures that the programme activities are aligned to provincial and national education imperatives for science education. Stellenbosch University staff members provide expertise related to professional development of teachers and resource materials. The teachers bring an understanding of local school contexts and possibilities for change in classrooms in these schools.

Eighteen schools accepted the invitation to become involved in the programme, twelve from the Retreat-Steenberg area and six from the Grassy Park area. The schools have been divided into three clusters (appendix I), which are served by two fieldworkers. Andre' Rowan deals with the Retreat-Steenberg clusters and Vanessa Bolters with the Grassy Park schools. Their role involves organisation of workshops and meetings,

training and support of teachers and to liaise with Mr. Fadli Wagiet and Dr. Chris Reddy regarding progress and emerging issues.

#### **4.3.2.2 PLANNING MEETINGS**

##### **1. Planning meetings with EMDC.**

Two planning meetings were held with Fadli Wagiet, Natural Science subject advisor, at the EMDC south offices, Mitchell's Plain. At these meetings the proposed plan was discussed and dates set up for the first workshop with schools in the Retreat-Steenberg area. It was also arranged that Fadli Wagiet would serve as the curriculum support person giving curriculum guidance and support regarding an outcomes-based approach to teaching and learning in the Revised National Curriculum Statement (RNCS) to ensure alignment to national and provincial initiatives. His role is organizational (meetings), curriculum expertise and endorsement of the partnership with the WCED. Regular reporting has been done to the EMDC south in terms of programme progress.

##### **2. Planning meetings: Schools**

###### **Retreat-Steenberg**

First Schools meeting: 11 October 2003 (register attached in addendum 1)

An introductory meeting was held with schools in the Steenberg-Retreat area at Delta primary school. Fadli invited (by fax) teachers from nine surrounding schools and arranged with **Delta Primary** to host the meeting (venue and refreshments). Fadli Wagiet introduced the programme to teachers and endorsed the process as an official initiative endorsed by the EMDC South.

Dr. Chris Reddy from Stellenbosch University explained the process to those present by way of a power point presentation. Schools were required to indicate whether they will be part of the process. Teachers agreed to discuss the programme with colleagues and report back at a later date. The feedback received indicated that twelve schools were willing to be involved. We (the programme team) decided to divide this group into two clusters of



six each with two teachers Mike Henry (Delta) and Mike Haeger (Square Hill) to lead clusters. It was also agreed that grades 6 & 7 would be the focus of the programme.

**Fig 4.1: SWAP display at initial workshop.**



### **Grassy Park**

A third cluster meeting was held for Grassy Park region, at the Zeekoevlei Environmental Education Centre on 12 March 2004. Fadli Wagiet arranged the meeting and invited teachers from seven schools in the area. Chris Reddy, Vanessa Bolters and teachers from various schools attended the meeting. At this meeting teachers were briefed on the programme process by Chris Reddy and schools were asked to indicate whether they would be interested to participate at a later date. All the schools present indicated that they were interested and were willing to be included in a cluster for this area assisted by Vanessa Bolters, as fieldworker.

### **3. General planning meeting: 23<sup>rd</sup> March 2004: Grassy Park Civic Centre**

The purpose of this meeting was to negotiate and organise dates for future workshops with fieldworkers and teachers as well as to set up a meeting for linking SWAP and Science curriculum to be conducted by Fadli Wagiet.

This meeting involved all the schools that agreed to participate in the programme. After a general introduction by Chris Reddy and Fadli Wagiet teachers who were attending for the first time were briefed regarding the aims of the programme and the envisaged process. The main aim of the meeting was to arrange dates for training of teachers and follow up river visits with learners. Another important outcome was to arrange a date for a general workshop at which the links between SWAP and the science curriculum for primary schools could be highlighted and clarified.

Teachers at the meeting were organized into their respective clusters and the fieldworkers were assigned to a cluster each. Fadli worked with the third cluster. Suitable dates were discussed and finalized during this period and are reflected in the tables below. Some questions arose related to possible clashes between dates for workshops run by the WCED and the SWAP workshops planned within the programme. Fadli assured teachers that the two would run parallel and that the SWAP workshops were officially sanctioned by the EMDC south. Three teacher coordinators were elected to assist the fieldworkers with organization of meetings and workshops. Dates and venues for meetings were also finalized.

Training sessions involve a three day programme facilitated by the fieldworkers. On day one participating teachers are introduced to the contents of the SWAP resource and how it could be used as learning support material. Day two involves further discussion of the kit and focuses on the reporting procedures suggested. On day three teachers are taken to a water source (river, canal) to practically apply the SWAP testing procedures and report on their findings- a hands trial of the resource is done. The dates agreed on are reflected in the tables below.

**Table 4.3 Dates negotiated for training of teachers**

**Cluster 1: Mike Henry Venue**

**Retreat Steenberg**

<b>ACTIVITY</b>	<b>DATES</b>
Teacher workshops to introduce SWAP programme and kits (1Aft)	<b>30 March</b>
Follow-up visit – SWAP training (2)	<b>20 April</b>
River visits with teachers (1)	<b>22 April</b>
SWAP and science curriculum workshops for teachers	<b>26 May 2004</b>
River visits (teachers and learners) (1 per school)	Various dates for different schools

**Cluster 2: Michael Haeger Venue**

***Retreat Steenberg***

<b>ACTIVITY</b>	<b>DATES</b>
Teacher workshops to introduce SWAP programme and kits (1Aft)	<b>19 April</b>
Follow-up visit – SWAP training (2)	<b>21 April</b>
River visits with teachers (1)	<b>26 April</b>
SWAP and science curriculum workshops for teachers	<b>26 May 2004</b>
River visits (teachers and learners) (1 per school)	Various dates for different schools

**Cluster 3: Vanessa Bolters**

Grassy Park /Lotus River

<b>ACTIVITY</b>	<b>DATES</b>
Teacher workshops to introduce SWAP program and kits	<b>22 April</b>
Follow-up visit – SWAP training	<b>26 April</b>
River visits with teachers	<b>8 May</b>
SWAP and science curriculum workshops for teachers	<b>26 May 2004</b>
River visits (teachers and learners) (1 per school)	Various dates for different schools

#### **4.3.2.3 Teacher Training**

In all three school clusters teachers and learners were introduced to water as a key resource and the importance of water quality in a healthy environment was emphasised. The SWAP kits were used as resource materials to train teachers in science education processes that promote learner centred activities for learners. These were done at various locations and follow up sessions were conducted at schools. All training of teachers has been completed in all three clusters (fifty three teachers) as indicated in the tables above and schools were issued with SWAP kits for future use. One kit was issued to each participating teacher and schools each received a total of five kits for school use.

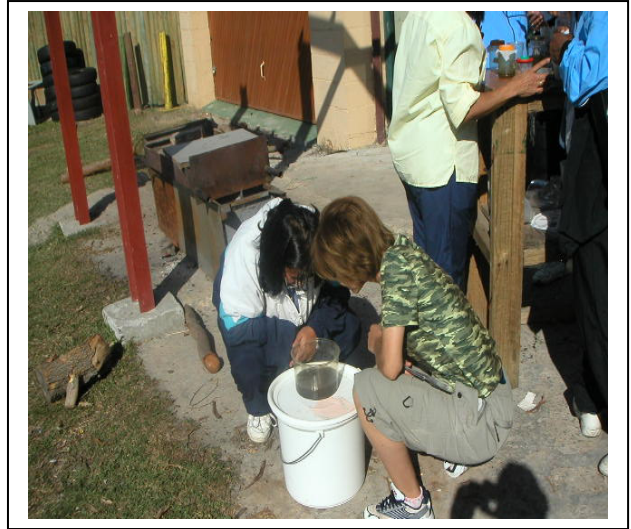
**Fig 4.2: Facilitators addressing teachers at workshop.**



**Fig 4.3: Teachers at training workshops**



**Fig 4.4: Teachers at training workshop, Zeekoevlei Environmental Education Centre (ZEEP).**



#### **4.3.2.4 Curriculum planning workshop: Wynberg 26 May 2004: Centre for Conservation Education.**

This workshop was arranged, organized and facilitated by Fadli Wagiet, the science curriculum advisor from EMDC south. The aim of this meeting was to link the SWAP resource pack to the natural science curriculum. This was done by way of collaborative activities for participants. The activities focused on the science outcomes as stated in the RNCS. The meeting was well attended with a total of sixty five teachers from the eighteen schools attending.

The activities started after refreshments were served. Chris Reddy welcomed everyone and discussed the proposed programme for the day. For the rest of the afternoon Fadli facilitated various activities during which teachers discussed and “unpacked” the science outcomes as they are spelt out in the policy documents. This exercise proved very useful as it made it possible for teachers to hear various perspectives on the outcomes and come to some consensus at the end of this session.

Further activities required teachers to apply their understanding of the science outcomes to the SWAP activities. This required teachers to make links between tests and activities in the SWAP resource and the formal science curriculum. This again proved to be a useful exercise during which much discussion took place. The quality of the feedback from teachers indicated that they had made meaning of the outcomes and had also made useful links between the activities provided by the SWAP kits and the science curriculum. This is an important area as it allows teachers to use SWAP as a resource in the course of their “normal” science teaching rather than to see the resource as an add on they need to make space for. Sixty-five teachers involved in the programme attended and the many expressed very positive sentiments regarding the meeting activities.

What emerged from this meeting and from a reflective session of fieldworkers, Fadli and Chris later, is that teachers need more details regarding possibilities for *assessment* and using SWAP as a resource to develop assessment strategies. Teachers also requested



more details on lesson planning and classroom application of SWAP activities. A further joint workshop will be organised in the new term to address these needs teachers have expressed.

At this meeting envisaged for the new term further activities will also be finalized. Efforts will be made to link further work with the formal training intermediate phase teachers have done with WCED officials during the June vacation.

**Fig 4.5: Teachers at the Science Curriculum Workshop 26 May 2004.**



#### **4. 3.2.5 River visits with children**

The purpose of these visits is to familiarize teachers with working with learners in fieldwork settings using SWAP resource materials. Andre has completed three visits with schools in the Retreat – Steenberg clusters: 14 June Levana primary, 15 June Sullivan primary and 18 June Square Hill primary. Vanessa has managed to do visits with Grassy Park area: Stephen Road primary 24 May, Kannemeyer primary 25 May, E.C. Primary 26 May and Fairview primary 27 May.

Outstanding visits to rivers with teachers and learners will be done early in the new term. Dates are still to be negotiated with teachers at the various schools.



**Fig.4 6: Children performing SWAP tests on fieldtrips**



#### **4.3.2.6 Concluding remarks**

At all the meetings the attendance was regular (registers in appendix II) and the atmosphere was very positive. The willingness of teachers to participate and attend has been attributed to the various factors which include the official nature of the process (WCED involvement), good organization of workshops and adequate funding from a reputable partner.

There has been very good co-operation from the volunteer coordinators, Mike Henry (Delta primary), Mike Haeger (Square Hill primary), Claude Meyer (Hyde Park primary). The efforts of these individuals have been very useful to the fieldworkers and played a big role in the success of workshop activities and attendance. On average we have been working with *66 teachers from 18 schools*. All schools received SWAP kits. The fieldworkers have developed good relationships with the teachers in their clusters and are getting good co-operation from them. The fieldworkers have also been doing excellent work in terms of training teachers and organizing workshops and fieldtrips.

One of the main aims of the programme was the professional development of teachers to improve science teaching in an outcomes based framework. What this involves is to assist teachers in understanding RNCS by providing opportunities and resources for learner centered teaching approaches and a forum for networking and sharing of ideas and perspectives amongst teachers. The activities were focused on the outcomes for science teaching as stated in the Natural Science curriculum statement.

Comments from the participating teachers regarding the programme activities in reflective sessions were generally positive. Many teachers indicated that the workshops provided a forum for discussion with other teachers and for sharing perspectives on their work in a changing working context. Teachers indicated that the workshops provided a “space” in which they could develop relationships of trust and collegiality with colleagues from other schools in their local area and beyond. Teachers have also commented positively on the collaborative nature of the training workshops held thus far and also on the river visits done with some schools. It was mentioned that they had

developed new ideas they could implement in their classrooms and were happy to have access to new resources (SWAP kits) they were formerly unaware of.

Various sets of indicators of and for professional development of teachers have been developed to measure the success of interventions or programmes of in-service teacher education. Janse Van Rensburg and Le Roux (1998: Part V) developed the following set of indicators in collaboration with participants in a participatory course in Environmental Education. These are summarized briefly in the table and discussed in terms of the SWAP. The indicators are:

- Did teachers develop new understandings of the knowledge areas embedded in the SWAP (of environment and environmental education)
- Were there any changes in their approach to teaching environmental education and resource –based learning programmes;
- Were teachers better equipped to teach in the these areas and did their ability to teach improve;
- Were they more confident in the classroom;
- Did they develop teacher networks and learn from each other in terms of teaching, methodology, content knowledge and resources and;
- Did they develop or adapt resources of these two programmes to contextualize the resources for their classes.

Adapted from Janse Van Rensburg and Le Roux (1998:PartV pp3-10)

The comments of teachers in reflective conversations thus far seem to indicate that some opportunities for professional development as described in the list above seems to have been provided in the programme process. These are particularly evident in changing approaches to work, new understandings and developing networks. Further discussions and focus group interviews will be held in the next phase of the programme as a form of internal programme evaluation.

The next phase will be planned through negotiation with teachers in the next school term. Essentially this will involve workshops on assessment for the RNCS, development of learning programmes for Natural Science using SWAP materials and follow up school-based support sessions. The fieldworkers will facilitate these in collaboration with Fadli Wagiet and Chris Reddy.

Sid G Rule primary has withdrawn from the programme (Grassy park Cluster) but was replaced by Lotus River Primary School. They cited excessive workload as the reason for their withdrawal

### **4.3.3 QUESTIONNAIRE**

I have divided the questions in the questionnaire into suitable categories to facilitate the analysis. Twenty-nine teachers returned the questionnaire. The teachers' responses are submitted. I kept the same numbering of the questions on the questionnaire submitted to teachers.

- **The teachers' responses to the SWAP kit**

In this part of the chapter, I will be presenting teachers' responses to the resource kits from the questionnaires completed by the teachers who participated in the programme. I am interacting with the literature in Chapter 2 and analysing the resource as learning support material based on the teachers responses in the questionnaires.

The teachers participated in four workshops over a period of a month using the SWAP kit. One of sessions included a river visit with the facilitators to familiarize themselves with the kit. This occurred before implementation in the classroom.

- 1. What made the classroom use of the kit easy?**

The instructions were clear and the kit was very friendly/ The instructions were clear and easy to follow/I used the information and applied it to draw up

information for grade 2 kids/ I could adapt it to use in the junior phase/ Size (large) of the charts. Easy to read and made it possible for group work/ Group work plus language – reader friendly charts/ understandable language and easy to do/ The size is friendly. I had duplicated most of the content (for example bug dial, turbidity dial, little containers etc.) but the inadequate amount of testing strips is a problem. It's a task accessing the strips and money is a problem. Please review. More kits, thermometers, pH sticks/ I think the kit can be a challenge for an educator just starting with the kit, finding the replacement parts can be a challenge, for example nitrate strips, thermometers, etc/ The kit was very useful. We could use certain instruments for our grade./ relevant to all learning areas. Very practical/ Practical. Relevant to usage in classroom management./ It was practical and relevant to the learning area .NS/ compact. User friendly/ pollution – water/ the practical showing how to use each item found in the tin./ not for the whole class at the same time. The few learners used had hands on experience and could relate to the kit/ easy to understand./ we have polluted vleis and rivers/ the fact that we have polluted rivers and vleis/ no answer/ yes very useful and could easily be incorporated into the lessons./ learners were very interested./ you were taught to use it. It was easy to use. Children were interested./ the educator was knowledgeable and confident due to training./ educator was knowledgeable and competent. Educator was confident to use the kit./ the kit was interesting and the teacher as well as the learner found it useful./ The kit was easy to use because the diagrams, wording and information was easy to understand for both educator and learners. The booklet that accompanied the worksheets was self explanatory.

All the teachers responded that the advantages to using the SWAP kits were:

- Clear instructions and easy to follow
- Adaptable to other grades
- Large size of charts
- Easy to read and understand because of diagrams
- Made group work possible
- Easy to do

- Could be photocopied
- Practical
- Relevant to learning area
- Compact , user friendly
- Practical showing the components
- Allows for hands –on experience
- Easily incorporated into lessons
- Learners interested
- Taught to use it
- Training provided
- Booklet self-explanatory

According to some of the teachers, the disadvantages to using the kit were:

- Inadequate amount of testing strips
- Inadequate number of kits
- Not enough equipment
- Difficult to find replacement equipment
- Difficult to use for the whole class at the same time

**5. Did anything prevent you from using the kit?**

No/ This year we waited for extra sheets to arrive. Nothing prevented me from using the kit./ No/ No/ Size of the classes. Difficult for teacher to take large groups of learners to the river or vlei/ Yes, because we had to take the child to the nearest river. Big classes – danger of crossing the M5/ no/ nothing prevented me really but due to time constraints, I overlooked it a lot of the time as it seems over and above. Kindly supply us with worksheets, rubrics, lesson plans etc. That was the barrier for sometimes using the kit- as well as the shortage of nitrate testing strips and thermometers./ No/ No/ Yes – we had to cross Prince George Drive to

walk to the canal which could be dangerous. When we started the project the canal was polluted due to power failures./ safety of learners. Weather. Pollution/ Safety. Learners had to cross M5 freeway to observe the canal. Pollution of canal/No/ yes- water had to be brought to classroom/ No it was very interesting using it and seeing the results/ No/ No/ No/No/ No – very user friendly. Provide learners the opportunity to be part of the science process. They enjoy playing the scientist./ yes , too few kits. Learners have to share./no/no , not really/ No/ No/ It would be helpful if more provision

Most of the teachers used the kits in their classrooms. Seven could not use the kits, mainly due to the safety of the learners and the need for more of equipment. The context of these teachers made it difficult for them to use the kit: large class sizes, the M5 freeway and the shortage of equipment.

**6. Could you use the SWAP kit immediately in the classroom in terms of the RNCS?**

Yes/ Yes/yes/ yes/Acid and base – grade 7, animals grouped into categories/ Yes, acid and base is part of the science(grade 7)/ yes – very user-friendly/ yes – but the learning programme is loaded. Our school is for the first time implementing “future entrepreneurs”. We need to marry the two approaches. Help us do it./ Refer to No.4/ yes/ Yes- part of natural science- water and other learning areas for example health – LO/ yes – NS./Yes – NS/Yes/ yes/ yes you can apply it where relevant and accurate/ yes/ yes – learners experienced how kits could be used/ yes/yes/ yes – very user friendly/ yes easily adaptable to many lessons./yes/ yes. It could have fitted in with the old curriculum and we could use it in RNCS./ yes/yes/

All the teachers said that they used the resource in their classroom immediately.

**7. In your opinion, was the kit useful?**

Very useful/ Yes/yes/ yes/ yes – but needed more kits and equipment for example bottles./ yes, needed more kits/ yes/ certainly/ Definitely but you need to provide replacement components/ Yes very useful/ Yes, very useful/ yes/ Yes/ Yes/yes/ yes effective, relevant and practical/ yes/ yes/ yes/yes/ very useful kit . It assists greatly in times where there is no science equipment./ yes especially the theme dealing with water in NS, but other lessons as well such as Social Science, Water conservation, etc./yes – very useful/the kit was useful because you could use it immediately./yes – learners enjoyed the new experience and tools./ yes. Children and educator enjoyed the experience/

From the responses, the teachers all said that the kit was useful. Three teachers said that it was difficult if not impossible for them to replace the equipment. This limited the use of the kit.

**8. Why was the kit useful?**

It was easy to use and easy to store/ By testing the quality of the water in the canal close to the school using the kit made the learners aware of their environment./ I used it at the river “Lotus canal” near our school. We could test the turbidity, temperature, oxygen, bacteria and pH of the water/ I could test the pH of the water, the oxygen and bacteria level of water and the temperature and turbidity of the water/ hands on for kids/ practical hands on. The child was able to recognize the advantage of a high pH and a low pH level for example soap and water/ interesting for kids/ When I took learners to the river it served the purpose besides the shortage of testing indicators. More learners should experience doing lab testing. / Yes/ We could use it in more than one aspect of a lesson/ Its very practical – hands on learners enjoyed or understand the work done in the classroom/ relevant for example practicals/ It was practical and relevant. Learners enjoyed it/ fitted in with practical application of lessons/ test for water/ it made



the theory real and one could practically test the water for various things/ It gave me the chance to teach the learners new and interesting (things) about water/ user friendly/ Children could see for themselves how dirty water is and the different kinds of animals it contained/ The children could see the results of the tests. They could also see the insects found in water./ provide resources and equipment. Help learners to do and carry out experiments and tasks. Address current situation. It can be applied across the curriculum. Integrate many learning areas in modules./ easily adaptable to content. Easy to use/ No answer/Environment is part of our lives and we need everything that could help us to make it a better place/ learners enjoyed the new experience and tools and it was hands on./ children very eager to experiment and could not wait for outcome./

Almost all the teachers based the usefulness of the kit on the learners experience while using the kit. Overwhelming majority agreed that it was practical, developed practical skills, easy to use and store and it made theory real.

**9. Have you incorporated the kit in your learning programmes in the classroom after the implementation of the project?**

Yes/ Yes/ Yes we had a follow- up at the river and they could observe the differences./ yes we could follow up at lotus canal with the kids and they enjoyed it./ Yes. Different animals found in the river and sorted into groups or categories./ Yes – the lesson on liquids/ no – we could use it only for the project./ Yes , especially when we did the safety and quality of water. The whole “rat-tailed maggot” scare prompted us to test the schools tap water./ certain components to some degree/ Yes/ yes – water week – NS/ yes – water week –NS – water life/ Yes – water week. Water Pollution/ yes/ so –so/ yes but not too intense only where relevant to our existing NS curriculum/ No /yes/no answer/ no answer/yes– ns scientific investigations- written work letter to councilor and report writing – social science – floods – canalizing of rivers – mathematics – measuring – arts and culture – drawing profiles/ yes most certainly./ yes/ yes- with Life and Living

in NS also with Matter and Materials/ yes had to do it in stages due to big class groups./ Yes- I use it on a lower scale for the Grade R learners and use it to its full potential for our environment club./

Two teachers responded negatively. Two teachers did not answer and the majority included the SWAP kit into their learning programmes after the programme was completed. One of the teachers mentioned that it had to be done in stages because of class size.

**10. Do you use the kit for practicals or demonstrations in science or any other learning area?**

Yes/ It was used for practical work or demonstrations in science. It was integrated – LLC – letter writing and discussions, AC – poster making/ Yes/ yes/ Science – measuring temperatures, weather, solid and liquid, temperature, mathematics- measuring and bar graphs, languages – reading instructions./ Yes, measuring the temperature, etc. Weather – body temperature. Solid and liquid temperature. Bar graphs- mathematics, language – reading instruction/ no/ Other than the above, I have not used it again./ practical work/ Yes/ Yes – we did the pH level /oxygen/ water life/ yes we did the pH level, oxygen/ Yes – excursion to the canal/yes-tin and labs – NS adapted to specific grade/ yes/ yes/ practical work. NS. Geography- wetlands, Lo – pollution/ yes/yes/ yes/ practical work/ both for NS and Social Science /yes/ In science- practicals although it was difficult with 47 learners in the class/ yes/ yes – but I adapt it according to my learners level./

The majority of the teachers included the kits in their practicals and other learning areas. Only two of the teachers did not use the kits for practicals. The teachers mentioned all the learning areas except technology and economic and management sciences.

**11. Any other comments or ideas you would like to share?**

No/ no answer/ It was very exciting and educational and learners were motivated to clean the “lotus canal” because they live along the canal./ My kids learnt a lot because lotus canal runs through the flats where they stay and they could go there every day and clean up. Please laminate the laboratories. No money at school./ Environment group also made use of kit. Would like more support next year/ Environmental club could test the pH of the soil and animals in the river. Children were excited/ The project should take place early in the year/ make things available to us. Let one school be responsible for resources, bugs must be in glass slides. Accessibility. Time is a scarcity. Worksheets available to ensure adequate outcome levels etc/ Please ask Glen Van Harte to tell colleagues to implement Swap as part of their learning programme even though their current learning programmes do not reflect detailed planning/ no answer/ looking forward to next project/ keep up the good work. Looking forward to the next kit/ looking forward to 2007/ opportunity for all learners to go on field trips. More field trips (affordable)/ no answer/ more guidance – assistance in planning./ No/ learners and educators enjoy this practical approach/ no answer/ no answer/ lab charts – too big – if A3 schools could laminate for reuse. For historical lab learners interviewed elderly at local old age home who enjoyed helping my learners. Lead to old people at old age home to be invited to grandparents’ day at my school. I commend Andre and Chris for the work they have been doing in sourcing funding for this project. Also a heartfelt thanks to shuttle and WCED for affording our learners this opportunity./ regular replacement items would be very useful./ no answer/ I would love to be part of the team again./ would like to see more of this type of workshops being offered. Good experience. Thank you./ more workshops offered especially practical experiences./

Teachers were very positive about the usefulness of the kit. They wanted and were eager to participate in the programme process again or a similar programme. Teachers felt empowered and said that their confidence in their teaching had improved.

- **Teachers responses to the programme/ process**

**For how long and how many workshops did you attend to implement the programme? When did you attend?**

2 years/the project started in 2003 and it was rounded off in 2005. I joined the project in 2004 and attended 3-4 workshops/ 2 years/ 2 years/ approx 5 workshops/approx 4 workshops/ 2-3 / all , since I became a member. (except the last one at the end of November) – notice came way too late./ in 2000,2002,2005/ no answer/ one year/one year/ one year/2 years/no answer/About 4 workshops – 2 hour session and one Saturday morning session 2004- 2005/ 2004and 2005/ no answer/ 2005/2004-2005/1995- 2005 – 2 workshops/ a few years ago and followed up last year. Initial programme started in 1997. This programme was started over a few months. / No answer/No answer/ Completed the course/ Completed the course. /The project started in 2003 until 2004. It was rounded off in 2005. /Started during 2003 -2005

The majority of the twenty- nine teachers had attended the four workshops. Some teachers had participated in the SWAP programme since its inception. One teacher had been part of the SWAP process since 1997.

**How, in your opinion, could the workshops have been improved?**

The workshop was very informative and I did not find any shortcomings/I had not attended all the workshops but those that I had attended was informative and interesting/ Yes, to be linked to learning outcomes and assessment standards. More activities, time allocation, educators involvement/ make it early – about 1pm with the permission of the EMDC and the principals- by 3pm I am brain dead. More junior water analysis to be handed to schools. More learners involved at the same time./ Would like more support. Train science educators. Educators

were moved to other grades and therefore needed more training./ Would like more support – for science educators moving in grades was a problem./ More support/ co-operative learning whereby the facilitators accompany the teachers on at least one excursion./ Workshops conducted well/ No improvement necessary/ no answer/no answer/ no answer/no answer/ no answer/ workshops could have intensified as Swap progressed/ no answer/ regular workshops. Maintain the interest. Educators can share their findings./ no answer/no answer/making workshops more practical and hands on/ they were effective as is./ no answer/ the workshops were always worthwhile, interesting and we learnt a lot./ More hands on/ more hands on experiences/ The workshops in Rondevlei were very interesting and quite adequate./ some of the workshops have been interesting and informative

Most of the teachers were satisfied with the quality of the workshops. Five of the teachers were satisfied with the quality of the workshops. Nine teachers did not respond.

Teachers requested these improvements:

- Links to learning outcomes and assessment standards;
- More activities;
- More educator involvement;
- Workshops earlier in the day;
- More equipment;
- Support for teachers who did not participate in the program but eager to use the kit;
- Co-operative learning;
- Intensification of workshops as SWAP progressed;
- More regular workshops to share with other educators;
- Workshops more practical and hands on.

### **Was any support provided by the project during the implementation?**

Yes/ Yes – Andre provided support/Yes. She took photos. She brought her own “water life” animals. It was hands on. The learners were actively involved as a group as well as / Yes/ Yes one of the non-governmental organisation’s members visited the school and only accompanied the grade 7’s to the river in Prince George Drive. /Yes, one of the non-governmental organisations came out to support us but this only happened once. / No/ Yes, I had Vanessa Bolters accompanying me on my first excursion. It gave me great confidence and I did the other excursions comfortably. / Very limited. / We received enough support throughout the project/ yes – Andre was very supportive. Activities were done at Rondevlei and at the canal/ yes. Practical/ yes we had one practical activity and observation at Rondevlei Bird Sanctuary/yes/ yes/yes-in terms of resources and kits. Hands-on approach. Facilitators took participants through the whole Swap process./ yes /yes/ yes/yes/ yes- did not make use of support – level of knowledge and experience when using the kit/ yes with Vanessa . She offered support and guidance to teachers implementing the programme in 1997./ yes/ yes, you could get hold of the facilitators whenever you needed them./yes/yes/ yes . we received support from Andre/ yes. Support has been provided by Andre.

Most of the teachers felt that the support was adequate. Three teachers requested more support.

### **In your opinion, was the support adequate?**

Yes/ Yes/ Yes/Yes/ No – more frequent visits would have helped us to implement programmes and lessons./ yes and no. a follow up should have been implemented./ No/ Yes especially since she helped me to obtain some of the bugs which I certainly would not acquire on my own. She brought along extra testing strips./ I think the challenge was integrating the Swap curriculum into an existing school learning programme so that it does not become something extra, but part of

the curriculum or learning programme of grades 5 -7/ Very adequate/ yes – very informative and practical/ Yes informative/ Lessons were interesting and we were actively involved/yes/ yes/ no – more guidance was definitely needed./ yes/ yes/ yes/yes/project manager . Facilitator always willing to support – always willing to travel from Stellenbosch to Steenberg to offer assistance and support/ more than adequate/ yes/ yes- it was adequate/yes/yes/ yes- the facilitator was helpful and very approachable./ yes

Most of the teachers felt that the support was adequate. Four teachers required more support through the process.

#### **4.3.4 CONCLUSION**

In this chapter, I reported on the process of the two case studies, MTN-SUNSTEP and SWAP. I reported on the teacher workshops I attended, the questionnaires and the informal interviews. The implementation and general process varied at each workshop with some teachers being very enthusiastic and others not using the resource due to various reasons and constraints. All teachers on both programmes were given access to the same INSET programme and the same resource materials.

In the following chapter, I evaluate and look for indications of effective professional development in each of the case studies through analyzing the data using the indicators developed in Chapter 2. I will identify possible evidence of teacher professional development through using the resource kits.

## **CHAPTER 5: ANALYSIS AND INTERPRETATION OF DATA**

### **5.1 INTRODUCTION**

I will analyze and interpret the data of the MTN-SUNSTEP and the SWAP programmes in terms of the inset processes and indicators reviewed in Chapter 2. Like Craft (1996) and Reddy (2004), I will use the terms, INSET, professional development and teacher development interchangeably to mean *all positive professional learning that teachers experience after their pre- service training*.

Data analysis is the process of making sense of the data (Merriam, 1998: 178). Making sense of the data involves interpreting, reducing, consolidating and categorizing what people have said and the researcher has seen to make meaning (Merriam, 1998: 178). I will discuss the programme processes and the role of the resource kits in enabling teacher professional development using the theoretical frameworks discussed in Chapter 2:

- Bell and Gilbert model of teacher professional development (1994)
- Indicators for measurement of success of professional development (JanseVan Rensburg and Le Roux, 1998)
- Critical levels of evaluation (Guskey, 2002)
- The factors of Garet et al, (2002)

### **5.2 CASE STUDY 1: MTN-SUNSTEP**

#### **5.2.1 THE MEASUREMENT FOR SUCCESS OF PROFESSIONAL DEVELOPMENT**

I used a mix of the Bell and Gilbert (1994) model and the JanseVan Rensburg and Le Roux (1998) indicators to analyse the data of the process of teacher development.



### **5.2.1.1 PERSONAL DEVELOPMENT**

According to Bell and Gilbert (1994), in their personal development teachers recognize that parts of their teaching is a problem (level 1), deal with the issue (level 2) and feel empowered ( level 3).

In MTN-SUNSTEP teachers accepted an invitation to attend the workshops. This implies teachers recognize aspects of their teaching and content knowledge are a problem and deal with the issue by attending the workshop on electronics. Electronics is a new content area in senior phase Technology and in physical sciences NCS in grade 12. At the time of the research, the education department had not held teacher workshops on electronics. In 2001 when the study started, electronics was not a compulsory in the school science curriculum. Teachers knew that they would be teaching this section at a later stage and they were looking for information and for innovative ways of teaching.

At this stage of curriculum implementation of the NCS, grade 9 teachers had not been trained in NCS yet but knew that they would be expected to teach this area in the new curriculum and took ownership of their own learning. They viewed the resource as a tool to excite the learners to learn science.

Teachers were initially excited about the workshop (Guskey: 2002). When most of them returned to school they found it difficult to introduce the resource in the classroom as they did not have the support and could not adapt the resource to their context. From the data, the teachers who used the resource felt empowered as a result of this process.

Some teachers attended more than one workshop which implies that teachers recognize and take ownership of their own learning. They needed more information and skills in electronics and the resource kits. They could see the value of the resource in the classroom.

In my opinion, teachers recognized their need to develop their knowledge of electronics. The resource made it easier for teachers to start understanding the concept and for teachers to learn. Teachers had to travel a distance to attend the workshops. It was held in

the afternoon and teachers were tired. Notwithstanding these constraints, teachers attended. This implies that teachers valued the resource and teachers were willing to sacrifice their own time to attend.

### **5.2.1.2 PROFESSIONAL DEVELOPMENT**

In the development of teachers' professional capacity, teachers tried new activities in the classroom and developed new ideas for teaching.

Interpreting the data from the questionnaire and the field notes of the teacher workshops it is evident teachers have experienced these opportunities for professional development during the process of the programme.

- New understandings of concept electronics and the use of resources

From the data, the teachers have a superficial understanding of the resource kit and required more time to study and interact with the concepts. This was not provided in the workshop and teachers had to make meaning of the concepts on their own. A few teachers mentioned that they had problem with the terminology, identifying the value of the resistors and understanding the functioning of resistors and capacitors. One teacher who had been attending the courses since 1998 said the following, "I am comfortable with the presentation, language and the instruction manual for the workshop. I have been attending workshops since 1998 and I will start a Technology Club in the afternoons to train learners." As previously stated, another teacher mentioned that, "I sat on the course on Monday past. I was the only experienced teacher with the group. I think they must really work on transferring the information. The guy, what's his name, Ulrich is not a trained teacher and they should train him to explain the kit in an educational manner." The teacher also mentioned that, "Not when I left the workshop. You have to go back and read the stuff to completely and fully understand how capacitors influence the sound generation and all that."

The data indicates that the teachers have some understanding of the concepts by the end of the workshop but were not confident enough to teach their learners. The data also echoes the research that time is a crucial factor in successful professional development (Garet et al, 2002)

- Changing approaches to electronics and resources in the classroom.

From the classroom observations, the teachers taught the kit to the learners, through 'chalk and talk' and the learners built the kit. The data gathered does not allow me to infer whether the teachers developed different approaches to work. The teachers that I interviewed seemed to enjoy completing the kit with their learners. Using the Bell and Gilbert (1994) model to evaluate the process, teachers taught the resource kits in the classroom. Learners completed the kits. Teachers had never taught this content before. The resource kit was the tool that teachers used to introduce electronics to the learners. Most of the teachers would not have introduced learners to this concept without the resource kit. Teachers used this new and innovative way in their classroom. They introduced their learners to the kits and to the applications of the kits as some of the learners built models for the competition.

- Increased confidence in the work environment

The data collected did not allow analysis of this factor. From my classroom observations at three of the schools, teachers interacted minimally with the learners, referring them to the resource manual. The learners generally continued to assemble their resource kits with little interaction between the learners and teachers. This could be due to my presence in the classroom. Teachers were confident enough to introduce this new concept into their classroom without adequate support as discussed later. In my opinion teachers wanted to excite learners to study science and mathematics, and make their lessons exciting and fun. The electronic kits were an ideal resource to assist with this process as discussed later in the chapter. Teachers attended the workshops and participated in the professional development process. From my interpretation of the data, teachers needed to be confident to introduce the resource kit and electronics in their teaching, whether the programme contributed to this confidence cannot be inferred from the data.

- Improved job skills

From the analysis of the data gathered, it is evident that the teachers acquired new skills. For most of them, the workshop was their first interaction with electronics. Some of them were learning about resistors and capacitors for the first time. These skills are essential to teach these subjects. The data show that the workshops made a difference. One teacher mentioned, “Absolut wonderlik” Another, “Very empowering, a wonderful learning experience and I leave with much more technological skills than what I had walked in.”

In my opinion, teachers needed to learn about electronics. This would assist them professionally in the classroom. The resource made it easier for teachers to start understanding the concept (Bell and Gilbert, 1994). Teachers attended the workshops and participated in the development programme because of their interest in the resource.

Most of the teachers did not initiate other professional development activities as they expected the assistance from the programme coordinators.

### **5.2.1.3 SOCIAL DEVELOPMENT**

Using the Bell and Gilbert (1994) indicators to evaluate the social development of teachers during the process, the data shows that the opportunity was not granted for teachers to interact with each other. They did not form networks and collaborate with each other. Teachers were not given the time and the opportunity to network with each other.

In my opinion, the programme coordinators did not see the value of this and their approach to teacher professional development was based on the deficit model (Bagwandeem and Louw, 1993). Teachers lack knowledge and their experiences were not valued.

As is evident from my observations of the teachers' workshops, teachers did not interact and no opportunities were provided for teachers to reflect and learn from each other. The coordinator stated that, "No reflection was done at the workshops with the teachers. Teachers did not evaluate the programme." The data of the interviews with the management of the programme, shows that the managers believe that the teachers lack knowledge and skills, and the programme provides these for teachers. Based on this philosophy teachers do not need to interact as they have nothing to share.

The programme was not based on teachers developing the material resources nor did they provide any input for the development of the resource. As stated by the coordinator, "The Head of the Architectural Planning Department at University of Stellenbosch who enjoys electronics developed the resources."

## **5.2.2 CRITICAL LEVELS OF EVALUATION FOR PROFESSIONAL DEVELOPMENT**

### **5.2.2.1 INTRODUCTION**

Guskey (2002), states that critical levels of evaluation are used to collect evidence on the effectiveness of professional development activities. Guskey's levels of evaluation provide us with a tool to analyse the data to evaluate the success of MTN-SUNSTEP.

- **Level 1: The participants' reaction**

The data was gathered at the end of the teacher workshop. Questions included teachers' response to the activities. For example, did they like the facilitator? What were the strengths of the activity? What could be improved? Did the participants learn anything? Did it add value? The data was collected immediately after the workshop.

Most of the teachers enjoyed the workshop but had difficulties during the workshop. The type of difficulties cited were the terminology used; it was a new field of study and

unfamiliar; the understanding of the codes and colours of the resistors; understanding how resistors and capacitors function; teachers were nervous; not enough third hands available; soldering and working with the components for the first time.

The overwhelming majority of the teachers were satisfied with the workshops and the ratings imply that it needed no improvement. From the analysis of the data, teachers needed more time to understand the basics of electronics and the functioning of the kits. One of the goals of the programme as mentioned by the coordinator was to support teachers in electronics.

- **Level 2 : Participants' learning**

The focus is on the teachers' learning. Data is gathered at the end of the workshop. In MTN-SUNSTEP, data was collected through observations of teachers in the workshop and the teachers' questionnaires. The teachers' knowledge and skills gained during the activity was assessed. The analysis of the data shows that the majority of the teachers had never attended an electronics course before. Most of the teachers attended the workshop to learn new skills to be able to implement electronics in teaching and learning.

In the programme, this level of evaluation can only be applied on the completion of the resource kit, as there was no other assessment of the teachers' knowledge. The only indicator of teacher learning would be the completion of the electronic kits. Most of the teachers in the workshop completed their kits. From the interpretation of the data, it is evident that teachers did not understand how the electronic kits function when they left the workshop. They had completed the kit based by following the instructions on the worksheet. From teachers responses on the improvement of the workshop, teachers requested more explanations. This implies that teacher learning was not optimal during the programme. The coordinator mentions that, "Teachers have become very innovative. Some teachers initially had no knowledge of electricity." The data indicates that different views on teacher learning exist, but I did not have sufficient time to conduct further interviews to probe the difference.

- **Level 3: Organisational Support and Change**

At this level of evaluation, the questions asked would be: Were the changes that were encouraged through the activity aligned with the mission of the school, district and national policies? Was the individual supported through this process? Was enough support available? Was successes acknowledged at different levels and shared?

The data was gathered by way of teachers' questionnaires, the field notes of the informal interviews and the classroom visits. The analysis of the data gathered indicates that the district and provincial officials approved the programme. Technology was a new learning area in the Senior Phase and electronics was a part of that learning area. The programme was accessible to teachers from all learning areas. From the data, teachers from all the learning areas and subjects attended the workshops. Eighteen teachers responded that the kit could form part of electronics in the Technology learning Area. Three teachers felt it could be part of Natural Sciences. The curriculum alignment was left to the teachers to decide. Most decided that the best fit would be technology, as this was a Senior Phase programme.

Further data on alignment with the national policies was collected through the interview with the manager who indicates that some of the accomplishments of the programme were, "Successful meetings with Education Department, seventeen curriculum advisors trained in Western Province and schools visited by the facilitators." She also mentions that, "Workshops for teachers were organized through the curriculum advisors of various Education Management and Development Centres. Many teachers were reached and the success can be measured by the acceptance and gratitude of the Education Department for the input of the programme." The coordinator mentions that, "The technology curriculum specialist at WCED head office gives feedback".

Was enough support available? The teachers received support at the school when it was telephonically requested. The support was dependant on time constraints of the

facilitators and safety issues. The coordinator stated that, “Ulrich, the technical assistant, attend to any technical queries. Either, the support is via the telephone or a school visit. Ulrich and I are also available to do lessons with learners at the schools. This is dependant on time constraints and personal safety issues.”

From the interpretation of the data, it is evident that support was available on request, but it would be difficult to support one hundred and ninety nine teachers from various schools who attended the workshops in the period 2001 -2002.

- **Level 4: Participants use of new knowledge**

The questions asked at this level, did the professional activity make a difference? Is the teacher implementing in the classroom to affect teaching and learning?

Data to analyse this level of evaluation was only available from the five schools visited as part of the study. The data was collected three months after the teachers attended the workshop and could be analysed for the schools in the study. Analysis of the data indicates that the teachers in the study used the electronic kit in their classrooms as a learning resource. These teachers implemented the kit and taught learners about building the kits and basic electronics. At one of the schools, the resource was used in Grade 10 Physical science class, at another in grade 8 technology classes, at another in grade 9 technology classes, at the other in the science club and in the grade 7 technology class. The teachers were using different kits at the different grades to suit their context.

#### **5.2.2.2 CONCLUSION**

I will use the critical levels of Guskey’s evaluation model as one of the models to assess whether professional development in the MTN-SUNSTEP was successful. From my interpretation of the data, the professional development process was not successful. There are areas that need improvement. The participants’ reaction to the workshop was positive. They found the resource exciting and thought the facilitation was excellent. This positive



feeling was not translated into the other levels of the evaluation. The participants could assemble the kit but they did not understand the functioning of the kit or the basics of electronics at the end of the programme. The support of the teachers at the schools was haphazard, based on request and the programme facilitators would not adequately support the numbers of teachers. It was difficult to track teachers' use of new knowledge. The coordinator of the programme stated that it was difficult to monitor whether teachers who attended the workshops implemented the programme. From these levels of evaluation, I would state that the professional development process was not successful, it was not well-planned and was haphazard. One of the reasons could be that the goals of professional development are not explicit in the programme.

### **5.3 CASE STUDY 2: SWAP**

I will use the same mix of models as my theoretical framework for the discussion of SWAP.

#### **5.3.1 MEASUREMENT OF SUCCESS OF PROFESSIONAL DEVELOPMENT**

I will use the Bell and Gilbert model (1994), (refer to TABLE 2.1 on page 30) of professional development as part of my conceptual framework to analyse and interpret the data. According to Bell and Gilbert (1994),

“Teacher development can be viewed as teacher learning as a purposeful inquiry or investigation on an aspect of their teaching, rather than teachers changing as a result of an outside agent.”

I am using this study as one of the lenses for the conceptual framework as similarities exist between the two studies. Their long term study allows for differentiation in each level, although this was a short term study the different levels were useful for interpreting the data (Reddy, 2001). The responses of teachers in the questionnaires also link to the findings in Bell and Gilbert (1994) study. Both studies introduced teachers to new

theoretical ideas and teaching strategies. I will also use the indicators of Janse Van Rensburg and Le Roux (1998) to add to the discussion.

### **5.3.1.1 PERSONAL DEVELOPMENT**

From the analysis of the SWAP data, the majority of the twenty- nine teachers had attended the four workshops. Some teachers had participated in the SWAP programme since its inception. One teacher had been part of the SWAP process since 1997. Teachers attended a minimum of two workshops voluntarily. One workshop was held on a Saturday morning. This suggests that the teachers recognize that an aspect of their teaching needed improving. It seems that they recognize their restraints in terms of content and concept knowledge of the environment and science skills. Teachers acknowledged their restraints in terms of the school context, lack of equipment, big classes, changing grades every year and being new to teaching the subject. One teacher mentioned that, “Would like more support and training for science educators. Educators were moved to other grades and therefore needed more training.”

From the data, some of the teachers also felt empowered and said that their confidence in their teaching had improved. One teacher stated that, “Yes, I had Vanessa Bolters accompanying me on my first excursion. It gave me great confidence and I did the other excursions comfortably.” The data shows that teachers wanted, and were eager to participate in the programme again.

This demonstrates that most of the teachers felt that the support was adequate. Three teachers requested more support. This is in line with Bell and Gilbert (1994), findings which demonstrated that though teachers attended the same programme, they had differing starting points in the development process and achieved different outcomes. Both Bell and Gilbert (1994) and Clarke and Peter (1993) emphasise the importance of the personal development of teachers without which professional and social development cannot occur.

Teachers were invited to be part of the programme, I would interpret this as teachers acknowledging an area in their teaching where growth was required (Bagwandeem and Louw: 1993). The introduction of the programme coincided to with the education department RNCS training where intermediate phase teachers were orientated into their subject area in a two to three hour session. Traditionally in pre-service, intermediate phase teachers were trained to be generalists, science teachers had very little knowledge of subject, their pedagogy was poor and they did not have practical experience (Arnott and Kubeka, 1997). The aim of the orientation was to introduce teachers to the new content in Natural Science. This was inadequate and teachers were not very confident in the class (Janse Van Rensburg and Le Roux: 1998).

Teachers were eager to be part of the SWAP process and to take ownership for their learning as the education department was not providing effective professional development opportunities.

### **5.3.1.2 PROFESSIONAL DEVELOPMENT**

The analysis of the data indicates that the majority of teachers included the SWAP kit into their learning programmes after the project was completed. One of the teachers mentioned that it had to be done in stages because of class size. Teachers were prepared to try out new activities in the classroom. One teacher mentioned that, “yes we had one practical activity and observation at Rondevlei Bird Sanctuary.”

Interpreting the data shows that teachers were developing new ideas for classroom practice. Teachers requested more activities and teacher involvement. One teacher said that, “(More) regular workshops. Maintain the interest. Educators can share their findings.” Another teacher mentioned that, “I think the challenge was integrating the SWAP curriculum into an existing school learning programme so that it does not become something extra, but part of the curriculum or learning programme of grades 5 -7”

Teachers were adapting the resource for their classroom and school context, “Yes- I use it on a lower scale for the Grade R learners and use it to its full potential for our

environment club.” One teacher wanted more explicit links with the curriculum, “Yes, to be linked to learning outcomes and assessment standards. More activities, time allocation, educator’s involvement.” Teachers also wanted to take more responsibility and ownership of the programme. One teacher mentioned, “Let one school be responsible for resources, bugs must be in glass slides. It should be accessible. Time is a scarcity.”

The data also shows that the majority of the teachers included the kits in their practicals and other learning areas. Only two of the teachers did not use the kits for practicals. The teachers mentioned all the learning areas except technology and economic and management sciences. In this manner the teachers used the activities to initiate activities in other areas.

In the development of teachers’ professional capacity, teachers tried new activities in the classroom; they developed new ideas for teaching and initiated other professional development activities. From the data, teachers developed new understandings of the knowledge areas embedded in the SWAP through the programme process. Environment education was a new area in the curriculum and teachers had difficulty with interpreting this area for effective teaching and learning. The education department’s orientation to the natural science learning area was a two-three hour workshop where environmental education was not emphasised. Teachers were not adequately prepared or supported by the education department to teach this section of the work. The programme provided teachers with an opportunity to engage with this knowledge area in a safe environment using a resource kit that made the learning exciting and practical. Teachers could engage with the theory and then see it happen in practice using the SWAP kit. . This is supported by the literature on context based resources. The programme is context –based and based on the literature, this approach helps teachers to make the links between science and their everyday life. When using this approach, teachers learn science concepts (Bennett: 2003).

From the data teachers, changed their approach to teaching environmental education and resource –based learning programmes. They did more practical work and took learners on a field trip to test the water. Teachers participated in a three hour workshop with Fadli

Wagiet to support them in the alignment of the resource with the curriculum. In the classroom teachers adapted the resource to suit their context for teaching and assessment. Teachers were better equipped to teach in the content area as well as assessment strategies, teaching styles, resources, curriculum and the use of the resource. The data show that teachers continued to use the kit after the programme was implemented and that their approach to teaching changed. In my interpretation, this occurred because teachers were more confident in the classroom; they were confident with using the resource; and comfortable with the content area.

Interpreting the data from the interim report and the questionnaire, it is evident that teachers have experienced these opportunities for professional development during the process of the programme. An extract from the interim report states that, “These are particularly evident in changing approaches to work, new understandings and developing networks.

The data also indicates, gathered two years later, that some teachers expect the programme managers and department (Glen Van Harte) to align the programme to the natural science learning programmes and were not confident enough to take ownership of the teaching in the classroom. This is one of the disadvantages of the traditional teacher training in pre-service where teachers were expected to do and not to take initiative (Arnott and Kubeka, 1997). This mindset still prevails with some teachers.

### **5.3.1.3 SOCIAL DEVELOPMENT**

Did they develop teacher networks and learn from each other in terms of teaching, methodology, content knowledge and resources? Did teachers value collaboration during the programme and did they initiate networks and collaborative ways of working.

Analysis of the data from the interim report suggests that teachers valued the collaborative ways of working. An extract from the report states that, “Many teachers indicated that the workshops provided a forum for discussion with other teachers and for sharing perspectives on their work in a changing working context. Teachers indicated that

the workshops provided a “space” in which they could develop relationships of trust and collegiality with colleagues from schools in their local area and beyond. Teachers have also commented positively on the collaborative nature of the training workshops held thus far and on the river visits done with some schools. It was mentioned that they had developed new ideas they could implement in their classrooms and were happy to have access to new resources (SWAP kits) they were formerly unaware of.”

Comments from the participating teachers regarding the project activities in reflective sessions were generally positive. Teachers developed networks for working with each other and learn and some of them adapted the resource for their own needs.

From the interpretation of the data, teacher valued the collaboration and the opportunity to form networks as they could share resources and discuss issues pertinent to teaching. When teachers developed relationships with their colleagues they felt more responsible to the programme and developed a sense of ownership. It also provided them with a safe environment with other intermediate phase teachers experiencing similar issues: difficult and new science content and very little support from the education department (Cross, Mungadi and Rouhani, 2002:184).

### **5.3.2 CRITICAL LEVELS OF EVALUATION FOR PROFESSIONAL DEVELOPMENT**

Guskey (2002) critical levels of evaluation are used to analyse the evidence on the effectiveness of the SWAP process as in MTN-SUNSTEP.

- **Level 1: The participants’ reaction**

The data was gathered at the end of the programme as well as during the reflective sessions of the workshop. Questions included teachers’ response to the activities. What were the strengths of the activity? What could be improved? Did the participants learn anything? Did it add value? Based on the teachers’ responses two years after the

programme implementation, teachers responded positively. One teacher mentioned, “The workshop was very informative and I did not find any shortcomings.” Teachers did mention improvements to the workshop. One teacher asked for more educator involvement. Four teachers requested more support.

- **Level 2 : Participants’ learning**

In the SWAP programme, data was collected through observations of teachers in the workshop and was focused on teachers’ learning. Teachers had to interact with the resource, make adjustments and contextualize it for use in their classrooms. One teacher mentioned that, “I used the information and applied it to draw up information for grade 2 kids.” Another teacher stated that, “I could adapt it to use in the junior phase.” This indicated that most of the teachers understood the resource and could adapt it for use in their classrooms.

- **Level 3: Organisational Support and Change**

Were the changes that were encouraged through the programme aligned with the mission of the school, district and national policies? Were the teachers supported through this process? Was enough support available?

Data was gathered from the interim report of the field workers and through the evaluation questionnaires completed two years later. Most of the teachers mentioned that they had adequate support throughout the process by the fieldworkers and the programme managers. One teacher mentioned that, “Yes especially since she (facilitator) helped me to obtain some of the bugs which I certainly would not acquire on my own. She brought along extra testing strips.” (In response to the question: Was the support adequate?) The findings from the data show the learning support material was aligned with the curriculum. The report states that SWAP was a collaborative programme with the education department through EMDC South. The resource was aligned with district and

national curriculum policies and the data shows that teachers were comfortable using the resources in the classroom.

The programme also hosted an award ceremony at the University of Stellenbosch in November 2004, where the work, success of the teachers and programme were acknowledged.

- **Level 4: Participants use of new knowledge**

The questions asked at this level: Did SWAP make a difference? Is the teacher implementing in the classroom to affect teaching and learning?

In examining the questionnaires, that data indicates that most of teachers used different aspects of the kit throughout the year and in different learning areas. The findings from the data show that the availability of the equipment restricted the teacher. Each school had only received five kits. From the data in the questionnaire, some of the teachers continue to use the kits in 2006. From analysis of the data, they were excited to participate in the programme again. One teacher mentioned that, “This year we waited for extra sheets to arrive.”

- **Level 5: students’ learning outcome**

This type of data collection would assess the improvement of the learning of the learners. This would be extremely difficult to verify as it is a very complex process. And pinpointing factors that contribute to the learning would be difficult. The data is anecdotal and from the teachers’ viewpoint.

In the SWAP programme, data for the learners’ interaction with the resource and their learning outcome would include the photographs of the learners working at the rivers in the interim report and the teachers’ responses on the questionnaire. Analysis and interpretation of the data suggests that learners enjoyed the experience of working with



the kit. They had developed new practical skills and were learning about the environment. Most of the teachers mentioned that their learners enjoyed the experience. One teacher stated that, “learners enjoyed the new experience and tools and it was hands on.”

When evaluating the data at this level, we need to take cognizance of research on the disadvantages of the context approach to science teaching, “Some learners view the interesting and enjoyable activities they are involved in as not really about science. A number of key ideas in science appear to be poorly grasped, irrespective of approach used in their teaching and the interest and enjoyment in science lessons do not appear to translate into a widespread desire to study the subject further” ( Bennett, 2003).

### **5.3.5 CONCLUSION**

Using the data from the five critical levels of evaluation to assess the process of teacher professional development in the programme, I would conclude that this process was successful and achieved four levels of the evaluation model. Teachers eagerly participated in the programme; teacher learning occurred; teachers were supported; alignment of the resource with the curriculum and the education policies occurred and teachers used their knowledge in the classroom. Some were still teaching the programme two years later.

In conclusion, it is evident from the data that the programme was planned and implemented by individuals with a theoretical understanding of professional development; as well as a long history of the education sphere; of working with and alongside teachers.

## **5.4 THE FACTORS THAT AFFECT PROFESSIONAL DEVELOPMENT FOR BOTH MTN-SUNSTEP AND SWAP PROCESS**

### **5.4.1. INTRODUCTION**

According to Garet et al., (2002), two types of factors: structural and core influence teacher development. These factors will be used to evaluate the process of the two programmes as discussed in chapter 2.

Using this as a conceptual framework to analyze the process of the programme, my interpretation, using the interpretive paradigm, of the data collected on the MTN-SUNSTEP workshop process suggests that these factors were not considered upfront when planning the programme but was part of the planning of SWAP.

The data collected on the SWAP process indicated that the structural and core factors were considered when conceptualising and implementing the programme. As in Garet et al. (2002) study, the results also support the importance of collective participation and coherence of professional development activities.

- Collective participation

Garet et al. (2001), emphasizes that professional development activities should be designed for groups of teachers from the same school, grade or department.

MTN-SUNSTEP invited teachers from all over Western Cape to participate in the programme. Teachers traveled from Khayelitscha, Nyanga, Camps Bay and Paarl (to mention a few areas) to participate in the programme. The programme focused on teachers from the senior phase. These teachers worked too far apart to form clusters where they could form networks, collaborate and share information.

In the interview with the manager, she stated that the goal of the programme “would be to reach out to schools and make teachers and learners aware of Engineering as a subject

choice.” She stated that the goal for 2001 was to “Reach 6 000 learners and 200 teachers in the Western Cape.”

The analysis of the data suggests that one of the goals of the programme was, to reach as many teachers and learners as possible. This implies that collective participation is not a priority of the programme.

At the workshops, teachers only interacted with each other during tea. The workshop programme did not allow for teacher interaction. At the start of the workshop, teachers were involved with the facilitator’s presentation. This was talk and chalk methodology with questions of clarity. No reflection was conducted at the end of the workshop with teachers as a collective. The workshop was a ‘one shot’ workshop and the same group of teachers did not have an opportunity to meet again. Generally, one teacher per school attended the workshop. From the data and my observations, teachers did not have the opportunity to participate as a collective.

SWAP only focused on Grade 6 and 7 teachers from the surrounding Grassy Park, Retreat and Steenberg area. More than one teacher at a school attended the programme and they could discuss and network with each other. Teachers could also form networks with surrounding primary schools, as the participating schools were located close to each other.

In SWAP collective participation was part of the programme. The programme was based on the growth model ( Bagwandeem and Louw, 1993); constructivist learning; and learner (teacher) centred. This was not the case in MTN-SUNSTEP. The objective of teacher professional development in the MTN-SUNSTEP was unclear and implicit in the programme. The approach to teacher professional development was based on teacher deficit ( Bagwandeem and Louw, 1993); that teachers could not learn from each other but from the experts in electronics.

- Duration

In terms of duration and contact hours, the MTN-SUNSTEP conducted a series of once-off three-hour workshops or ‘a one shot workshop’. One workshop per resource kit was conducted. Teachers decided which workshops they wanted to attend. After this, teachers were expected to implement the kit in their teaching and learning or in the science club at the school. In addition, the learners had to apply the kit in an appropriate model.

The analysis of the data confirms that one of the goals of the programme was to reach as many teachers and learners as possible. Not much time could be spent with a group of teachers. The coordinator mentioned that, “She would have liked to do more workshops with teachers over a longer period.”

In terms of duration and contact hours, SWAP facilitators were in contact with the teachers over a period of three months, from March to May 2004 on an ongoing basis. Two facilitators planned follow-up visits later in the year. The final certificate ceremony of the teachers occurred in November 2004. Follow –up plans for 2005, was discussed based on teachers’ needs.

The teachers were involved in eight formal meetings over a period of three months. This included two full day workshops with teachers around the content and skills development with the resource. This is an extract from the interim report, “Training sessions involve a three day programme facilitated by the fieldworkers. On day one participating teachers are introduced to the contents of the SWAP resource and how it could be used as learning support material. Day two involves further discussion of the kit and focuses on the reporting procedures suggested. On day three teachers are taken to a water source (river, canal) to practically apply and do the SWAP testing procedures and report on their findings- a hands trial of the resource is done.”

The duration of professional development would have an important influence on teacher learning. The longer the time spent on the activity the greater would be the impact on

teaching practice. The amount of time spent as well as the span of time would influence this process (Garet et al, 2001: 922). Daloglu (2004) echoes this in his study. In interpreting the MTN-SUNSTEP data, time spent with the teachers was not a factor to be considered. After the workshop teacher support could be requested. Although one of the aims of the project, as stated by the coordinator and manager, is teacher learning, the data suggests that teacher learning was not effectively realized during the programme. One of influencing factors could be time spent with teachers. In my interpretation, one of the reasons was that the aims of the programme were to train as many teachers as possible.

- Content

From the field notes' data of MTN-SUNSTEP, the facilitator spent twenty to thirty minutes at the start of each workshop on the content of the resource kit. The identification of the components, its function and its position on the PC board of that particular resource kit was explained to teachers.

From analysis of the data, it is evident that teachers entered the workshops at different levels of content knowledge and skills. The workshops had a mixed ability group of teachers from various subjects and learning areas. In each of the workshops, some of the teachers had never attended an electronics workshop before and some had attended at least one other workshop. One of the teachers had attended three workshops. One teacher mentioned that, "It is the first time and I find it challenging".

In one of the sessions, the facilitator explained the kits to the teachers in Afrikaans. Although none of the teachers objected, in the workshop, one teacher raised this as a problem on the teacher questionnaire. The language would also hamper teachers' grasp of the content.

One of the goals of the programme according to manager and coordinator was to "Train teachers to have a basic understanding of technology and be able to present workshops

themselves in order to reach more learners.” She said that, “The main aim was to motivate teachers to understand technology and for their learners to receive hands-on experience thereof.” Another stated goal was, “To provide electronic teacher training for teachers that have to be re-skilled to teach technology.” According to the coordinator, the programme wanted to support teachers with electronics teaching.

Most of the teachers attended the workshop to learn new skills to implement electronics in teaching and learning. From the data, most of the teachers had difficulties during the workshop. Some of the difficulties were: terminology; new content; understanding resistors and capacitors; soldering and working with the components for the first time

One of the teachers mentioned that the teaching of the kits in the workshop was not effective. Some of the difficulties stated by the teachers indicate that teachers do not understand the functioning of the kits or the basics of electronics at the end of one workshop. Teachers followed the instructions on the worksheet to build the kit. Teachers seemed to have learnt the skills of soldering and assembling the kit by the end of the workshop.

Content and the use of the resource as a learning support material was an integral part of SWAP. Teachers used the kits at a river site to familiarise themselves with the kit and the skills involved. Teachers were actively involved in the process of learning and planning and could develop their kit to suit their needs in the learning environment. An extract from the interim report stated that, “Teachers have also commented positively on the collaborative nature of the training workshops held thus far and also on the river visits done with some schools. It was mentioned that they had developed new ideas they could implement in their classrooms and were happy to have access to new resources (SWAP kits) they were formerly unaware of.”

The data show that the aim of teachers’ understanding of electronics in MTN-SUNSTEP was not achieved as most of the teachers did not understand the working of the electronic kit at the end of the workshop. Neither did they discuss the pedagogy of the kit. This was

not discussed with teachers during the workshop as a result of the programme approach to teacher development. From the data and informal discussions with the coordinator, teachers were expected to teach what they had learnt in the workshop. In SWAP, as a result of the different approach to teacher professional development content and the pedagogy was the focus of the programme and teacher learning was optimal (Cohen and Hill, 1998; Kennedy 1998).

- Fostering coherence

As discussed earlier, MTN-SUNSTEP did not give teachers the opportunities to form networks. Teachers did not speak to each other much during the workshop and could not exchange any ideas or information. Schools were located far apart and it would have been difficult for teachers to form clusters on their own without assistance from the programme coordinator.

In terms of coherence with district and curriculum policies, the data indicates that the programme manager had met with WCED as part of the planning and advocacy of the programme. The coordinator mentions that, “The technology curriculum specialist at WCED head office gives feedback.” The manager cites as achievements for 2001, “Successful meetings with Education Department and seventeen curriculum advisors trained in Western Cape.” From the data, curriculum advisors of various Education Management and Development Centres organised workshops for teachers. The manager states that, “Many teachers were reached and the success can be measured by the acceptance and gratitude of the Education Department for the input of the programme.” From the analysis of the data, it is evident that meetings were held with education department to ensure curriculum alignment and departmental approval of the programme.

Garet et al (2001: 933 -934) state that activities that have a greater emphasis on content connected to teachers experience, standards, assessments and communication with other teachers are more likely to produce enhanced knowledge and skills. From the interpretation of the data, the programme management did attempt to foster curriculum

alignment but this was done in superficial and inconclusive manner. In my interpretation of the data, the approach of the programme to teacher development permeated the functioning of the programme. Expert knowledge was vested in the programme managers and coordinators; the programme was expert driven with very little consultation with other stakeholders (Russo and Lotz-Sisitka, 2003).

SWAP gave the teachers the opportunity to network with each other as stated earlier. The programme was planned in collaboration with the education department and a workshop was conducted to discuss alignment with the curriculum and to support teachers in making the connections between the resource and the curriculum.

From my interpretation, the SWAP approach is participatory and collaborative with the input from all the stakeholders: teachers, university specialist, curriculum advisors and facilitators being valued in the process (Russo and Lotz-Sisitka, 2003).

- Promoting active learning

Active learning occurs when teachers are actively engaged in the professional development activities through discussion and debates, planning and practice (Loucks-Horsley, Hewson, Love and Stiles, 1998).

From my interpretation of the MTN-SUNSTEP data, the teachers were not actively involved in their learning process. No discussions occurred during the workshops, no planning or discussion of teaching methodologies occurred during the programme process. Discussions could have occurred when the facilitators visited the schools that requested support. From my personal experience as a teacher on the programme and from informal discussions with the teachers on the case study, these discussions were rare.

In SWAP, the data indicate that teachers were actively involved in their learning. Teachers were planning, discussing, forming networks and adapting the resource to suit their contexts.



## 5.4.2 CONCLUSION

When I consider and interpret the data from an interpretive framework, factors examined by Garet, Porter, Desimone, Birman and Yoon (2001: 918), the data suggests that there was not an in-depth consideration and inclusion of the core and structural factors in MTN-SUNSTEP programme. Improvements of the workshops suggested by teachers were: smaller groups, more support, more explanations, alignment with the curriculum and more workshops.

This list indicates that more time, content explanation, collective participation, alignment with curriculum (coherence) and support are needs that teachers identify as crucial elements to the teacher development programme. This echoes the findings in the literature reviews.

Using the indicators from the mix of models as my conceptual lens, Bell and Gilbert (1994); Janse Van Rensburg and Le Roux (1998); Guskey (2002) and Garet et al (2001) show through analysis of the data that the process of teacher professional development was not effective in MTN-SUNSTEP. Professional development took place but teachers struggled with understanding the functioning of the kits; no teacher networks; teachers taught the kit in the class but did not discuss methodology with their peers.

What I found exciting about the SWAP process was that teachers were eager to attend more SWAP workshops. This shows a commitment to their personal and professional development. Teachers are prepared to take ownership of their own professional development. Most teachers cited the support and the practical nature of the workshop as positive factors. This is echoed in Daloglu's (2004) study with teachers in Turkey. Teachers have requested more workshops to assist in incorporating SWAP into their current learning programmes.

From analysis of the data, the context of the school is a major factor in determining the use and effectiveness of the resource. Issues of safety, both at the river and the location of the river, have to be discussed and negotiated with teachers beforehand. Large classes and the availability of the equipment also deter teachers from using the resource.

Notwithstanding these factors, when interpreting the data in terms of the indicators developed from the mix of models, SWAP would be classified as a successful teacher professional development programme. It contributes to ‘the positive professional learning that teachers experience after pre-service training’ (Reddy, 2004).

The approach of the programme permeated the functioning. It was participatory and collaborative. The core and structural factors of Garet et al ( 2001) was integral to the programme: alignment with the curriculum, collective participation, constructivist learning and support. From the Bell and Gilbert model (1994) and Janse Van Rensburg and Le Roux indicators (1998), teacher development occurred at personal, professional and social level, teachers formed networks and alignment with the curriculum was ensured.

The study indicates that teachers are not negative towards professional development, but that professional development activities should take into account the professional development approach and the needs of teachers.

## **5.5 LEARNING SUPPORT RESOURCES (SCIENCE KITS)**

### **5.5.1 INTRODUCTION**

In this study, the emphasis or the unit of the analysis (Durrheim, 2006: 41) is the teacher and more specifically teacher development. My research question: “Does the kit enable teacher development in science teaching?” allows for analysis of the MTN-SUNSTEP and the SWAP kits as a resource, its value to the teacher and classroom practice using a conceptual framework developed through the literature review. I have identified a list of factors from my readings, which could possibly determine the success and usefulness of

resources in the classroom. I will be using the twelve factors as stated in Chapter 2 as a conceptual framework to evaluate the effectiveness of the kit in enabling teacher development.

For the purpose of the study, I use Brown's definition of materials as "any systematic description of techniques and activities to be used in classroom teaching (Brown, 1995:139)."

### **5.5.2 FACTORS THAT DETERMINE THE EFFECTIVENESS OF LEARNING SUPPORT MATERIALS IN TEACHER PROFESSIONAL DEVELOPMENT**

From the data collection, analysis and interpretation, I conclude that the MTN-SUNSTEP electronic kits do not conform to all the five criteria of Eisner, (1990:65 -66) for resource development. The teachers' responses to the questions highlight the nature of the resource.

From the responses of teachers, I conclude that the activities in the SWAP kit conform to the five criteria of Eisner (1990:65 -66), for resource development. The teachers' responses are in line with the findings of Daloglu (2004) in his study with English teachers, "Considering the pivotal role of materials, the quality of the materials used in the classroom can improve the quality of the teaching while achieving the curriculum goals (Daloglu, 2004: 681, in International Journal of Educational Development, 2004)."

- The activities should develop skills, ideas and perceptions that are educationally sound (Eisner, 1990:65-66).

All the teachers agreed that the activities in the kit develop skills and perceptions. Electronics is a new field in the learning area and the data indicates that the majority of the teachers had never attended an electronics course before the workshop. Most of the

teachers attended to learn new skills so that they could implement electronics in teaching and learning. Thirty-one teachers indicated that they spent their time well.

From the interview data of the programme managers, the kits were developed by the Head of the Architectural Planning Department at University of Stellenbosch who enjoys electronics. There was no involvement of people with experience in teaching at high school. This is contrary to what the literature indicates. Learning support materials are best developed with stakeholder participation (Russo and Lotz, 2003). From my interpretation of the data teachers could assemble the kits, developed new ideas and perceptions but their understanding of the functioning of the kits and electronics were sketchy as teachers did not have enough time during the programme to grapple with the concept. Teachers were expected to study the content and develop their own methodology to teach after the workshop. Many teachers have a heavy teaching workload and do not have the time outside of their teaching and attending the programme to study electronics without support (Cross, Mungadi and Rouhani, 2002).

In SWAP, the teachers agreed that the activities in the kit develop skills and perceptions. One teacher mentioned, “It was practical and relevant to the learning area. NS.” Another teacher said, “I could test the pH of the water, the oxygen and bacteria level of water. I could also test the temperature and turbidity of the water.” Another teacher echoed this, “practical hands on. The child was able to recognize the advantage of a high pH and a low pH level, for example soap and water.” The general feeling of teachers was that the kit is educationally sound. Teachers were given the opportunity and the time during the programme to grapple with the content, pedagogy and the skills embedded in the resource kit. Their understanding and confidence using the kit improved. They were also supported through their learning.

- The activities should stimulate higher order critical thinking and be intellectually challenging (Eisner, 1990:65-66).

In interpreting the data from the questionnaire using various responses from the teachers, the majority felt that the activities stimulated higher order thinking. The data of the difficulties that teachers experienced while using the resource indicates that it was not easy to build and understand the electronic kit. Teachers cited understanding the kit; the codes of the resistors and capacitors and the terminology as problems. From my interpretation, this indicates that the resource was intellectually challenging. One teacher mentions that, “It is the first time and I find it challenging”.

In the classroom, the resource allowed the learners to connect the classroom activity with everyday life. Learners were supposed to build an application of the kit as part of the programme. Many of the learners could not due to time, financial constraints or lack of motivation.

In interpreting the data from the questionnaire using various responses from the teachers, the majority felt that the activities stimulated higher order thinking. The resource allowed the learners to connect their environment and their science learning in the classroom. The activities are intellectually challenging.

From my interpretation, the opportunity that the kits presented to unpack electronics, an area that teachers had very little knowledge of was not used by the programme. This would have been ideal to teach teachers the basics of electronics, develop pedagogy and assessment strategies. So though teachers learnt to assemble the kits, they were also disempowered in the process of professional development (Bell and Gilbert, 1994: 2004).

The SWAP kit is an example of a context-based resource. Bennet (2003), states that research into the context based approach has provided valuable information on curriculum innovation and its implications for teaching practice. It provided concrete examples of materials which increase learners’ interest in science and help them see the

links between science and society. In some cases, the resources help to develop better understanding of particular science ideas than more traditional approaches. Many of these activities particularly pH activities, learners would only encounter in high school science. Some of the teachers mentioned that using the kit made the learners aware of their environment.

- The resource content should be visually stimulating and should not rely on text only (Eisner, 1990:65-66).

Most of the teachers indicated that the kit was easy to assemble in the workshop but also indicated their difficulties in the workshop, codes and colours of resistors; small writing on the components; working with the components for the first time and the language of instruction and of the resource. The coordinator mentions that, “Teachers want the worksheets translated to Afrikaans. Some IsiXhosa speaking teachers have a problem with their eyes and soldering. Some teachers struggle with the fine motor skills required to complete the kits. Each stand now has a helping hand lens.”

From analysis of the data, teachers do not have a problem with the presentation of the resource content but with the building of the kit itself, the components, soldering and fine motor skills. The programme coordinator tried to address some of the issues. Although the kits were easy to assemble, teachers encountered some of the skills required for the first time and electronics is a difficult concept.

For the SWAP kit, in response to the question: What made the kit easy to use; many teachers responded that the large size (A3) of the charts, diagrams and reader friendly charts contributed to its use. One teacher mentioned that, “The kit was easy to use because the diagrams, wording and information were easy to understand for both educator and learners.”

From the data of the two kits, the presentation of the content of the resource is important as this could create difficulties for teachers. The presentation could contribute towards

the difficulty levels of the kit. From my interpretation, as teachers were not involved in the development of the MTN-SUNSTEP kits, the presentation was not teacher friendly.

- The content and concepts should be integrated and help learners make connections to other areas (Eisner, 1990:65-66).

Thirty- four teachers would implement the project because the learners are interested and would benefit. “To bring the world of electronics to the learners.” Two teachers did not respond. From the data, the electronic kit helps the learners to make connections with other areas of their lives. Learners are also supposed to build an application of the kit and present it to the class. This activity would further connect everyday life and the classroom.

The data indicates that the resource was not developed with teacher consultation. The resource was not integrated and connected to areas of the curriculum. Teachers indicated that they would use different learning areas to teach the resource. Eighteen teachers responded that it could form part of electronics in the Technology learning Area. Three teachers felt it could be part of Natural Sciences. One responded that it could be used to teach calculations in Mathematics. Four teachers responded that it could be part of crafts in entrepreneurship. Teachers have differing views on the integration of the electronic kit in the teaching and learning process and did not have an opportunity to discuss this in the workshop.

In SWAP, teachers mentioned the integration of the content and the concepts with other learning areas and other areas of the learners’ everyday lives. One teacher mentioned that, “For historical lab, learners interviewed elderly at local old age home who enjoyed helping my learners. This lead to people from the old age home being invited to grandparents’ day at my school.” Another teacher mentioned that, “It was used for practical work or demonstrations in science. It was integrated – LLC – letter writing and discussions, AC – poster making.” The teachers mentioned the integration into six of the learning areas other that technology and economic management sciences.

- Teachers should be given options of activities through the materials, for example, enhanced activities (Eisner, 1990:65-66).

The programme supplied different electronic kits. The teachers decided which electronic kit to build in the classroom and at which level. According to the management of the programme, some kits were more difficult than others.

Many of the teachers adapted the SWAP materials for their use in the classroom. Some mentioned that, “Yes- I use it on a lower scale for the Grade R learners and use it to its full potential for our environment club.’ One teacher mentioned that, “Yes, especially when we did the safety and quality of water. The whole “rattailed maggot” scare prompted us to test the schools tap water.”

From the responses by the majority of teachers, it can be deduced that the SWAP kit was an asset to the teacher in the classroom. The activities developed skills, ideas and perceptions that were educationally sound; it stimulates higher order thinking; it was visually stimulating; content and concept integration occurred, and the resource could be used in other learning areas and teachers could choose which sections to teach when using the kit.

Most teachers though stated that there was not enough equipment in the tin. The learners could not do individual work; they had to do group work. In addition, replacement equipment was a problem. Teachers did not know where to access the equipment.

- Activities should be context driven – in terms of school and district (Russo and Lotz, 2003:11-13; Remillard, 2000:348; Hargreaves, 1994)

The majority of the teachers would implement the electronic kit in their teaching and learning. The context of the teachers could be a deterring factor. It determined the use of the kit in the classroom. Some of the teachers had difficulties with their class size; the



safety of the learners; not knowing how to replace equipment; time constraints and fitting the resource into their learning programmes. The difficulties that teachers experience in the classroom in implementation of the resource are: the purchasing of equipment and the kits; overcrowding in the classroom; assistance in the classroom; burglaries at the school and learners' inability to follow instructions

One of the teachers had adapted the resource to his context and said that, "At Xola High I teach large classes with 5 soldering irons". The teacher was comfortable with the presentation, language and the instruction manual for the workshop as he had been attending workshops since 1998. He will start a Technology Club at his school in the afternoons to train learners as facilitators to assist with language as the he cannot speak isiXhosa.

This teacher has been attending the workshops for three years and had adapted the resource to his context, but he had not shared his experiences with his colleagues at the workshops. This highlights that teachers need to be comfortable and understand their subject matter (electronics) to be confident to change and adapt the resource to suit their context. Because teachers were not given the opportunity to network and collaborate with each other and the time to understand the functioning of the kit, they were not comfortable with adapting the kit to their context.

The majority of the teachers commented that the SWAP kit could be adapted to their context in the classroom. The nature of the resource also allowed teachers to use aspects of the kit that they thought would be appropriate for a particular context at a particular time. They did not need to complete the kit but could ignore certain parts of the kit which did not suit their context. One of teachers mentioned, "Very useful kit. It assists greatly in times where there is no science equipment." One teacher also said that, "I used it at the river, Lotus canal near our school. We could test the turbidity, temperature, oxygen, bacteria and pH of the water." One teacher had a problem with storage and said that, "It was easy to use and easy to store."

The context of the teachers could also be a deterring factor. It determined whether they used the kit in the classroom. Some of the teachers had difficulties with their class size; the safety of the learners; not knowing how to replace equipment; time constraints and fitting the resource into their learning programmes.

In response to the question of whether anything prevented them from using the kit, one teacher mentioned that, “Size of the classes. It was difficult to take large groups of learners to the river or vlei.” Another said that, “Yes, because we had to take the child to the nearest river. Big classes – danger of crossing the M5.” One teacher expected that the programme would provide worksheets, lesson plans and rubrics, “nothing prevented me really but due to time constraints, I overlooked it a lot of the time as it seems over and above my normal work. Kindly supply us with worksheets, rubrics, lesson plans etc. That was the barrier for sometimes using the kit- as well as the shortage of nitrate testing strips and thermometers.” It seems that the teacher did not have the time to develop the resource to fit in with the context of the school and the class. This highlights the expectation of some teachers that everything should be done for them.

Hargreaves (1994); Jackson (1986) and Sarason (1982), emphasizes that teacher development and curriculum development occur in a school context. The data confirms this. It seems that teachers need time to develop the resource to fit the context of the school or to discuss and reflect on the constraints.

- Resources should support the learning process ( Russo and Lotz, 2003:11-13)

Thirty- four teachers would implement the MTN-SUNSTEP programme as the learners are interested and would benefit. This is a general response of the teachers at the end of the workshop.

The data on MTN-SUNSTEP suggests that resource, as a support for the learning process was not discussed with teachers. In my observations of the four workshops, the facilitator

did not discuss this. The electronic kits as learning support materials were treated as 'objects' or 'commodities' and their integration into the teaching and learning process neglected. A lack of reflection occurred on the role of learning materials in the learning process, how learning occurred and how support material was integral in that process. Russo and Lotz (2003:11-13), advocate the research based learning approach. This involves adapting the materials to the context and ongoing reflexive research on how learning support materials support the learning process.

Twenty -two teachers used the SWAP kit in the teaching and learning process and agreed that it supported the learning process in the classroom through exposing the learners to new concepts and content in a practical and context related manner. One teacher responded, "The kit was interesting and the teacher as well as the learner found it useful."

This is one indication of the general responses of the teachers. Most teachers also judged the usefulness of the kit on the learners' response to the kit. According to the teachers most of the learners responded positively to the kit.

This finding from the data is echoed by the research. In the SWAP programme teachers integrated the kit into the teaching and learning process. Teachers were taken on a river visit. The kit was not treated as 'objects' or 'commodities'. From the data, reflection in the workshop and focus groups occurred on the role of learning materials in the learning process, how learning occurs and how support material is integral in that process. These are contributing factors to the usefulness of the kit in the classroom.

- Resources should engage teachers in the learning (Remillard, 2000:331)

The data shows that most of the teachers did not understand the functioning of the electronic kits when they left the workshop.

The data on the process of the workshop show that teachers listen to the presentation on the kit for twenty to thirty minutes; assemble the kit and leave as they complete. There is no other form of engagement with the resource other than at their school.

The findings are echoed by Remillard (2000). His research suggests that ‘materials most likely to foster teacher learning are those that engage teachers in the learning’ (Remillard, 2000: 331 in *The Elementary School Journal*).

In SWAP, four teacher workshops were facilitated to engage teachers in the learning process and to assist teachers in contextualizing the resource for their classrooms. This included a river visit exclusively for teachers to familiarise themselves with the resource and build confidence when using the resource with their learners. One teacher requested that, “Make things available to us. Let one school be responsible for resources, bugs must be in glass slides.” Another teacher stated that, “Yes, to be linked to learning outcomes and assessment standards. I would like more activities, more time and more educator involvement.”

One teacher commented that, “I was knowledgeable and competent. I was confident to use the kit.” This indicates that teachers are at different levels of development.

In this process teachers engaged with the kits and the process and teachers became more knowledgeable and competent and were willing to take ownership of their own learning.

- Implementation of the resource should be a supported process (Remillard, 2000:347)

The analysis of the data on MTN-SUNSTEP indicates that most of the teachers were satisfied with the support during the workshop. The data on the support during the implementation indicate that it was impossible to support all the schools that attended the workshops adequately.

Most of the teachers felt that the support for SWAP was adequate with three teachers asking for more support. Most teachers responded that, “Workshops conducted well. No

improvement necessary.” Three of the teachers needed more support and one asked for, “co-operative learning whereby the facilitators accompany the teachers on at least one excursion.”

The facilitators tried to accompany each school to the river site, but this was not possible for all the schools. This school did not receive this support due to time constraints and clashing timetables. Teachers also required different levels of support based on various factors including their confidence in the classroom; their content knowledge; and their exposure to the kit.

The findings from the data gathered strongly agree with the findings from Remillard’s: if teachers have to interact with resources in new ways that was not demanded in the old curriculum, teachers need opportunities to learn to use resource to assist in the construction of their classroom curriculum. Reformed curriculum materials will only significantly affect teaching if support is provided for the use of the materials (Remillard, 2000: 347).

- Teachers should be able to use the resource immediately in the classroom (Clarke and Hollingsworth, 2002)

Twenty- seven schools do not have the electronic kits immediately available. Five schools had the resources available. The schools that did not have resources used school funds or obtained donations to buy the equipment.

The data indicates that teachers will not teach the kit immediately in their classrooms. This would affect the use of the kit in the classroom as the consolidation of learning and practice did not occur.

The teachers agreed that they could use the SWAP kit in the classroom immediately. One teacher responded that, “the kit was useful because you could use it immediately.”

Teachers were given five kits at the workshop to use in their school immediately. This contributed to the effectiveness of using the kit in the teaching and learning process and consolidated the teachers' knowledge about the resource and the content. Teachers started to use the kit while participating in the programme. Support was provided for the use of the kit and this positively affected teachers' teaching.

- Impact on learners must be immediately visible to sustain the change for teachers (Clarke and Hollingsworth, 2002; Daloglu, 2004: 689 - 690)

The overwhelming majority of the teachers would implement MTN-SUNSTEP at their schools. Thirty-four teachers would implement the programme because the learners are interested and would benefit. One teacher said that, "It will be exciting and motivating for the students." Teachers would implement the resource if they see the impact on their learners. From this study, many teachers could not implement the resource immediately as they did not have the equipment and needed to raise fund to purchase the equipment.

In SWAP, one teacher responded that, "It was very exciting and educational and learners were motivated to clean the "lotus canal" because they live along the canal." One teacher stated that, "the environment group also made use of kit. Would like more support next year." One teacher mentioned that, "Children very eager to experiment and could not wait for outcome."

Almost all the teachers based the usefulness of the kit on the learners experience while using the kit. The overwhelming majority agreed that it was practical, developed practical skills, easy to use, store and it made theory real.

The data is in line with the findings from Daloglu's study, confirming that for teachers to change and learn through professional development, change has to be identified with learning (Clarke and Hollingsworth, 2002).

- District should support the resource to ensure curriculum alignment and teacher acceptance of the resource (Remillard, 2000:348).

Programme management of MTN-SUNSTEP tried to ensure district support. The manager states that the accomplishments of the programme were successful meetings with education department and training seventeen curriculum advisors.

From the data, it is evident that the resource was supported by various districts. This does not ensure curriculum alignment unless that was requested from the programme management. As noted from the data, many of the teachers were not sure how to integrate the resource in the curriculum and teachers from all the learning areas and subjects attended the workshop.

SWAP was endorsed by the district. The life sciences curriculum advisor was one of the presenters and facilitators on the programme . In this way curriculum alignment was ensured. In some of the comments teachers made, they requested that resource be linked to the outcomes. This educator needed more explicit alignment and teacher involvement. In the questionnaire it was not possible to explore the kind of teacher involvement that was required.

One teacher asked that, “Please ask Glen Van Harte (Chief Curriculum Advisor of EMDC South) to tell colleagues to implement SWAP as part of their learning programme even though their current learning programmes do not reflect the detailed planning.” This teacher required more district support in the implementation of the kit in the classroom.

### **5.5.3 CONCLUSION**

The interpretation of the data on the use of the electronic kits, its value to the teacher and classroom practice within the framework as discussed above, indicates that the teachers had a positive experience with the kit but that the implementation of the kit in the

classroom would require more support, curriculum alignment of the resource and contextualizing. From my interpretation, this is due to the programme approach to resources in teacher development: expert driven and developed for a target group and not with teachers.

The data on the SWAP kit indicates that the teachers had a very positive experience with the kit. Teachers' responses emphasize the need for well-designed curricular guidance (Brown, Smith and Stein, 1996) to support the teaching and learning process.

From the findings of the data gathered, electronic kits were developed by an expert without teacher participation. This process would not be in line with the participatory model for material development where teachers are more involved with the process and develop a better understanding of the issues. Teachers develop a greater sense of ownership of the materials, the materials are developed "*with* people rather than *for* target groups", the kits would be used more extensively as teachers have a better understanding of their use and it is easier to contextualize the materials for both learners and teachers (Russo and Lotz: 2003).

In SWAP, the process of introducing the kit to teachers and engaging teachers in the process has encouraged teachers to use the kit as it addressed issues of content and methodology. This addressed an issue raised in current research on the use of curriculum materials which shows that teachers' beliefs and knowledge about the process of learning and teaching and their understanding of content will influence their decisions about what and how to teach more so than text books (Putnam, 1992; Remillard, 1992; Stephens, 1982). The data shows that most of the teachers used the kit to suit their context.

SWAP uses the approach that combines the role of the expert with teacher participation (Russo and Lotz, 2003: 11). Learning support materials are not developed in a vacuum, but are designed for particular situations and contexts. With this approach, time is used optimally and the success of the resource is enhanced.



Curriculum materials are indispensable tools that allow teachers to best work with learners as these materials provide the framework for the science programme based on the best thinking in the field (expert) and allow teachers to make the best decisions about their learners learning (Kesidou and Roseman ,2002:523).

From the discussion above, the resource kits play a valuable role in teacher professional development and provide the framework for the science programmes (Kesidou and Roseman ,2002: 523). The data from the MTN-SUNSTEP and SWAP kits indicate that the resource kits contribute towards the successful teacher professional development. The SWAP kit is aligned to the twelve factors that ensure successful teacher professional development. MTN-SUNSTEP kit is aligned to most of the factors. I would argue that good resource kits could play a bigger role than ordinary curriculum materials, like text books and worksheets in attracting teachers to teacher development programmes.

Resource kits play a valuable role in teacher professional development as they attract teachers to the development programme. They are the focus point around which teachers initially rally. Teachers will make the time in their busy schedule to attend a workshop which involves a resource kit and its application in the classroom. In my opinion, this happens because teachers are looking for new ways to teach; need more information; need content knowledge; want to excite their learners; want to know the everyday context and application of science; if the kits excite them they assume their learners will be excited. These are but a few reasons.

The resource kits intensify teachers' development on a personal and professional level and in this way allow for teacher professional development (Bell and Gilbert, 1994). Kits are also a way for teachers to learn new and difficult content areas like electronics and environmental education. The kits become the entry point for teachers into these areas. Kits that are user- friendly provide an unthreatening tool for teachers to learn difficult content which they would not normally have been exposed to or would not have studied on their own. When these resource kits are introduced in a safe environment with support, teachers are willing to learn new content; they are willing to experiment and try new

methods. In the South African context, where teachers are poorly qualified in science content and methodology (Arnott and Kubeka, 1997), resource kits can assist teachers' learning. The resource kits should be part of a well-planned teacher development programme based on teacher professional development principles with an approach of teacher growth. This would enhance teachers' learning and teachers' teaching in the classroom.

The context based - resource kits like SWAP and MTN-SUNSTEP allow teachers to connect the content areas, electronics and environmental education and every day life. This could allow teachers to understand the content.

In my opinion, from interpreting the data, teachers would not have continued with the MTN-SUNSTEP programme if the resource kit was not part of the programme. The large group of teachers would not have travelled and spent their afternoons, after teaching, studying electronics without the resource kit.

The resource kit is a key to opening the door to teacher professional development opportunities in science teaching and allowing teachers to introduce innovative resources in the classroom to increase learners' understanding of the subject (Arnott and Kubeka, 1997).

## **5.6 EVALUATION OF THE CASE STUDIES**

### **5.6.1 INTRODUCTION**

In this chapter, the two sets of data will be analysed for the assessment of the process of MTN-SUNSTEP and SWAP programmes.

I will use the conceptual framework of social programmes developed by Babbi and Mouton (2001: 343), which has been adapted, as guide to assist in categorizing the components of the two programmes that should be evaluated. The analysis of the data is based on the categories identified in the model as illustrated in Table 3.1 on page 67

Chapter 3. I will use this programme evaluation model as an added tool to further evaluate the process of teacher development in the two programmes and the role of resource kits in enabling this process.

### **5.6.2 THE CONTEXT OF IMPLEMENTATION**

The context of a programme can be a deciding factor in its success or failure. This includes the broader socio-political context, the geographical location as well as the timing of the programme implementation. In both the MTN-SUNSTEP and SWAP programme the context is South African classrooms in disadvantaged areas, at a time of curriculum innovation and change in South Africa. The classrooms were in various areas in the Western Cape and implementation was dependant on many factors in the school and the local environment.

In the MTN-SUNSTEP case study, the target group was both the teachers and the learners. Teachers attended workshops at the University of Stellenbosch. From the data gathered, nine teachers from the Khayelitscha, Nyanga and Mitchell's Plain areas, responded that the venue was too far. The data indicates that these teachers would possibly not have returned for more workshops. Twenty -six teachers were happy with the location of the venue.

The data indicates the context within which the implementation of the programme occurred and the teachers' difficulties. The equipment required by the programme was a deterrent to implementing the programme. Learners had to buy their own kits and the schools purchased the necessary equipment to implement.

In SWAP the target group was the teachers. The teacher workshops were held in the areas where the teachers taught. This made it easier for teachers to attend the workshops. The schools were located in the Southern Suburbs of the Western Cape, near a water source so that teachers did not have to struggle to get to a water source. Some teachers did not implement the programme as they had problems with the safety of the learners.

### **5.6.3 GOALS AND OBJECTIVES**

There is a symbiotic relationship between programme goals and the target group. The programme is conceptualized to address the needs of the target group (Babbi and Mouton 2001: 343). The broad goals of the programme should be refined into measurable indicators with clearly defined outcomes. In the MTN case study, the goals are broad as stated earlier. The manager states that, “The main aim was to motivate teachers to understand technology and for their learners to receive hands on experience thereof. Sunstep wanted to see competent teachers and learners who could make an informed career choice, including the field of electronics and electricity.”

The goals are broad. The data on the outcomes and indicators of the programme indicate that it centred around teacher training in electronics; developing electricity concepts and to motivate learners to pursue careers in engineering.

From the data gathered, the programme reached 4 732 learners in 2000 in the Western Cape. WCED endorsed the programme. From the data of the case study, teachers in the four schools were implementing the programme. One of the teachers highlighted that he had difficulty understanding the concepts because of the teaching style.

From the interview and my school visit to the teacher indications are that the teacher did not fully understand how the kit functioned at the end of the workshop and had to study. In this case the understanding of the electronic kit did not happen in the workshop. This teacher had also done a short course on electronics before the workshop and had attended a few MTN-SUNSTEP workshops.

In the MTN-SUNSTEP case study, the goals are defined in brochures and have been reiterated in interviews with the programme manager and coordinator. The target group or beneficiaries are the teachers and the learners. The explicit measures of success in the programme and the measurable goal are the applications the learners design and build

and the teachers teaching the kits in the classroom. Most of the goals in the programme are generalized statements that are difficult to measure. The implicit measure of success was the number of teachers that participated in the teacher workshops at Stellenbosch University.

In the SWAP programme the goal of the programme was explicit and measurable. The main aim of the programme was the professional development of teachers in science teaching. In outcomes based framework for teaching and learning. The measurable outcomes were listed: new approaches to work, development of new networks, improved understanding of the local environment and better understanding of environmental education. The programme targeted teachers.

#### **5.6.4 PROGRAMME COMPONENTS**

The programme components refer to those mechanisms and means that make the attainment of the goals possible. In MTN-SUNSTEP, the programme components would include the teacher workshops at the University of Stellenbosch, the instruction booklet, the electronic kit, the two facilitators to offer support to participating teachers and the programme manager.

In the SWAP, the programme components would be teacher workshops, SWAP kits, the learning support booklets, two facilitators Andre and Vanessa to support teachers, EMDC South, focus group meetings, questionnaires and programme manager, Dr. Chris Reddy who was actively involved in the programme. The question that should be asked is: Will the programme components listed produce the desired outcomes?

#### **5.6.4.1 TEACHER WORKSHOPS**

In the MTN-SUNSTEP case study, teachers were invited to attend a “one shot” three – hour workshop on the electronic kit of their choice. The data show that the majority of the teachers had not attended an electronics course before. The teachers thought that the workshops were worth the effort. Most of the teachers left the workshops very happy and most had completed their kits, which they took home with them. The teachers did not evaluate the workshop at the end of the session.

The data collected at the workshop indicate that the overwhelming majority of the teachers would build the electronic kit in their classroom as it would interest the learners. The coordinator mentioned that it was difficult to determine whether the programme was implemented at the schools.

Most of the teachers had difficulties during the workshop as indicated in the previous discussion and the data gathered indicated ways of improving the workshops.

In the SWAP case study teachers were invited to a meeting in the Southern Suburbs. They attended four workshops. This component of the programme was set up to achieve the outcomes of the programme. The workshops allowed teachers to interact with each other, form new networks, develop new approaches to work, improve their understanding of the local environment and develop a better understanding of context work. The majority of the twenty- nine teachers had attended the four workshops. Some teachers had participated in the SWAP programme since its inception.

#### **5.6.4.2 RESOURCE KITS**

In both the case studies, the resource kits were an integral part of teacher professional development in science teaching. In the MTN-SUNSTEP case study, the teachers experienced the kit positively and enjoyed working with the kit.

The resources had to be purchased and were not immediately available for teachers to use. The teachers indicated that one of the difficulties that would hamper implementation would be the purchasing of equipment and resource kits.

In the second case study, one kit was issued to each participating teacher and schools each received five kits for school use. Most of the teachers used the kits in their classrooms. Seven could not use the kits, mainly due to the safety of the learners and the need for more of equipment. The teachers indicated that they used the resource in their classroom immediately.

From the responses, the teachers indicated that the kit was useful. The usefulness of the kit was limited by the accessibility to the equipment. Almost all the teachers based the usefulness of the kit on the learners experience while using the kit. Overwhelming majority agreed that it was practical, developed practical skills, easy to use and store and it made theory real. The kits were included in the practicals and other learning areas.

Teachers were very positive about the usefulness of the kit. They wanted and were eager to participate in the programme process again or a similar project. Teachers felt empowered and said that their confidence in their teaching had improved.

#### **5.6.4.3 FACILITATION AND SUPPORT**

In the MTN-SUNSTEP case study, the workshops were facilitated by both the coordinator and Ulrich. Sometimes, three facilitators were available. The standard of the workshop was excellent as rated by the teachers. One of the teachers had difficulties with the teaching style as it did not assist him to understand the functioning of the kit.

From my interpretation of the data, support is offered, but it is not coordinated. It would also be difficult for two people to support two hundred teachers on the programme.

In the SWAP case study, the workshops were facilitated by the programme manager, the two facilitators and the curriculum advisor. Each cluster of six schools was assigned a

field worker to assist and dates negotiated to visit the school. Volunteer coordinators are also assigned to each cluster for additional support of the teachers in the classroom. The efforts of these individuals have been very useful to the fieldworkers and played a big role in the success of workshop activities and attendance. The fieldworkers developed good relationships with the teachers in their clusters and have supported the teachers by organizing field trips. The field workers and the volunteer coordinators increased the support base of the programme.

The data show that the support at the workshop and during the programme was provided to all the teachers although some teachers needed more support based than others.

#### **5.6.4.3 FOCUS GROUP MEETING**

In MTN-SUNSTEP, teachers did not reflect on the process at the workshop. When I observed the workshops, teachers did not evaluate the workshop.

From the data, evaluation of the programme occurred with the curriculum advisors and the management but not the teachers. If it was done it was informal and anecdotal.

In the SWAP case study, focus group sessions occurred to discuss and evaluate the programme. The data show that teachers were positive about the programme and valued the forum for discussion with other teachers. In the reflective conversations, teachers' comments indicate that opportunities for professional development as listed in the objectives have been achieved. From the data, these evaluation sessions were used to listen to teachers, improve and ensure effective implementation.



#### **5.6.4.5 EMDC SOUTH**

In MTN-SUNSTEP the case study, Western Cape education Department was consulted before the programme was initiated. The technology curriculum specialist at WCED head office provided feedback

In the SWAP case study, the programme was planned with the district office. The curriculum advisor was part of the planning meetings. It was arranged that Fadli Wagiet would serve as the curriculum support person for curriculum guidance; and to ensure alignment to national and provincial policies. He would organise meetings; ensure endorsement of the partnership with WCED and report to the district office.

The data shows that the district office was part of the planning of the workshops, the human resource base and the support of the programme.

#### **5.6.5 HUMAN RESOURCE BASE**

The human resource base refers to the individuals who manage the programme. Issues to be considered are the abilities, competencies and personality styles of people managing the programmes ( Babbi and Mouton, 2001: 344). In MTN-SUNSTEP it would be the programme manager and the programme coordinator . In the SWAP, this would be the programme manager, Dr. Chris Reddy and Fadli Wagiet from EMDC South. In SWAP both the programme managers were actively involved in the programme. They attend the workshops and the reflection sessions.

#### **5.6.6 CONCLUSION**

Using the Babbi and Mouton programme evaluation model (2001) to evaluate the whether the resource kits enabled teacher professional development in science teaching: the question asked earlier in the section has to be answered: Does the programme components produce the desired goals and outcomes?

In the MTN-SUNSTEP case study, it depends on the goal and the outcome that is being assessed. Many teachers attended the workshops and learners were aware of the kit. Teachers struggled to understand basic electronics and the functioning of the resource kit. It was difficult to monitor the implementation of the resource kit in the classroom. The research shows that teachers require more sustainable support and more time to interact with the resource kit.

Financial constraints of the schools also create difficulties in the implementation of the programme. In four of the schools visited the programme was implemented as part of the curriculum and in the one school, it was implemented as part of the science club. When the programme is not integrated into the curriculum, the implementation is hampered (Eisner, 1990:65-66).

From my interpretation of the data and the application of evaluation model, I would state that in MTN-SUNSTEP professional development occurred but was limited by programme components and the broad goals. The resource kit was not used to its full potential to enable teacher professional development as the approach to teacher professional development was expert driven and not participatory.

In the SWAP case study, the programme components supported the teachers throughout the process and teachers accompanied teachers on the river visits. The managers were visible and actively involved in the process. The SWAP kits were given to schools free of charge. The teacher workshops occurred over a period to lengthen the time spent with the resource. The goals of the programme were achieved and the resource kit enabled teacher professional development and teacher learning.

In summary, most of the teachers involved showed evidence of professional development and the resource kits seem to have a role in enabling teacher development. But I am cautioned by Hoban (2002) who states that professional development and change

processes are influenced by a number of factors, which rules out a mechanistic approach in the complexity of teaching and learning.

In Chapter 6, I discuss themes that emerged from the case studies and explore limitations of the study. I will make suggestions for further research.

## **CHAPTER SIX**

### **CONCLUDING COMMENTS AND POSSIBILITIES FOR FURTHER STUDY**

#### **6.1 INTRODUCTION**

The study was undertaken at a time of curriculum change in South Africa with the new constitution of South Africa providing the base of curriculum transformation and development. To implement the changes in the curriculum meant changes in the teaching and learning process. How teachers teach, what they teach and how they assess has to change to ensure quality in education. (Lotz, 1997:3)

In terms of curriculum imperatives, largely Curriculum 2005, teachers had to develop their own teaching and learning resources, use a combination of text books and fulfil their role of being 'interpreters and designers of learning programmes and material (Norms and Standards for Educators policy statement department of education: 2000). Technology was introduced as a new learning area with electronics as one of the content areas to be taught. Teachers had not been exposed to the learning or the content area before. Environmental education was included in the formal curriculum. Many teachers lacked capacity to implement environmental education ( Lotz and Robottom, 1998) and this probably applied to technology teachers as well.

Initially the purpose of the study was the evaluation of MTN-SUNSTEP. At that time, as a teacher, I wanted to know whether the programme made a difference to teachers and learners in the classroom as education was going through major changes. Teachers were eager to access resources that would assist them in the teaching process, excite learners and make them interested in science.

In the SWAP study, the programme was initiated to partially address inadequate professional development of the education department. Teachers were presented with an INSET programme to assist with the adoption of the innovation and to better understand

the environment and curriculum processes. I reflect briefly on the process of the study with particular reference to the achievements, limitations and opportunities for further study.

## **6.2 EVALUATION OF THE PROCESS**

The evaluation of the process of professional development and the role of resource kits in enabling professional development is an integral part of the study. The questions asked are: Is the programme being implemented as designed? Has the programme been properly implemented and managed? (Babbi and Mouton, 2001). As discussed before, I have used a mix of models as a framework to critique the processes of the two case studies. These models have highlighted issues of the study.

### **6.2.1 DURATION OF TRAINING AND SUPPORT**

In both the case studies, teachers were eager and motivated to participate and implement the programme at their schools.

A shortcoming in the MTN-SUNSTEP case study was the time spent on training and support of the teachers. I agree with Garet, Porter, Desimone and Yoon (2001:917) who state that a number of studies indicate that the duration of professional development is an important factor in successful teacher development. More time should be spent with teachers both in workshops and in the school based support to enable professional development at deeper levels.

The opportunity for teacher input was not created in the programme. The data show that teacher input was not encouraged in the programme. Bell and Gilbert (1994: 494) writes that teacher development can be seen as having two main aspects: the input of new theoretical ideas and teaching suggestions and trying out new ideas in the classroom. The process in the MTN-SUNSTEP introduced teachers to new ideas in the once off workshop. This was not enough to foster confidence in teachers.

The learning period was limited to the workshop and teachers received very little support. Generally, professional development requires a longer period of implementation and support to enable development at the three levels (Bell and Gilbert (1994); Garet, Porter, Desimone and Yoon 2001: 917). Bagwandeem and Louw (1993:64) state that the critical factor in INSET is teacher involvement and opportunities to implement, make changes and suggestions on the activity, the methodology and the effectiveness of the activity.

I feel that this opportunity was not granted to teachers and negatively affected and limited the process. This is supported by Guskey (2002:45) and Bell and Gilbert (1994: 496) in their conceptual models for teacher development. Teachers' acquisition of new knowledge and skills can be enhanced by teachers, involvement with the process of the programme.

In the SWAP case study teachers were given time to understand the concept through the workshops and support was provided at the site of implementation. Time was also important to allow teachers to change their mindset about teacher workshops. In my opinion, teachers also need time to change from the mode of teaching and management to a workshop mode of interaction with curriculum. Some teachers, depending on their context needed more support. This encouraged implementation of the programme.

### **6.2.2 THE ROLE OF THE FACILITATOR**

The role of the facilitator should not be under estimated in the process. In the MTN-SUNSTEP case study, most of the teachers rated the facilitation as excellent but some of the teachers had a problem with the method of facilitation. The facilitators though proficient in electronics did not have an education background and this was evident in their methodology.

In the SWAP case study, the facilitators were educators previously and none of the teachers had a problem with the facilitation. The programme was enhanced by the participation of a curriculum advisor; to provide the curriculum alignment, guidance and collaboration with the education department and a university specialist to provide the expertise in the field of environmental education and teacher professional development.

### **6.2.3 GOALS AND OBJECTIVES**

The goals, the objectives and the indicators of the programme have to be very clear when developing the programme. In the MTN – SUNSTEP case study, some of the goals, objectives and indicators are vague, making the evaluation of the programme difficult. Although this programme worked mainly with teachers, professional development was not an explicit goal. Goal clarification and measurable objectives with clear indicators have to be developed by the programme managers with input from the stakeholders.

In the SWAP programme the goal, objectives and the indicators were clear and measurable. They were based on professional development models and theory. The outcomes were measurable and the programme was developed to achieve them.

### **6.2.4 PROFESSIONAL DEVELOPMENT**

The focus of my research is teacher professional development through the use of resource kits. The two case studies highlight the variables and the complexities involved in professional development. Two of the most important factors are highlighted, the process of the programme and the context of implementation.

Using the mixed model of indicators, it is evident that the two programmes had many achievements. Teachers were involved in the process and gave up their personal time to attend the workshops. In the MTN-SUNSTEP case study teachers had to travel and in many cases spend their own money on transport to attend.

Teachers developed new understandings of the content areas, electronics and environmental education. Teachers were introduced to new content areas in their field of work. This was a huge task for the programme managers and is an achievement for the programmes. At the schools in the case studies, teachers taught their learners about electronics and environmental education which they had not taught before. At most of the schools in the SWAP study, teachers introduced the learners to the resource kits. This is an achievement of the programme.

The programmes contributed to teachers increased confidence. From the questionnaires and interviews teachers were eager to implement the programmes and most agreed that they had acquired new skills.

Using the Bell and Gilbert model (1994: 485), teachers were at different levels of personal, professional and social development. In the case studies teachers, teachers were willing to try out new ideas in the classroom. New theoretical ideas and teaching strategies were introduced to teachers and this allowed for teacher learning with the use of resources.

### **6.2.5 THE ROLE OF RESOURCE KITS**

In both of the case studies, teachers were provided with learning support materials and support in the use of the materials as well as in the implementation in the classroom. All schools were provided with the same development opportunities, learning materials and support.

The resource kits played a valuable role in introducing teachers to teacher professional development. An exciting resource kit was the initial attraction for teachers to attend the workshop. It allowed teachers to explore both the functioning of the kit and the new knowledge area without feeling threatened. It was an introduction into new content areas. When teachers could assemble the electronic kits, they were more eager to study the concept of electronics and willing to study in their own time. Some of the teachers



attended more than one workshop, they were eager to learn more about the resource kits irrespective of the professional development process and whether the workshop assisted them with their understanding of the content. In my opinion, the electronic kit should be used as an introduction to electronics. The programme should be longer so that teachers could be introduced to electronic concepts and understand the functioning of the kit.

In the SWAP programme, teachers were also excited about the kit. It was the initial attraction for attending the workshop. Teachers were excited to receive resources for their school free of charge. Once teachers attended the workshop and they were introduced to the resource kit which is an interesting resource for teachers and learners, teachers participated in the full teacher professional development programme. They also attended other courses of SWAP so that they could use the kit and participate in the teacher development.

In my opinion, resource kits allow for personal and professional development (Bell and Gilbert, 1994) of teachers and could be used as an entry point in teacher professional development. Teachers are initially attracted by the resource, remain on the programme as they have become involved and were learning through the process.

In some of the schools, most of the outcomes of the programmes were achieved based on measurable indicators. This however differed from school to school. In the SWAP process, most of the teachers implemented the programme at their schools. This was not the case in the MTN-SUNSTEP study.

In the MTN-SUNSTEP programme, the teachers were introduced to new concepts and learning support materials in a single workshop. Hoban (2002) writes that this mechanistic approach assumes that teachers will leave the process with new ideas they will implement immediately. This approach also assumes that teacher learning is independent of context and ignores the complexity of the teaching process in the classroom as well as the broader context within which the teacher works. This type of

model is individualistic and ignores the social, cultural and physical factors that influence teaching and implementation (Hoban: 2002)

The programme fits “the deficit model” of INSET described by Bagwandeem and Louw (1993:69). The model assumes that teachers are deficient and that this lack of knowledge and skills can be corrected through INSET.

The study highlights the importance of context in curriculum implementation. Harley (et al, 1998) writes that we need to understand teachers’ context when introducing and working with policy. He states that:

Policy assumptions about the context in which policy is to be implemented are problematic. Teachers’ roles were very clearly affected very substantially by different school contexts. While differing levels of resourcing was a major factor, differing value systems appeared to be a crucial factor. Different value systems were evident at the level of the individual teacher, the culture of the school and the community.

In the different case studies context was a crucial factor in the implementation of the programme. The influence of the teachers, the principal, school resources and school culture and the community affected professional development in various ways.

The teachers in the case studies taught in historically disadvantaged areas. The schools are in similar communities but differ in school ethos, leadership and management. Teachers were enthusiastic and eager to implement the programme but differing levels of implementation were evident at the schools. Professional development was evident in both the case studies but limitations were evident.

In the SWAP programme, the teachers were introduced to the new concepts and learning support material over a period. Support was provided at the school by the facilitators and more than one teacher from the school participated in the process. Teachers were allowed

to reflect on the process and return to the workshop with fresh ideas. This model fits in with Bagwandeem and Louw (1993) “growth model” which assumes that teachers want to be better practitioners and recognize the need for improvement in their practice.

Most of the schools in the study implemented the programme, teachers were enthusiastic about the process and at the time of the evaluation, some of the teachers were still using the resource kits in their classrooms. One of the schools did not implement based on the context of the school. This highlights the importance of context as stated by Hoban (2002).

From the data, it is evident that science resource kits have a positive role in enabling teacher professional development. As stated before, effective resource kits attract teachers to the teacher development programme; it allows teachers to explore new content areas without feeling threatened by difficult content areas; teachers feel that if they can assemble the kits it is possible to understand the content; it is an entry point into difficult content areas as well as teacher professional development opportunities; teachers are excited about the kits and initially stay on the programme or return; it gives teachers confidence to explore both the kits and other areas, for example adapting worksheets, developing models, and trying new ideas and practical activities in their teaching.

In science teaching, attempts are made to incorporate the methods of scientists into the science classroom. Science processes allow science learners to make informed decisions and understand the nature of science and its impact on their lives (Loucks-Horsley et al., 2003: 43). The resource kits make it possible to introduce teachers to these science processes in a safe environment using a kit that was not daunting.

The two programmes focused on intermediate and senior phase teachers, teachers which the data shows, were not science specialist but generalists. Some of the teachers’ pre-service training had not necessarily included science and science methods. Research shows that context based resource kits provided concrete examples of materials which should increase learners’ interest in science and help them see the links between science

and society. In some cases, it also helped to develop better understanding of particular science ideas than more traditional approaches (Bennett, 2003:121). In this manner the resource kits would assist teachers on the programmes to better understand the science concepts.

### **6.3 REFLECTIONS AND CONCLUDING COMMENTS**

In professional development activities, investments in activities that have the characteristics highlighted in the research have to be developed to foster improvements in teaching. Resource kits can be an important tool in enabling teacher professional development which is framed in professional development theory. Teachers are attracted by interesting resource kits. It is an entry point into professional development activities and assist teachers in understanding difficult science concepts.

Based on the above discussions, I would like to propose a model for professional development that involves the stakeholders: district officials, teachers and university specialists as part of the conceptualisation team.

This model would be resource- based, involve science kits and traditional activities coupled with reform activities. For example, a workshop followed by classroom based activities. It would be focussed on a smaller group of teachers that belong to the same school, and/or grade and would be developed based on the previous experiences of teachers. The coherence with the curriculum would be a pre-requisite and teachers would be encouraged to communicate with each other, belong to professional organizations, present research papers and attend teacher conferences. This would not be a once-off experience but a well-devised programme involving the same group of teachers.

As a district official, I am relieved to discover that it is not the type of activity but the duration of the activity, that is more important in professional development. It is time to re-look at teacher development at district level and devise ways of making it more meaningful for teachers. For too long we have relied on the one size fits all model.

#### **6.4 REFLECTION ON THE RESEARCH PROCESS**

My research process was haphazard, uncoordinated and messy. In my reading of Le Grange 2007: 423, I am excited about the discussion of method and

“.....how method might be imagined differently and how it can be crafted in ways that recognize that the world is multiple, complex, fluid, heterogeneous, ephemeral, vague and so on.” Le Grange 2007:428

The acceptance that research is done by people with people and that messiness is part of the process allows me to think of research in a new way and to accept my research process as ‘normal’.

I followed an interpretive research methodology to attempt to make meaning and understand the process of teacher professional development based on my personal worldviews. I wanted to interpret the INSET processes, highlight effective practices and recommend changes for effective professional development to make a difference in teaching and learning.

Personally, the research has been a tortuous but valuable journey. My experience as a teacher and curriculum advisor contributed towards my subjectivity during the study. The research has limitations but provided insight into teachers’ experiences of the processes and the context of teaching.

#### **6.5 LIMITATIONS OF THE STUDY**

A number of limitations were identified during the study. Initially the study included six schools but I could not visit all six due to time constraints and changing of my career. All the schools identified did not participate in the complete programme for that particular year. Teachers attended the workshop but the schools did not implement the programme

at the school for various reasons. Research was conducted in 2000 and 2001 and completed in 2005. Limited information was gathered during an interrupted period. Due to the limited information, the SWAP study was included as a case study much later in the study. Midway through the study, the research focus changed. The object of analysis changed from the learner to the teacher.

Yin 1994:1 mentions that when “how and why” questions need to be answered and the focus is on real –life contexts, case studies are preferred as a strategy. A criticism of case studies is that they cannot be used as the basis for generalizations (Yin 1994:10). In this study, information from two case studies, MTN-SUNSTEP and SWAP, were used to attempt to generalize about the theory and models of professional development and not about instances. One of the limitations of the study was that the teachers were not representative of the population of the Western Cape or South Africa.

## **6.6 POSSIBILITIES FOR FURTHER RESEARCH**

Possibilities for further research would be:

- Researching the effectiveness of INSET programmes over a longer period;
- Researching the core and structural factors that determine the effectiveness of a programme in a given context;
- Setting up programmes using the suggested model of participation of the teacher, the university specialist and the curriculum advisor and evaluating the process.
- Researching INSET programmes with a learning resource component where the factors for the creation of successful resources are taken into account and;
- Studying the role of school management in teacher professional development.

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