Teachers as curriculum developers: a case study of natural sciences teachers in a school district.

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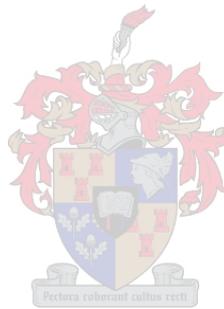
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I

Declaration

I, the undersigned, do hereby declare that the content in this submission is my original work, and that I have not submitted part or whole thereof for the purpose of securing a degree at any university.

Signature : …………………………………..

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II

ABSTRACT

This investigation reports on the extent to which teachers became curriculum developers while participating in a collaborative research project with a university based researcher as facilitator. The aim of this study was to examine teacher's interaction with learning support materials, fostered by a process of professional development, to gain insight into their potential to engage in the activity of curriculum development.

To support this whole process, the research strategy of Action Research was employed. Teachers were introduced to the learning support materials during initial workshops, and links were established with the RNCS and the three learning outcomes for the learning area of Natural Science. They were then requested to draft a lesson plan, and following the implementation of the materials, observation of the teachers engaging with the materials, and a process of reflection, they were once again requested to re-draft the initial lesson plan.

Three frameworks for analysis, situated within the interpretive paradigm, were employed to ascertain to which extent both professional and curriculum development was evident at the conclusion of the program. The analytical framework used to ascertain the measure of professional development was the model proposed by Bell and Gilbert (1994), consisting of three aspects namely, personal, professional and social development. The two frameworks employed for the analysis of possible curriculum development were firstly, a model adapted from the research by Boomer (1992) consisting of five stages for mapping the curriculum, and secondly the model proposed by Remillard (1999) that includes three arenas of curriculum development, namely curriculum design, construction and mapping.

The conclusions of this investigation were that teachers partially engaged with the activity of curriculum development, and that a certain measure of professional development was achieved by the participating teachers. Recommendations for further research was that a more sustainable effort over a longer period of time constituting the aspects of action research, and even added different learning support materials should be engaged in. Also that could be conducted on a larger scale involving more schools, and also closer links to be established with the educational structures and authorities.

III

SAMEVATTING

Hierdie ondersoek rapporteer oor die mate waartoe onderwysers curriculum ontwikkellars geword het terwyl hulle deelgeneem het aan 'n navorsingsprojek in samewerking met 'n universitetsgebasseerde navorser, wat die rol van fasiliteerder vervul het. Die doel van die studie was om die onderwysers se interaksie met die leer ondersteunings material, ondersteun deur 'n proses van professionele ontwikkelling, om insig by te row poor die potensiaal van die onderwysers om deel te neem in die aktiwiteit van kurrikulum ontwikkelling.

Om hierdie hele proses te ondersteun was die navorsingstrategie naamlik Aksienavorsing gebruik. Onderwysers was voorgestel aan die leer ondersteunings materiaal gedurende die inisiele werkswinkels, waar skakels gemaak was met die HKNV en die drie leerder uitkomste van die leerarea vir Natuurwetenskappe. Onderwysers was versoek om 'n lesplan op te stel, en na die implimentering van die materiale, observasie van die onderwysers terwyl hulle daarmee werk, en meegaande refleksie, was hulle weereens versoek die inisiele lesplan te herbeplan.

Drie raamwerke vir analiese, gesetel binne die interpretatiewe raamwerk, was gebruik om uit te vind tot watter mate professionele-en-kurrikulum ontwikkelling teenwoordig was teen die einde van die studie. Die analietiese reaamwerk wat gebruik was om 'n idee te kry oor die mate van professionele onwikkelling, was die een wat voorgestel was deur Bell en Gilbert (1994), bestaande uit drie aspekte, naamlik professionele, sosiale en persoonlike ontwikkelling. Die twee raamwerke wat gebruik was vir die analiese van moontlike kurrikulum ontwikkelling, was eerstens 'n model wat aangepas was van die navorser genaamd Boomer (1992), wat bestaan uit vyf stadia vir karteering van die kurrikulum, en tweedens die model wat voorgestel was deur Remillard (1999), wat drie arenas van kurrikulum onwikkelling insluit, naamlik kurrikulum ontwerp, konstruksie en kartering. Voorstelle vir verdere navorsing is dat 'n meer volhoubare

Die gevolgtrekking van die ondersoek was dat die onderwysers gedeeltelik deelneem in die proses van kurrikulum ontwikkelling, en dat 'n mate van professionele onwikkelling behaal was deur die deelnemende onderwysers. Voorstelle vir verdere navorsing is dat 'n meer volhoubare poging oor 'n langer periode, inaggenome die aspekte van aksienavorsing, en selfs met addisionele leer ondersteunings materiale van staple gestuur moet word. Verdere voorstelle is ook dat die studie op 'n groter skaal, met meer skole betrokke, gedoen kan work, en dat meer hegte skakels behoort gemaak te word met onderwys strukture en gesag.

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CHAPTER 1

Introduction

> "*The benefactors of humanity deserve due honor and commemoration. Let us build a Parthenon for teachers. Over the entrance to the ossuary I would inscribe, in letters six or seven feet high, the simple words:*
> Sacred to the memory of the World's Educators.
> Si momentum requiris circumspice."
> ALDOUS HUXLEY. BRAVE NEW WORLD. 1932

1.1 Background

The sudden and dramatic demise of apartheid and the ensuing introduction of a multi-party, majority-rule political landscape was the definitive event in the modern history of South Africa. Lotz and Olivier (1998:2) indicate that the change in government in 1994 has enabled fundamental change in the education policy environment in South Africa. This policy is primarily aimed at transformation at systemic, social and methodological levels – transformation that has subsequently prompted a series of changes in political and economic systems, as well as acknowledging the importance of educational change in building a new society. In this regard, Welch (2003:22) illustrates that radical change, occurring in almost every facet of education, was imperative: "When the new government took over in 1994, it was faced with the task of dealing with a segregated, fragmented, authoritarian and dangerously unequal and inefficient education system".

In recent years policymakers have launched efforts to change and improve education by creating a fundamental shift in what children need to learn, and how

it is to be taught. A definitive step in this direction was the launching of the new national curriculum, Curriculum 2005, by the national department of education (NDE) in 1997. The new curriculum was informed by the principles of outcomes-based education, an approach that in effect constitutes the foundation of the post-apartheid school curriculum (Chisholm 2005:193).

The Revised National Curriculum Statement (RNCS), resulted after the original Curriculum 2005 was rigorously revised after being introduced countrywide. The RNCS was phased in during 2004, having been accepted as official policy in April 2002 (Chisholm 2005:19).

Pretorius and Lemmer (1998:2) point out that traditional education was content-bound, incorporating evaluations and examinations as means of assessing learning content mastered. In a radical deviation from this method the same authors explain that the desired outcomes in an outcomes-based approach are used as the basis for all curriculum processes. In this approach, outcomes are achieved when the curriculum developer, in order to guide the learner, uses the *outcomes* as basis for designing learning programmes in a particular context or field of learning.

It is also argued that these outcomes cannot be indicated by a certain percentage, but rather by "a culminating demonstration, which is the result of meaningful learning in context". However, the learner's progress is measured against agreed criteria, described as learning outcomes and assessment standards, particularly in terms of his/her prior performances (Pretorius and Lemmer 1998:3).

The RNCS (2002) state that the outcomes encourage a learner-centred approach to education. It is also envisaged that learners will be able to make decisions by using critical and creative thinking to identify and solve problems. In this regard, it is pointed out that child-centred education, as one of the

cornerstones of OBE, was adopted in reaction to traditional schooling with its emphasis on information storage. Learners' critical thinking and problem-solving abilities are also perceived as two key aspects at the heart of an outcomes-based approach (Meier 2003:223,237).

1.2 Introduction

In South Africa changing images and roles are expected of teachers, and policy documents akin to the following indicate this:

> " … they will be able to fulfil the various roles … these include being mediators of learning, interpreters and designers of learning programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area or phase specialists."
>
> (RNCS, 2002)

Statements like these indicate that the implementation of a new curriculum irrevocably alters elements of teaching practice, especially with regard to content and pedagogy. According to various authors, the three pillars of curriculum change are to be found in the concepts of curriculum resources and content, pedagogy, and teacher development.

1.3 Problem statement

Historically South African teachers have largely been subjected to strong top-down education initiatives. Curriculum development implemented by the Research, Development, Dissemination and Adoption (RDDA) method and support materials were largely developed by experts in isolation from the end users (teachers) and classroom realities. Ayers (1992), states that in such situations school systems turn teachers into clerks, as the curriculum becomes the product of someone else's thoughts, knowledge, experience and imagination. Papadimitriou (1995:95) indicates that "this system has brought a tradition where

teachers work like technicians implementing a given recipe without any personal intervention."

The new curriculum statements and guidelines for teachers emphasise learning programme development (curriculum development) as an important aspect of planning and implementation and also requires more learner-centred approaches to teaching and learning. Not surprisingly, many teachers have been found to be lacking in capacity to meet these requirements, which Marsh (1990) calls the general skills that teachers need to create curriculum frameworks that incorporate new forms of knowledge. Preliminary research indicates a possible lack of capacity in many teachers to develop a curriculum (Reddy, 2000, 2001) and also a lack of learning support materials for assistance with learner-centred curriculum development.

In this project I will introduce teachers in a specific school district to various resources that require active involvement of learners in scientific enquiry based, user-friendly science-testing procedures and enquiry procedures. The teachers who will form part of the research are natural science teachers who will attempt to develop their own curriculum units in terms of guidelines provided by the policy documents, notably the Revised National Curriculum Statement. The research process will follow a collaborative process that requires teachers to work with colleagues and then on their own, and to report back during reflection sessions. The process is based on a work-together-work-away process model. This allows for collective development, individual implementation and follow-up sessions for collective discussion. The aim of the participatory process is to break down isolation and to provide a forum for a process of collective curriculum development using learner support materials as suggestion materials (Papadimitriou 1995).

In an earlier project involving teachers I took part in a curriculum development process using the Schools Water Project kit (SWAP), during which I observed the

positive reaction of the teachers concerned. After the first round of workshops the teachers were extremely enthusiastic, pointing out how the useful the programme was and how it assisted them with implementation issues and teaching towards science outcomes. It is in this context that the curriculum development process was chosen as the subject of enquiry for my research, which is based on teachers taking part in a curriculum development process to develop curriculum units that are designed to work towards the achievement of natural science outcomes.

1.4 Curriculum resources and content

In terms of curriculum resources Meier (2003:235) notes that resource provision is an issue in the new curriculum based on a child-centred approach. He adds that the issue can be defined in the fact that it should no longer be the custom to have multiple copies of the same textbook, but rather to make use of a variety of books in order to support the thematic work, which is a core practice in current OBE. Adler et al. (2002:54,58,63) also point out that further challenges concerning educational resources are presented by the fact that resources are not only limited in SA schools, but that they are also unevenly distributed. However, it is further noted that more resources do not necessarily lead to better practices in an unproblematic and linear way. They therefore conclude that redistribution of both human and material resources is essential for the implementation of a new curriculum in South Africa.

Eisner (1990:66) suggests that the designers of a curriculum should build different paths into the resources that teachers can take, but to refrain from providing so much information that the volume of reading becomes discouraging. In support of this view, Remillard (2000:346) considers flexibility of curriculum materials indispensable, because the paths that students and teachers follow through the pedagogic space cannot be predetermined by writers, but are the results of day-to-day and moment-to-moment decisions. Bridgeham (in Remillard 2000:346) also notes in this regard that 'good' curriculum materials should

provide multiple possible routes for teachers and learners through a defined pedagogical field.

Considering the vital role of curriculum materials in teaching and learning, two issues of concern are raised by Adler et al. (2003:63). These issues have to do with the form and function of textbooks in school mathematics, science and language teaching. The first issue entails that textbooks in use currently present a narrow approach to these subjects, covering too many topics, resulting in failure to develop any of these topics adequately. A contribution by the textbooks to the disempowerment and de-professionalisation of teachers is raised as the second concern.

1.5 Pedagogy

The shift to a child-centred approach in pedagogy advocates that educators should change from being primary suppliers of knowledge to facilitators, while learners should assume greater responsibility for their learning (Meier 2003:223). Because this approach radically deviates from previous practice, Meier (2003:223) also states that this changing focus "impacted virtually every aspect of classroom interaction and didactical aspects of teaching and learning."

However, the same author observes that the concept of child-centred learning may become more rhetoric than reality, as educators are faced by constraints like the number of learners in classes and insufficient teacher training, which could contribute towards teachers feeling inadequate for the challenge of effecting the paradigm shift (Meier 2003:238).

 It is therefore apparent that appropriate curriculum materials are crucial to teachers during the induction phase of reforms. In support of this view, Remillard (2000:332) notes that previous research pointed out that teachers are required to change their pedagogy needs in order to access well-designed curriculum materials, as they tend to struggle to implement new pedagogical ideas.

Reys, Reys, Laplan and Holliday (2003:74) also observe in this regard that curriculum materials provide guidance and structure to teachers when they implement the intended school curriculum. They also maintain that instructional approaches suggested by learning support materials often influence teachers' pedagogical strategies, particularly if the content and pedagogical approaches closely match the implemented curriculum. From this it may be concluded that learning support materials like the SWAP can play a major role in teaching and learning strategies.

1.6 Teacher development

Remillard (2000:332) revisits the role of the teacher, and maintains that a requirement for learning is essential, as the ideas central to the changing focus may be foreign to educators when changes in the field of teaching is occurring. When teachers are thus required to teach in ways that are unfamiliar to them, or that they did not experience as students, they may have difficulty in altering their methodology.

Remillard (2000:331-332) also emphasises that the interpretive function of the teacher is critical to the curriculum development process, and that the task of the teacher, rather than text, is critical to the process of curriculum development since teachers usually decide what is taught. She further maintains that the materials most likely to foster teacher learning would be materials that engage teachers in learning opportunities (Remilllard 2000:331).

It is therefore concluded that curriculum materials are essential requirements, in conjunction with teacher development. In this regard Eisner (1990:63) maintains that no curriculum teaches itself, and that the way in which teachers interpret whatever information they absorb is crucial to the quality of education that students receive and the kind of growth that teachers have an opportunity to experience. He further adds that mediating a programme is an unavoidable

aspect of the teacher's work, and that this is complicated by factors like a lack of support from the school, or a relatively untrained or inexperienced staff component. He concludes that good curriculum materials should educate and emancipate teachers, as some teachers may need more guidance than others who are able to cope with more complex material (Eisner 1990:65).

In this regard Kesidou and Roseman (2002:522) state that appropriate resources are helpful to teachers during periods of education changes and transformation that promote high quality teaching and learning. However, despite the previous points made on the essential contribution of curriculum materials, Wade (1996:14) expresses the concern that "today's dominant approach to staff development is that teachers are spoonfed pre-packaged activities and treated as curricular consumers rather than professional educators".

To investigate the possibility of a benign role of learning support materials, Remillard (1999:317) suggests that an investigation into the role of textbooks in teaching and teacher learning would entail a process of studying the teachers' process of constructing the enacted curriculum and the role that resources like text play in it. Following this recommendation, the study aims to examine the function of the 'SWAP' learning support materials in the teaching of Natural Science for Grade seven, and the effect of it on the professional development and engagement of teachers in possible curriculum development.

However, until now developing materials and curricula were roles hitherto not expected of or afforded to teachers. This potentially problematic situation became even more complex when it became evident that many teachers currently in service learned to teach by means of a model of teaching and learning that focuses heavily on memorising facts without the additional emphasis on deeper understanding of the subject (Darling-Hammond & McLaughlin, 1995).

Shifting to a more current approach of teaching as suggested by the RNCS, a continuous deepening of the knowledge and skills necessary to teach will be an integral part of the profession. The new approach to education, namely Outcomes-Based Education (OBE), offers innovative alternatives to obsolete practices such as rote learning and examination-driven learning (Pretorius and Lemmer, 1998:2).

In addition to the current climate of educational reform, there are also multiple reform agendas that include teaching towards outcomes, multiple assessments and equity of learning opportunities, all within a reconfigured school organisation. It is also in this context that the notion of professional development has been receiving increased attention as educators at all levels are realising the importance of teachers in the process of school reform and improvement.

In the past decade professional development has emerged as an identifiable field of study, and much has been written on the subject. However, upon surveying the literature it becomes evident that very few efforts for fostering professional development have had a successful outcome. Teachers claim different reasons for this state of affairs, among others: inadequate duration of the programme; lack of consultation; a Research, Development, Dissemination and Adoption (RDDA) approach by facilitators, and a "one size fits all" approach. Research done by Clark (1992) concurs with these statements: "… in some quarters the phrase 'professional development of teachers' carries a great deal of negative connotations. It implies a process done 'to' teachers that teachers need to be forced into developing, that teachers have a deficit in knowledge and skills that can be fixed by training."

1.7 Educational change and transformation

It has been argued, and copiously documented by different researchers that there is a definite link between curriculum development by teachers and professional development of teachers. As mentioned earlier in this chapter, an

attempt will be made to define curriculum development in the first place, and secondly professional teacher development, and to show how the two themes link with action research. However, before clear definitions of professional or curriculum development can be formulated, the notion of change in the work of teachers and education and the significance of these changes need to be examined.

For the purposes of clarity a brief overview of the history, sources, processes, and outcomes of change and the implications for dealing with it should be provided. This will be followed by the main factors that relate to the adoption or decisions to initiate change, and then by an examination of the extent to which changes actually occur and are sustained.

1.8 The history of educational change

Blenkin, Edwards and Kelly (1992:v) write that many attempts have been made to create conceptual frameworks for analysing and understanding the process of educational change, and that a number of different though related perspectives have been offered. They add that such attempts have revealed the conceptual complexities of educational change and that social change has far greater ramifications than might at first be recognised. Change processes are complex and they have an effect on – and are in turn affected by – many factors and conditions.

According to Hargreaves (2001) large-scale transformation was a failure at best, with evidence that the yield of transformation was miniscule by the early 1970s, and there was an absence of change at classroom level. Elmore (in Hargreaves, 2001) states that these models missed "… the complex process by which local curricular decisions get made, the entrenched and institutionalized political and commercial relationships that support existing textbook-driven curricula, the weak incentives operating on teachers to change their practices in their daily work routines, and the extraordinary costs of making large-scale, long-standing

changes of a fundamental kind in how knowledge is constructed in classrooms."

Therefore, great pressure on schools to adopt reforms for which they did not have the capacity has resulted in innovations adopted on the surface, as well as in alterations in structures, without any changes to the practice of teaching. Another major force for reform in the western world has been the movements for civil rights in the 1960s, pointing out scores of inequalities, and the education system was thought to be one of the major societal vehicles for reducing social inequality. In the 1980s a renewed interest in large-scale reform was evident, and in the 1990s the reasons for reform were the increasing complexity of the global society, diversity and a need for continuous learning.

1.9 Factors influencing decisions for change

Hargreaves (2001) states that change is a process, and not an event. This is experienced by the fact that whatever happens during one stage of the change process strongly affects subsequent stages, and that new determinants also appear. This poses the question of what some of the main factors of change are, and how these factors influence the process at each stage.

The eight factors that affect the initiation of a new innovation are the following:

1. Existence and quality of innovations: these exist in great numbers, but the two main issues to be addressed in this regard are firstly what innovations are in place, and secondly the quality of the new programmes.
2. Access to innovation: this refers to the selectivity that occurs as a result of differential access to information.
3. Advocacy from central administration: change rarely occurs without an advocate. The important role-players here are administrators and principals.
4. Teacher advocacy: the fact has emerged that teachers do innovate, and are preferred sources of ideas.
5. External change agents: these come from regional, state or national roles.

6. Community pressure/support/apathy: some communities support innovation and others block it. The point is that communities can instigate change.
7. New policy and funds: major educational initiatives are generated through government policies and funds.
8. Problem-solving and bureaucratic orientations: schools adopt many programmes, and districts need to act in a problem-solving and capacity-building way, and not in a bureaucratic manner.

Hargreaves (2001) writes that the list is not exhaustive, but that it does attempt to point out that innovations are initiated from many different sources, and for many reasons.

The same author also identifies the factors affecting continuation. He states that a large part of the problem of educational change is not so much a question of dogmatic resistance and bad intensions, as an issue about the difficulties related to planning and coordinating a multilevel social process involving thousands of people, as well as real change that has to take place to reach all of the objectives (Hargreaves, 2001).

It is of imperative importance for the success of the implemented programme that continuation should be considered in its own right. Berman and McLaughlin (in Hargreaves, 2001) have found that projects that have not been implemented effectively were discontinued. They found that the reason for discontinuation was very much the same as the reasons that influenced implementation. Added to this was a lack of interest from the central office. Huberman and Miles (in Hargreaves, 2001) have stressed that change needs to be embedded into the structure through the timetable, the budget, the policy and so forth.

With regards to the significance and meaning of change, Hargreaves (1994) also states that the nature of teaching has changed profoundly over the years. He

contends that there are needs of special students to be met, constantly changing curriculum programmes, and increased pressure for reform, more diverse assessment strategies, and more extensive teacher responsibility. He asks what the significance of these changes are, and concludes that there are two broad contending explanations namely:

- Professionalisation: which emphasises that the struggle for, and in some cases, the realisation of greater teacher professionalism through the extension of the teachers' role. Teachers are portrayed as having more experience in school-wide curriculum development, and in these accounts, teaching is becoming more complex and more skilled.
- Intensification: this line of argument is derived from Marxist theories of the labour process, and highlights a major trend towards the deterioration and de-professionalisation in teachers' work. In these accounts, teachers' work is portrayed as becoming more routine and deskilled; more like the degraded work of manual workers and less like that of autonomous professionals trusted to exercise the power and expertise of discretionary judgment in the classroom.

In the work of Apple (1986), intensification is evidenced in the fact that teachers' work is growing dependant on externally produced and imposed apparatus of behavioural objectives, for example in-class assessments, classroom management technologies, and accountability instruments. He states that this has led to a proliferation of administrative and assessment tasks that lengthen the teachers' day, and eliminates opportunities for more creative work. There is indeed a strong case for the intensification thesis, as Apple (1986) also states that "… the increasing technicization and intensification of the teaching act … [is] misrecognised as a symbol of their professionalism."

1.10 Outline of the chapters

Chapter two: Literature review

In this chapter I review the literature available on curriculum development as well as professional development of teachers. This review examines these two notions in an international as well as in a South African context. The chapter also contains a review of the development of literature on the concept of action research.

Chapter three: Research methodology

This chapter offers a review of the paradigm of critical research that informs the study, followed by an examination of the approach used in this study, known as action research. It also examines the methods of obtaining data, as well as the framework of analyses utilised in the study.

Chapter four: Data and analysis

Data gathered from research and the analysis of the data is presented in this chapter. The contents consist firstly of a brief overview of the context and background of the study, and secondly of the profiles of the educators that participated, as well as their reasons for participating. Thirdly and finally the process of workshops and the enactment of the curriculum resource are examined.

Chapter five: Data analysis

The data produced related to implementation of the programme, experiences of doing fieldwork as well as interviews related to curriculum and professional development are presented and discussed by way of various analytical frameworks presented in chapters 3 and 5.

Chapter six: Conclusion

The concluding chapter provides a summary of the study, and makes recommendations, based on the key themes emerging from the study, for further research and possibilities of more effective methods of professional and curriculum development.

CHAPTER 2

Literature review

2.1 Introduction

The purpose of this chapter is to provide an overview of research into the fundamental aspects related to this study, namely the role of learning support materials and the impact of these on the activities of teacher learning and curriculum development. To achieve enlightenment on these topics, it is necessary to touch upon the role of learning support materials within the realm of curriculum and teacher development. In this regard, the Norms and Standards for Teacher Education (1996) have indicated the following:

> ' … there should be coordinated and sufficient initiatives to ascertain that role players including teachers are equipped with the necessary information, knowledge, insight and skills required for them to take a meaningful part in curriculum development …'

Policy statements like these express and highlight the need to involve teachers in ongoing materials and curriculum development processes. It has emerged that the involvement of teachers in curriculum development was a direct result of further policy documents that indicated a decentralisation of many school activities and the surrendering of functions to local control. However, these changes require new kinds of behaviour from the professionals who staff the schools with new roles – roles which have hitherto not been afforded to them.

These initiatives were implemented in reaction to, and in a context determined by the historically top-down educational approach in South Africa, characterised by the RDDA methods of experts developing materials in isolation from end users and classroom realities. Concerning this approach Ayers (1992), states that ' …

schools and school systems turn teachers into clerks. Curriculum is the product of someone else's thought knowledge, experience and imagination. It becomes something developed out there. The teacher takes the package and hands it to the students. Everyone is passive, everyone is a consumer, everyone deficient and dependant.'

As a result, most of the teaching corps has been found lacking in what Marsh et al. (1990) term general skills, that is skills like decision-making abilities, group processes, collaboration with peers, and the assumption of leadership roles. However, a contentious issue has arisen from the centralisation-decentralisation debate, namely which structures should design a curriculum. In South Africa deliberate polices of decentralisation have been adopted, encouraging schools to engage in teacher-driven and school-based curriculum development.

A cursory glance at the concept of school-based curriculum development reveals that it can literally be described as involving decentralised decision making or devolution of control: all educational decisions are made at an individual school level (Marsh et al. 1990). Skibeck (in Marsh et al. 1990) defines SBCD as ' … the planning, design, implementation and evaluation of a programme of students' learnings by the educational institution of which those students are members.' As there are many contending definitions of SBCD, a single definition can not do justice to the many permutations in schools (Marsh et al. 1990). A significant feature of these practices, though, is the central involvement of practitioners in voluntary processes.

In view of this it can be argued that drastic reform programmes, such as those proposed in South Africa, will require teachers who can involve themselves in the change process with investigative enthusiasm for experimenting with alternative models of teaching and learning, including curriculum development. However, a strong call for teacher participation in curriculum development in South African

policy documents has found a mostly disempowered teacher corps.

Part of the solution for this state of affairs could be that both teachers and schools need to experience a shift from centralised curriculum development to more localised processes. Hargreaves and Fullan (1992) also suggest that this necessitates the organisation of professional development activities for teachers.

In this study it was attempted to introduce teachers to experimentation with some of these alternative models of teaching and learning by presenting them with effective learning support materials. The goal of these learning materials was dualistic in the sense that it may encourage efforts from the teachers to engage in curriculum development, as well as implementing a process of professional development.

2.2 Changes in science education

It is evident from recent literature that there has been a concerted effort to reform science education (van Driel, Bejaard & Verloop, 2000). It appears that the reform efforts in different countries share some important characteristics that are apparently related to dissatisfaction with how science is traditionally taught. Generally speaking, lectures mostly seem to convey science content as a rigid body of facts and rules to be memorised, with technical training for acquiring practical skills. Research on learners exposed to this approach often end up with a poor understanding of scientific concepts. Moreover, it is felt that science education in its traditional form has become outmoded, and that it does not adequately prepare future citizens to understand science and technology issues in a rapidly evolving society (Millar & Osborne, 1998).

In an attempt to change this situation, a series of influential publications in the United States like the AAAS and NRC (Van Driel, Bejaard & Verloop, 2000) has

advocated a nation-wide reform of science education, with the following aims:

- to achieve scientific literacy as a central goal of science education, with a focus on understanding the nature of science by studying the history and philosophy of science;
- excellence and equity for all learners;
- the premise that science is an active 'hands-on' process;
- to focus on inquiry as a central element of the curriculum, with the understanding of scientific concepts along with reasoning and thinking skills.

In South Africa most of these aims are echoed in the RNCS (2002) for natural science when it states that the purpose of the natural science learning area is the development of science process skills, which constitutes the development of a variety of forms of reasoning from the learners' point of view (and the building blocks for constructing suitable learning tasks from a teaching point of view), as well as the development of scientific knowledge and understanding. Scientific knowledge and understanding should also be used to enquire and answer questions about the physical world. Careful selection of science content and use of a variety of ways of teaching and learning science should promote an understanding of the history of science, among other concepts.

The learning area Natural Sciences has three outcomes that learners have to achieve. Each outcome has associated assessment standards which distinguishes the level of the outcome from one grade to another. The three learning outcomes for the Natural Sciences learning area as stated in Department of Education (2002:6) are:

Learning Outcome 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and investigate relationships and solve problems in scientific, technological and environmental contexts.

Learning Outcome 2: Constructing Science Knowledge

The learner will know and be able to interpret and apply scientific, technological and environmental knowledge.

Learning Outcome 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

The activities in the SWAP kit offer first-hand encounters with the environment, and encourage action to respond to risks and issues related to water quality. These kits also enable students to become familiar with basic scientific tests, and to learn skills related to scientific investigations by using scientific skills and tests. This links directly to Learning Outcome 1 for Natural Science, as described earlier.

The tests conducted by means of the SWAP kit provide evidence of the conditions of rivers and catchments and also enable learners to make judgments about water quality. The data and information developed are used to make inferences and develop ideas about water quality. This again represents a link to Outcome 2 for science.

Furthermore The SWAP kits also lend itself to discussions about the socio – political aspects of rivers. The information developed from data and discussed can be taken further in subsequent discussions. The kit also allows teachers and learners to discuss social, political and environmental factors that influence the chemical, biological or physical nature of the water quality. This could include

looking at issues of management and equitable distribution of the water resource which in turn could lead to discussions on issues of power, economic and social concerns and their relationship to each other. This is supported by De Lange and van Zyl:

> 'that SWAP can support teachers to mediate true critical investigations challenging hegemonic social structures and thinking styles.' (p. 28 van Zyl).

The Swap kit addresses both the educational aspects as well as the socio-political aspects within the classroom.

2.3 Learning support materials

The learning support materials used in this study was the Schools Water Project kits. Having started as one of the projects of the Environmental Education Programme of the University of Stellenbosch (EEPUS) early in 1992, SWAP is a low-cost water quality monitoring resource kit that was developed from the original Global Rivers Environmental Education Network (GREEN) kits in America. These kits include 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's guide and A1 poster-size pro formas for data recording. SWAP was developed as an environmental education resource for teachers and learners in schools, but has also found application in community-based projects and adult education programmes in various contexts.

SWAP kits and activities have proven to be useful tools for understanding the construct environment, an important aspect of environmental education, which is a central focus in the revised National Curriculum Statement. Results from the tests provide evidence about the conditions of rivers and catchments, and also enable learners to make judgments about water quality. By means of these tests learners discover the symptoms of polluted water. This often leads to debates

about possible causes of the problems. Such discussions have proven useful in developing an understanding of the construct environment as interaction between human activities and the biophysical environment. SWAP kits instigate first-hand encounters in the environment and encourage action in the form of responses to risks and issues related to water quality. The kits also enable students to become familiar with basic scientific tests, and to learn skills related to scientific investigations by means of the tests. The tests conducted with the SWAP kits therefore provide opportunities for learners to progress towards achieving Learning Outcomes 1-3 for Natural Sciences through active learning encounters as described above.

A literature review on learning support materials indicates that these resources play a major role in teaching and learning. This is pointed out by Russo and Lotz-Sisitka (2003:15): they state that these materials provide a framework for guiding teaching and learning interactions, as well as a structured framework for planning and implementing learning programmes.

Kesedou and Roseman (2002:522) agree, adding that '… teachers often come to depend on them for some or all of their content and pedagogical content knowledge.' From this it can be argued that well-designed materials can function as a means of promoting effective teaching and learning, and also that the design and production of learning support materials can be an integral part of curriculum development.

According to Russo and Lotz-Sisitka (2003:15) a myriad of resources used by teachers can be seen as 'materials'. These would include learner work-cards, computer programmes, work books, text books, teacher guides, booklets, as well as non-standard materials like slides, overhead transparencies, science kits and posters. In support of this, Adler et al. (2003:54) point out that reflective and critical teaching practitioners draw on a wide range of additional resources (material and socio-cultural) besides the chalkboard and learners' class work

books and prescribed text books to create a rich mathematical, scientific, linguistic and social environment for learners.

Upon investigating who the producers of these learning support materials are, it was found that the link on the Western Cape Education Department's website (WCED, 2002) concerning learning support materials states that it is not only the exclusive domain of publishing houses and educators to design and produce these materials. On the contrary, the same website states that entities responsible for the design and production of learning support materials may include among others:

- commercial publishers, formal support material committees that is structured on a provincial or regional basis,
- informal support material committees such as
    a) teacher centre working groups,
    b) voluntary teacher groups,
    c) subject interest groups, and
    d) NGOs.
- knowledgeable individuals in the community,
- support material committees within schools,
- the teacher in the classroom,
- the products of the learners, e.g. projects, reviews and notes, and finally
- the possible input of parents.

This approach specifies a way in which learning support materials are designed and produced that indicates a stark contrast to methods of the past that was usually characterised by subject experts creating packages of knowledge in isolation from the school and classroom, all within a strictly top-down bureaucratic system. However, Russo and Lotz-Sisitka (2003:9) argue that the assumption that materials development should be the concern of only the 'experts' in the field – who decided what had to be included in materials and how

these are to be used – is still evident today.

The approach that learning support materials should be developed by experts and then circulated to schools where they have to be implemented, has been described as being in line with the RDDA (Research Design Disseminate Adopt) approach by Robottom in Russo and Lotz-Sisitka (2003:9). Despite the fact that the RDDA approach has been criticised for social engineering, it should be pointed out that it remains the most cost-effective and time-effective approach (Russo and Lots-Sisitka 2003:9).

According to Russo and Lotz-Sisitka (2003:9-10) approaches that foster greater participation by educators are in response to the RDDA-dominated material development programmes. They further observe that the rationale offered for development of more participatory methods of material design, is that existing methods make for a lack of continuation, thereby imposing fixed ideas that do not allow an approach that is responsive enough for the changing contexts, or for learners' needs.

Several advantages associated with a more participatory approach to materials development is identified by Russo and Lotz-Sisitka (2003:10), which include;
a) the design and production of germane materials that are more in keeping with learner needs, and that are more responsive to contextual factors, and
b) the fact that involvement in such development processes is extended to engage many more people in such practices.

A recent development to combine the expert-driven RDDA approach with participatory approaches has emerged according to Russo and Lotz-Sisitka (2003:11). This development was in response to some of the pitfalls associated with an overemphasis on participatory design, especially in terms of quality and purpose, as well as in terms of the use of the learning support materials. They point out that greater participation in the development process is time-

consuming, and often leads to issues concerning the integration of differing viewpoints without compromising the focus of the materials (Russo and Lotz-Sisitka 2003:10).

According to Russo and Lotz-Sisitka (2003:30), when materials are developed 'with people rather than for target groups', a sense of ownership is encouraged, and the materials would most likely be used more extensively and characterised by being more related to the needs of the teacher. They also stress that it will be advantageous to engage in a collaborative process by means of interactive discussion when developing materials, since teachers then develop a greater understanding of the issues being considered.

Russo and Lots-Sisitka (2003:24) argue that due consideration should be given to the context where the learning support materials will be used when developing these materials. In view of this, they note that the materials development process often do not consider the manner in which the materials are actually incorporated into teaching and learning situations. In support of this statement the problems presented by the 'commodification' and 'trivialisation' of learning support materials are cited.

The problems of 'commodification' on the one hand point to the overemphasis of learning support materials as 'objects' or 'commodities', with the neglect of the critical relationship between product and process, while 'trivialisation' on the other hand is defined as a lack of clarity, presented by the materials, on how the learning process occurs, as well as a lack of reflexivity in consideration of the role of the learning support materials in the learning process (Russo and Lotz-Sisitka 2003:11-13).

Materials that are indiscriminately 'adopted' without consideration for the context of their use, and the resulting selection of 'easy' materials that might lead to inappropriate and poor learning, is regarded as further evidence of a lack of

reflection on how materials are actually used to effect learning. For the reasons described above, Russo and Lotz-Sisitka (2003:11-13) argue in favour of a preference of the use of research-based learning approaches, demonstrating ongoing reflexive research into how learning support materials can support (environmental) learning, with an emphasis on approaches that involve the adaptive uses of learning support materials in context.

Russo and Lotz-Sisitka (2003:18) conclude in their support for continuous research into materials development that such studies form an integral part of the process of developing learning support materials, indicating how the materials correspond to the 'bigger picture' and its related context, and that these studies could contribute valuable insights into learner needs and the content of the materials.

In this study the terms 'learning support materials', 'resources', 'text', 'text books', and 'curriculum materials' have been used interchangeably with reference to text materials used in teacher-learning situations. This investigation has regarded learning support materials as the impetus for teacher development, and assumes that the process of professional development for teachers in turn will ultimately lead to teachers engaging in the process of curriculum development. The learning support materials used in this investigation was the Schools Water Programme (SWAP).

2.4 Curriculum development

Different concepts of curriculum have emerged from both theoretical and practical perspectives in the literature. A common feature, though, is that curriculum is central to the education process and includes the sum of the teaching and learning activities provided by schools. How we see curriculum and curriculum development directly shapes and influences our practice, so we regularly need to think about what underlies our ideas. Our reasoning and practice are never value-free or neutral.

On the topic of developing the curriculum, Stenhouse (1975) regards it as vital that individual teachers should accept a research and development role in respect to the curriculum by modifying, adapting and developing it to suit the needs of individual pupils and a particular environment. It is thus a significant feature of this sort of approach that individual practitioners should be involved in a voluntary process of curriculum development, which brings one to the issue of centralised or decentralised decision-making in terms of curriculum.

In this regard South Africa has adopted a deliberate process of decentralisation, and encourages schools to take a greater part in decision making. Recent policy documents have noted that individual schools and teachers should be given the autonomy to develop curricula to meet their particular classroom needs, and that curriculum development should be teacher-driven and school-based (Reddy, 2000). In view of these facts one of the aims of this investigation was to employ analytical frameworks to ascertain the extent to which teachers have engaged in the activity of curriculum development.

The first framework for analysis of the data generated by this study in terms of curriculum development by teachers was a model that emerged from research by Boomer et al. (1992:1), who present an ongoing international conversation about the theory and practice of curriculum negotiation in the classroom. It is contested that all developed countries face complex global, cultural, economic and ecological challenges, and to meet these challenges educators need to go beyond basic learning that is mostly offered by means of traditional methods. It is becoming increasingly evident that teachers must forge liberal relations with learners to facilitate methods for developing critical, enquiring and flexible minds.

During the late 1970s Boomer and Cook worked on the shifting images of the traditional educational bureaucracy and the classroom teacher as consultants, agents of change, and curriculum developers. Discoveries were made through

their action research networks, and it was essential that these facts were to be made accessible and useful to teachers. As a result, their work became widely used templates or guides for a range of teacher enquiries and system-wide work in curriculum development (Boomer 1992:1).

In the late 1970s it had become fashionable in Australian schools to produce language policies across the curriculum. The author was of the conviction that these policies would be ineffectual if they were not to be embedded in the whole school by making changes to its administrative structure, its curriculum, and its educational philosophy. He wanted to explore an issue that went behind a language policy, to the eternal educational triangle, namely teacher, child and curriculum. To clarify this issue, he explored different ideas on how to negotiate the curriculum (Boomer 1992:4).

Boomer (1992:4-5) starts out by asking entire school staffs the question "How do children learn?" adding, "Under which conditions do children learn most effectively?", and "Do we all learn in the same way?". Coupled to questions like these the author explores the first notion on navigating the curriculum which relates to *learning theory*, emerging in his terms as stating one's best-educated understanding of how people come to internalise new information or to perform new operations. The author states that the importance of formulating a learning theory is that if we are able to formulate our theory, it should be presented to the learners in terms that they might understand, so they can try it out to see if it works in helping them to learn. From joint evaluation the theory can be modified and tried again. The result of this process will then be that teachers and learners will be able to collaboratively build learning theories.

In a further concept related to learning theory, Boomer (1992:5-6) refers to education as an almost self-perpetuating chain of subjections. He contends that the education system is subject to the ingrained educational myths of society; teachers are subject to the myths of the system, and learners are subject to

teachers who choreograph all the myths in subjects. In addition to this he states that learning should be inseparable from curriculum theory, but curriculum theory is also shaped by the mythologies of a specific culture. Following from this it becomes evident that teachers who become learning theorists also need to become curriculum theorists. In making suggestions to break this chain the author further examines the remaining mythologies and theories at all levels, and then takes an alternative approach to navigating the curriculum.

While reflecting upon the problems that teachers encounter and the problems of gathering data in the classroom, Boomer (1992:6) examines the next notion on navigating the curriculum, which is the question of *power* relationships in classrooms, schools, systems, and within society itself. According to his research it became evident that, with a few exceptions, there seems to be a dyadic relationship in the classroom between the teacher and the learner, namely that the teachers, who are in control, define the knowledge that is to be transmitted to the learner, who is perceived as a passive receptacle. In his opinion there are no doubts as to the sincerity of the teacher that professes humanism, respect for the learner and democracy, but doubts, rather, as to the ability of these teachers to perceive the power vested in them.

The author contends that the outright autocrat may be less dangerous than the self-deluding humanist pretending to divest some of the power vested in him or her by giving learners a limited amount of decision-making opportunities. The crucial question posed by Boomer (1992:6-7) is "Are schools dedicated to the promotion of the child's power to learn, and ultimately to learn independently of instruction and guidance?" He answers this question by means of even more questions on why so much dependent learning in contrast to experimentation and inquiry is found in schools, and why fact is usually revered above principle.

The third notion explored by Boomer (1992:7) on navigating the curriculum refers to the *constraints* that teachers face, which are partly implied by the

aforementioned power relations long embedded by the feudal structures in schools as well as in the system. Examples of these are fragmented timetables, external examinations, larger classes, or a limited choice of commercially produced resources with an implicit behaviourist learning theory. Despite an array of cosmetic changes in the form of, among others, forty-minute lessons to one-hour modules, it seems to be difficult to effect real change.

Examples of change that teachers try to import, and the constraints faced, are numerous. Teachers who wish to change their role of examiners to that of collaborative evaluators are faced by constraints such as learners that have been conditioned for years into seeing the teacher as a judge, aggravated by attitudes from colleagues who do not share the same vision. The author goes on to say that radical changes are needed to produce a school context where exchange can flow between learners and teachers in the pursuit of action knowledge.

Another of the findings that emerged in the research conducted by Boomer (1992:7) is that a more equitable distribution of power, or a more healthy exercise of power, will not be possible while those in power monopolise the so-called talking space, thereby keeping other parties in relative ignorance. From this emerges the fourth notion on navigating the curriculum, namely demystification and the concept of open communication.

Boomer (1992:8) suggests that there are three important areas of action to be paid attention to in order to redress this imbalance:
- Strategies should be applied to all levels of the system and society. Politicians, administrators, parents, teachers and children should all be brought into discussions about how we learn.
- There will always be inequalities of power in schools and society, but the negative effects can be neutralised if those in power state clearly on which values, criteria and assumptions they base their actions.
- Real change will only be effected by means of collaboration on all levels.

He adds that this does not mean that teachers should delay action until they find support from their colleagues, but rather that they should talk openly with learners about their reasons for doing what they do, as well as how they think people learn, and the societal consequences of various behaviours.

Boomer (1992:9) examines the concepts of motivational learning in contrast to negotiated learning in his penultimate notion of curriculum navigation. The former is labelled as the traditional curriculum model, where the teacher decides to teach a certain programme after taking into consideration past experience, the content to be taught and the practical constraints of the school and the society. Motivation of some sort, where learners are led to intend following roughly the same direction as the teacher, will precede teaching.

During teaching of the curriculum unit tension and discrepancy exists between the goal of the teacher and the intent of the learner. At the end of the unit most learners will receive a grade for work done, sometimes externally decided, and this will give an indication of how close the learner have come the intentions of the teacher. The result of this approach is that it leaves a good deal of what has been learned unexamined or unevaluated, as the teacher or external examiner only tests what is set in the curriculum.

The other approach, known as negotiated learning, is labelled as one with a view to open communication and a personal learning theory with an awareness of the harmful effects of inexplicit power. In this case the teacher reflects, and comes to some non-negotiable conclusions about the basic content of the unit. The teacher next communicates openly to the learners the topic to be covered, regarding the reasons why it is to be included, why it is of importance, and what the constraints are that will be present. Initial communication also deals with the learners foreknowledge, how the teacher thinks new information may be learnt, and how the necessary tasks may be shared among the learners (Boomer

1992:9).

The teacher and the learners then plan the unit within the negotiable options in a collaborative manner, deciding on the goals, assignments and activities. The dualistic general aims here are firstly that the topic and central content are prescribed while the outcomes cannot be set down in advance and secondly, that learners do not move down a narrowly defined path, but rather explore the broad territory of the topic. Both the teacher and the learners carry out the process of reflection after the learning is done by using comparison as a vehicle for respect for quality and rejection of inferior work by those who did it (Boomer 1992:12).

The final notion that Boomer (1992:12) explores is the one on *quality*. In this he contends that the model for motivated learning is a recipe for the potential failure of many, and the model for negotiated learning to dynamic exploration and a rigorous pursuit of quality. The former relates to traditional whole class, and modern individualised-transmission teachers. The latter relates to clear-thinking, self-aware teachers. The author states that this kind of teacher does exist, and the characteristics that describe those best are that they uphold a philosophy of collaboration, theorise about practice, are able to compromise without capitulation, and that they do not fall prey to educational fads.

Boomer (1992:14) finally states that the implication of negotiating the curriculum is that learners should deliberately be invited to contribute and modify the curriculum, the result being a sharing of the commitment on the curriculum and finally a natural flow of negotiation. Learners will now also feel that they have a real investment in both the learning journey and in the outcomes. Cook (in Boomer 1992:15-16) shares some insights on this point, concerning the reasons for the necessity of negotiations, and also relates some answers from the viewpoint of learners on the question, "How do you learn best?"

Cook (in Boomer 1992:15) contends that negotiations share the same meaning

in education as it does in politics and industry, as parties come together to work toward outcomes that are to the satisfaction of all concerned. The focus in education is thus to bring about the best possible learning for learners. The key to negotiations lies in the principle of ownership: people tend to strive hardest for the things they wish to own, or to keep and enhance things they already own.

The author concludes that children and adults are both capable of being successful negotiators, and that teachers have been refusing to recognise the fact that learners are capable of the principle of ownership in practice. He thus stresses that negotiation is important, because negotiating the curriculum offers teachers the best chance of maximising the learning productivity of the classroom. The reason for this result is that learners will work harder and learn better when they are discovering their own ideas, asking their own questions, and making a real effort to answer these questions. It follows that out of negotiating comes a sense of ownership in the learners for the work they do, and therefore a commitment to do it and learn from it. Cook (in Boomer 1992:16-18) goes on to explore the most favourable conditions, from the point of view of the learner, for learning.

- Engagement, i.e. they learn best when they intend to learn, and their purposes are more important than those of the teacher. They need to know what they are to do and why. This develops a clear sense of direction. Internal motivation is more effective than external motivation, and curiosity needs to be peaked. New learning must relate to previous knowledge and as such should be relevant.
- Exploration, i.e. learning experiences need to be as individualised as possible with different starting points, interests and abilities to be taken into consideration. The teacher needs to open up a range of options for modes of learning. They need to be active participants in the process, and find out by trial and error. Small-group learning is the preferred base, allowing more flexibility and involvement. The teacher needs to be a

supporting facilitator, working with learners when they need it.

- Reflection, i.e. learners like to share what they have found, which is a method of testing themselves, while new questions, challenges and directions for further learning emerge.

A practical approach to classroom negotiation is then related by Cook (1992), stating four questions that represent a logical approach to tackling a problem:

1. What do we know already?
2. What do we want and need to find out?
3. How will we go about finding it out?
4. How will we know, and show, that we have found out when we have finished?

These questions have a wide application in the classroom and across the curriculum and also embrace the scientific method – problem, clarification, hypothesis, test, and conclusion. In conclusion the author notes that negotiation is not a separate process, but integrated into the whole learning process, with some of the work already done when all the questions have been considered. The central result of this process is that the learners own the work they do, that they know 'what', 'how' and 'for whom' they work, and that they believe that the best methods of achieving valuable learning are always in operation.

According to Cook (in Boomer 1992:27-30) natural consequences of the process of negotiation are the following:

- Time factor – the initial planning takes longer, but when this is done, work will progress faster.
- Across the curriculum – this approach is applicable to all ages.
- Role of the teacher – the teacher plays the roles of facilitator, coordinator and scribe.
- Wall charts – because this approach is learner centred, all the sources and products of the learning experiences must be available. Thus the

process, possibilities and conclusions must be made public. The use of a wall chart is beneficial here.

- Small groups – the basic unit of organisation must be the small group consisting of four learners. Optimal learning takes place when interaction is possible, and the discipline of negotiation acts as a safeguard against the excess of small group activities.
- The issue of when to use this approach – it is useful for planning a curriculum unit, but also for just a single period or activity.
- Constraints – acknowledge constraints, and meet and beat them.

The next logical step in this process, after using the approach of navigating the curriculum to programme learning as it was explained in the previous section, would be to map some parts of the exceedingly complex course of a curriculum in action, and to offer some strategies for evaluating the quality of the learning taking place.

Boomer (1992:32) states that teaching has always been a case of 'negotiating the curriculum'; analogous to the distant past when the captain of a ship had to make decisions on the course of a treacherous journey. The challenges to the teachers are physical environment, the set syllabus, available resources, school policies, learners and the general community. It is evident that each teacher needs artistry, experience, knowledge and his or her own reliable map in order to find the way.

From this it follows that a curriculum is no longer a pre-packaged course to be taken; it is a jointly enacted composition that grows and changes as it proceeds. A new definition of curriculum is needed, and new ways of evaluating it must be found. In the previous section Cook presented what learners say about their own learning, and Boomer (1992:33) developed a simplified series of steps that divide the picture of what naturally occurs when learners divide the intention to learn into five steps:

1. This learning sequence begins with a *challenge* of some kind which constitutes the first step.
2. After this the learners need to gather together and clarify what is already known by *defining the problem and gathering resources*.
3. The next step will be *seeking out further information* and *extending previous knowledge* by using strategies like narrowing the field of enquiry and shaping a hypothesis.
4. Step four entails *interim trials*, and eventually settling on a possible solution and putting it to the test by making errors, having success, modifying, consolidating and assessing.
5. The final step in the sequence is *learner reflection* on and *evaluation* of the success of the venture.

A curriculum model consistent with this learning model would also have five stages. The following section will deal with each stage and offer strategies for formal and informal evaluation (Boomer 1992:35-45).

Stage 1: Planning a unit of work
Teachers may find it useful to consider the following seven elements of a curriculum plan:
1. Content: this is the content that learners should explore. It is based on the teacher's knowledge of the learners and intuition of what would be worthwhile.
2. Justification of content: the aim is to decide what learners know, and to introduce new perspectives. Key questions to be addressed will be outlined. These questions provide the teacher with a philosophical framework, which will give purpose and direction to the learning activities.
3. Products: these are what the learners will be able to say and do as a result of their work. Unforeseen outcomes and learning are also included.
4. Skills and media: to achieve the planned goals, learners will have to

develop skills and use certain media.

5. Learning activities: these will be completed after negotiation. The teacher will suggest approaches and these will be modified in discussion. Constraints should be made clear.

6. Aids and resources: resources that may help need to be listed.

7. Methods of evaluation: teachers and learners will list the methods of evaluation to be used e.g. journals, comparison, formal tests.

In the process of planning the unit the teacher will also have in mind the criteria to judge success both during the learning process and in the outcomes. The following is a possible checklist of questions and strategies.

- Is the content justifiable in terms of challenging the learners experience and foreknowledge?
- Is it justifiable with respect to overall goals, aims and values?
- Does it provide opportunities for learners to contribute to detailed planning?
- Have all the constraints been taken into account, and are the goals achievable within the timeframe?
- Is the plan flexible?
- Does the plan allow room for individual learners to pursue a special interest?
- Are there sufficient resources?
- Will the culmination of the programme please the learners and stimulate further learning?
- Can the learners explore using a variety of media?
- Is the proposed process consistent with the learning principles?

Stage 2: Negotiating with the learners

The degree of negotiation will depend on the extent of collaboration to which the class is accustomed. If the class is new to this process, the plan will be discussed only and not altered, so that the learners can simply know what is

expected of them. If the class is accustomed to this approach, the teacher's plan will be introduced only as a tentative proposal to be discussed. The reasons for negotiating are that the learners are able to claim ownership of the tasks, and that they are led to intend earning from them. Questions will be asked on what the learners already know and what they need to know, as well as on what resources are available and what resources will be needed.

The responsibility of the teacher at this stage is to state the constraints and the non-negotiable demands. After consultation and explanation the teacher needs to draw up a structured programme that will be binding for all the learners. However, the plan should be subject to adjustment if it is not proving to be successful. Learners may at this stage contribute to the negotiation activities by:

- suggesting resources,
- deciding on extra goals,
- suggesting learning activities and sequencing,
- brainstorming possible methods for evaluation,
- arranging deadlines and contracts,
- suggesting modifications and extensions to the content, or
- contracting individually to follow an alternative programme in special circumstances.

Evaluation may follow the form of the following checklist of questions:
- Was the existing knowledge marshalled in such a way that the learners felt that the journey was worth making, and possible to make?
- Was the strategy to get the learners to accept the proposal successful?
- Did the learners have the opportunity to shape the course?
- Was a good decision made regarding the requirements for the learners that rejected or were indifferent to the proposals?
- Are the learners committed to the contract and are they aware of areas where modification needs to done if the plan is not working?

Some other strategies for finding answers are suggested, like informally observing the learners in and out of class to see whether they continue to talk about what is intended; inviting another teacher to evaluate using the set criteria; recording class interaction and reflecting on it later, and finally keeping a journal to reflect.

Stage 3: Teaching and learning

This is the stage where the programme moves from being a script to becoming a 'performance'. The role of the teacher is to facilitate and offer critical and constructive advice. The classroom should now take on the appearance of a workshop where various groups work on their problems. According to the learning process, this is the stage where the learners will be using media to find answers and practising skills to complete assignments. A checklist of questions follows:

- Are learners seeking and contributing resources?
- Are learners initiating questions and discussions?
- Are learners conducting in exchange of information?
- Are learners showing and teaching each other things?
- Are the learners coping with difficulties?
- Are they using different media?
- Are people outside the classroom becoming involved?
- Do learners have access to the teacher's experience?
- Are learners cooperating?
- Is there proof that learners are carrying out their ideas?
- Is the teacher teaching the whole class, small groups or individuals?

Strategies for answering questions are the following:
- asking the learners to evaluate this stage and suggest modifications,
- inquiring which of the above criteria is working for them, and
- asking a librarian to comment on the type of usage of resource material.

Stage 4: Performing

This is the stage where the learners test, shape and show what they have achieved and learned. The learners should show peer-to-peer disciplining, a growing intensity of concentration, asserting themselves with more immediacy toward the product, and a general absorbing into tasks by the learners. The role of the teacher is to be a critic, an advisor, and a general audience presenting the learners with how their work might be accepted in the world outside the school. A checklist for questions at this stage may be the following:

- Are the learners redrafting and revising to deliver a quality product?
- Do they 'own' their product in the sense that they are defending it or talking about it?
- Are they using their own time and doing the work quietly in an absorbed fashion?
- Are the learners electing appropriate learners depending on the circumstances?
- Are they experiencing frustrations, and are the learners seeking alternative strategies for coping?
- Can the learners accept the failure of a programme, and are they willing to start over?
- Is there a spirit of comradeship when giving or receiving advice?

Stage 5: Evaluating

This stage can be done through informal discussion and reflection as well as by means of a formal method of assessment. Questions can be asked about the 'journey', on issues like whether the class has achieved what it intended to achieve. Questions about the product, skills and use of media may include whether the products compare favourably to those made previously; which aspects are to be improved, and whether the products will be used and valued in future.

Questions about the knowledge acquired could be whether the learners understand the concepts or whether the learners can express what they know through different mediums; whether they are able to teach others the ideas and concepts they set out to understand; whether they can apply the concepts, and whether these can be compared to those of a similar group. Questions concerning attitudes will include whether they can articulate their own values and whether these are comparable to those of the school.

Issues regarding the products delivered may include allowing a wider audience to evaluate them, and reflecting upon the quality of the relationship between the teacher, the class and individual as well as the group.

This is the final checklist:
- Are the strategies helping me to become a more effective teacher?
- Are the strategies helping the students to become more effective learners?
- Which of the present strategies need modification?

A second analytical framework that was used for analysis of data generated concerning curriculum development by teachers, refers to a study done by Remillard (1999:315), to examine teacher's interactions with curriculum materials and whether these can contribute to reform in mathematics teaching; a model emerged that offers a framework for exploring teacher's curriculum construction activities.

The model delineates three areas of the curriculum development process:

1. the design arena that involves selecting and designing tasks,
2. the construction arena involving the enactment of these tasks, and

3. the curriculum mapping arena that determines organisation and content of the entire curriculum into which daily events fit.

The table below illustrates the organisation of her conceptualisation for reviewing curriculum development processes.

Figure 1: Overview of the three arenas and the relationships between them (Adapted from Remillard, 1999: 322) after Dharsy 2007
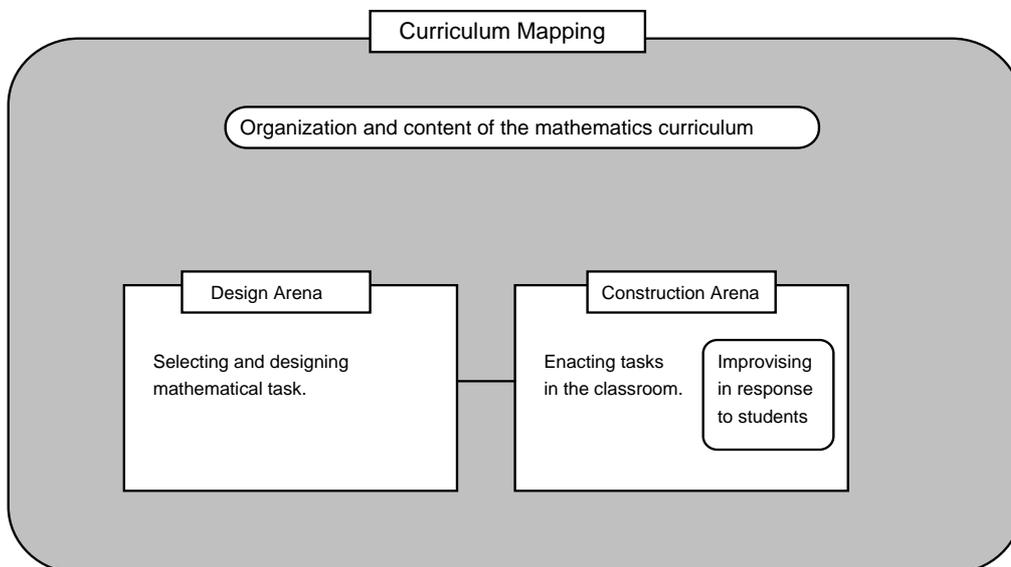
1. The design arena

This involves selecting and designing tasks for students. Remillard (1999:323) relates that a crucial component of a teacher's role in curriculum development is the process of selecting, altering and constructing tasks to present to the student.

Remillard (1999:323) also states that the choices of tasks represent the teacher's assumptions about content (what students should learn) and pedagogy (how they should learn it).

According to the author, teachers' task selection choices are influenced by their ideas about the subject, students, and their learning, as well as by the teaching context and available resources. The role that these factors play is illustrated in the different approaches of the two participating teachers in using their text books (Remillard 1999:323).

The first factor that has an influence on task selection are the two approaches to task selection used by the participating teachers, namely those of appropriating tasks and inventing tasks. Appropriating tasks takes place when tasks are taken from the resource in their original form by means of a process of selecting certain tasks to present to the learner, while inventing tasks takes place when teachers use the text of the resource as a source, adapts it, and invent their own tasks (Remillard 1999:323-324).

The second factor identified by Remillard (1999:324-325), is that of the different readings of the text book by teachers. The author relates that the different approaches to task selection can be traced to the different ways of reading the text, since they attended to some parts of the text and dismissed others, and that they read similar suggestions for different purposes.

The third factor that impacted on the selection of tasks was the role of the teaching context, in the sense that professional development opportunities supported the one teacher's approach of using her own textbook as well as that of the other teacher (Remillard 1999:327).

The final factor playing a part in the selection of tasks was observed as the role played by the textbook. The author concludes that certain characteristics of the textbook, for example the design for choice of a range of activities, may have facilitated the variation in their readings (Remillard 1999:327-328).

2. The construction arena

This is the second arena of curriculum development, in which teachers and learners transform planned tasks into actual classroom events. This arena comprises all interactions in the classroom, planned or unplanned, that influence, shape, or contribute to the enacted curriculum (Remillard 1999:328).

A central activity of the construction arena is *task adaptation*. This is defined as the unrehearsed adaptation and adjustment of tasks in order to facilitate students' work for them. In this respect she points out that the nature of any change requires teachers to operate without familiar routines. The reason for this is that when the concepts and skills presented in the text book are unfamiliar, the teachers cannot anticipate and plan for learners' responses. The result is that teachers tend to rely on ongoing assessments of learners to guide their activities in this arena. Furthermore, Remillard describes patterns in the teachers' task enactment and adaptation process. Enacting tasks include two types of activities:

a) *reading learner's performances* and the tasks in which they are engaged, which entails observing and listening to learners in order to assess their understanding, and
b) *improvising in response*, which entails a process of responding to learners' encounters with the tasks by engaging in on-the-spot curriculum construction (Remillard 1999:329-332).

3. The curriculum mapping arena

The design and construction arenas involve the day-to-day decisions that directly impact the enacted curriculum. They exist within a third analytical realm, the curriculum mapping arena, which involves decisions that effectively define and organise the curriculum as a whole and determine the content, sequence, and timing of its topics. Teachers' decisions that shape their curriculum maps, Remillard explains, go unnoticed because they are often by-products of decisions concerning daily classroom events in the other two arenas. According to the

author the teachers map the curriculum when they decide how or whether to use these materials. An example of this might be that a teacher may skip certain parts, spend twice as long on it, or combine it with another topic. She also notes that this arena is less distinct than those of the other two (Remillard 1999:333-334).

After an analysis of the teachers' mapping decisions Remillard (1999:334) suggests two categories of decisions in terms of curriculum mapping, namely

a) topic determination, which entails decisions concerning the broad categories or topics into which the (mathematics) curriculum is divided, and
b) content determination, which refers to teacher's decisions about specifying the concepts or skills addressed by a given topic, the sequence in which they are taught, and the amount of time devoted to each topic.

Remillard's (1999:336) model of teachers' curriculum development concludes that teaching is multidimensional, and that, since each dimension requires different types of decisions, teachers are likely to use text books differently in each arena. Other issues highlighted are the unique demands that the construction arena places on teachers, emphasising its responsive nature and its dependence on how learners encounter and learn (mathematics). This model thus illuminates the multiple dimensions of teaching, emphasising that learner's encounters with a new curriculum are mediated by a range of teacher's decisions, evolving from a complex interplay between the teacher's reading of the text book, the learner's performance, and the beliefs of both about teaching and learning

2.5 Professional development

Data interpretation was done in terms of frameworks developed from other studies and these will be discussed briefly to guide the analysis process. The framework used for examining the concept of teacher development in this study

refers to research done by Bell and Gilbert (1994:483), which states that the concept of teacher development involves professional, personal and social development. They contend that many teachers experience frustration in the sense that they feel unable to use new teaching activities to improve the learning of their students, despite attending in-service courses. They state that many teachers may develop a cynical view toward new initiatives and professional development, and it is therefore necessary to raise the issue of how to organise teacher development programmes in order to support change.

In an overview on research into learning in science education, one of the main implications are that the roles and activities of the teacher in the science class have changed from transmitting a body of scientific knowledge to learners regarded as empty vessels waiting to be filled with knowledge, to helping learners to develop their own conceptions while taking into account the learners' thinking, and facilitating this conceptual development (Bell & Gilbert 1994:483).

According to the model for teacher learning presented by Bell and Gilbert (1994:484), it is possible to identify three main types of development for teachers and their related phases, namely professional, personal, and social development.

Table 1: An overview of teacher development (after Bell and Gilbert (1994:485))

PERSONAL DEVELOPMENT *attending to feelings*	PROFESSIONAL DEVELOPMENT *developing ideas and actions*	SOCIAL DEVELOPMENT *developing collaborative ways of relating to other teachers*
Stage 1 Accepting an aspect of teaching as problematic	Stage 1 Trying out new activities	Stage 1 Seeing isolation as problematic
Stage 2	Stage 2	Stage 2

Dealing with restraints	Development of ideas and classroom practice	Valuing collaborative ways of working
Stage 3 Feeling empowered	Stage 3 Initiating other development activities	Stage 3 Initiating collaborative ways of working

Part of the initial phase of *personal development* was that the teacher was aware and accepting of a professional dissatisfaction or problem. Teachers in the Bell and Gilbert (1994:485) study commented on reasons for joining the programme as that they were not reaching every learner in class, and that the learners were sometimes lethargic, with information just coming from the teacher with the class not being engaged.

The first phase of *social development* emerged from the feeling by teachers that the isolation in the classroom was problematic. Teachers were in varying degrees seeking to work with other teachers (Bell & Gilbert 1994:486).

The goal of the first phase of *professional development* was to encourage the teachers to adopt the role of teacher-as-researcher. Activities given to the teachers helped them to find out more about their students' thinking, and while engaging in being researchers, they were clarifying a problematic aspect of their teaching. The programme also helped teachers to clarify their existing ideas on teaching, the role of the teacher, learning and learners (Bell & Gilbert 1994:486-488).

The second phase of the *personal development* of the teachers involved dealing with, among other things, the feelings and concerns of behaving differently in the classroom. One of the components that were of concern to most of the teachers was their relationship with the learners. Most teachers wanted to be liked by their learners, but also respected professionally. Feelings associated with the change

in the relationship was reported as positive, as the learners were saying that the teacher is more on a par with them now (Bell & Gilbert 1994:488-490).

The second *social development* in the continuation of the programme emerged through the fact that teachers were more likely to share information with colleagues, and valuing collaborative ways of working (Bell & Gilbert 1994:490). The second *professional development* was characterised by the teachers' continuing development of their ideas about science, science education, and developing their classroom activities. The teachers were reflecting on their classroom actions, both in terms of what works in the classroom and whether the actions matched their new theoretical ideas (Bell & Gilbert 1994:491).

The third phase of the *personal development* of the teachers was that they indicated that they were feeling more empowered to be responsible for their own development. This personal development had enabled more skills in them, like becoming more involved in staff debates, school management, policies and draft curricula. One of the teachers in the study commented that he was regarded as an expert because he had participated in the programme (Bell & Gilbert 1994:492-493).

The third phase of *social development* saw the initiating of relationships with other teachers outside the programme time. For example, when one of the teachers encountered a problem, she asked other teachers to work collaboratively with her on the problem. In the final phase of *professional development* teachers took initiatives to continue their development after the programme by doing some form of curriculum development or by facilitating development programmes themselves (Bell & Gilbert 1994:493).

In retrospect at the completion of the programme presented to the participating teachers, some conclusions on the effectiveness of the programme was drawn by using the framework (identifying features of an effective professional

development programme) proposed by Garet et al. (2001:916). In their investigation the authors note that teachers are at the centre of reform initiatives imported by policymakers and educators. For this reason the qualifications and effectiveness of teachers are of utmost importance to the success of reform initiatives.

However, in shifting to a more balanced approach to teaching, where there is more of an emphasis on how learners come to knowledge and a deeper knowledge by teachers on the understanding of subject matter, it has become evident that teachers are lacking. The reason for this is that many teachers learned to teach using a model that focuses on memorising facts, without an emphasis on a deeper understanding of subject knowledge.

Garet et al. (2001:919-920) propose some ideas on the effectiveness of a professional development programme, and provide a framework relating to features of an effective professional development programme. Their ideas have influenced and served as a reference for this study, which will be elaborated on in chapter five. They have highlighted certain 'structural features' and 'core features' in their model of professional development. The structural features entail:

1. the form of the activity; where they contend that the most criticised approach is known as the 'workshop', that usually involves an outside expert and a participant, who attend at scheduled times after school hours. In contrast to this approach, 'reform' types of professional development, such as study groups or mentoring and coaching, are gaining popularity. These efforts often take place during the school day, and are more likely to make connections with classroom teaching than traditional forms of professional development programmes.

2. the duration of the activity; here recent literature states that professional development should be sustained over time that will provide for more in-depth discussion of content and pedagogical strategies.

3. the degree of emphasis on collective participation; a growing interest has emerged among teachers to invest time in professional development designed for groups within the same school, fostering collaborative discussions on skills, concepts and problems that arise during their professional development experiences. It also appears that teachers from the same school are more willing to share curriculum materials, and by focusing on the same school, professional development may help to sustain changes over time (Garet et al. 2001:920-923).

The authors also examined three core features of professional development activities:
1. the degree to which the activity has a content focus; the content covered in professional development programmes varies in terms of the relative emphasis placed on subject matter, the specificity of the changes in teaching practice, the goals for learning, and the ways of learning.
2. the extent to which the activity offers opportunities for active learning; these opportunities may take a number of forms, such as observing an expert teacher, to be observed and obtain feedback, and planning how new curriculum materials and teaching methods will be used in the classroom.
3. the degree to which coherence in teacher's professional development is promoted; a frequent critique from teachers concerning professional development programmes is that the activities are disconnected, and thus do not form part of a coherent programme (Garet et al. 2001:923-929).

In the final part of the research, the authors note teacher outcomes, which are self-reported increases in knowledge and skills, as well as changes in classroom practice. Concerning teacher knowledge and skills, the teachers were asked to which extent their knowledge were enhances in certain areas, among others
 a) curriculum,

b) instructional methods,

c) approaches to assessment,

d) use of technology in instruction (e.g. computers, graphing, calculators), and

e) deepening knowledge of the subject.

In terms of changes in classroom practice the teachers were asked to what extent they made changes in the following domains:

a) curriculum content of their subject,

b) cognitive challenges in classroom activities,

c) types or mix of assessments to evaluate, and

d) ways in which technology is used in instruction (Garet et al. 2001:929).

 The implications of the findings of this study is firstly that professional development sustained over time, based on collective participation and the coherence of development activities, is more likely to have a significant impact on teacher development, and secondly that development focusing on subject matter and content, giving teachers a 'hands-on' opportunity for work, integrated into the daily life of the school is more likely to enhance knowledge and skills (Garet et al. 2001:935-937).

These ideas were considered in this investigation as an analytical framework and guidelines for the research approach and planning.

CHAPTER 3
Research Methodology

3.1. Introduction

This chapter aims to clarify and justify the particular research design used for this enquiry. Terre Blanche and Durrheim (2006:36), maintain that a research design is a strategic framework for action that serves as a bridge between research questions and the execution or implementation of the research, adding that in research observation is planned and guided by concrete research questions as well as the research design. The researcher seeks to draw coherent and plausible conclusions from observations, and plans observation in such a way that it will fulfil the purposes of the research. Decisions regarding the choice of the research design were informed by the research question, and the nature of this investigation.

In developing the research design, a series of decisions were made in accordance with the four dimensions of research design identified by Terre Blanche and Durrheim (2006:37):
1. the purpose of the research,
2. the theoretical paradigm informing the research,
3. the context or situation in which it is carried out, and
4. the research techniques employed to collect and analyse the data.

The main focus of this chapter is the theoretical paradigm that informs this study, and the research techniques employed to collect and analyse the data. It further explores measures adopted to ensure the validity of the study, as well as ethical considerations adhered to in this enquiry.

3.2. Theoretical Paradigm

The key point about a paradigm, as identified by Kuhn (1970), is that it is a source of guidance for conducting and evaluating educational research that is consensual within a particular scientific discipline. In terms of research, Hitchcock and Hughes (1995:16) note that paradigms can be described as "some basic principles and foundations, which have developed and evolved over a long period of time. These background assumptions have come together to create different models of social and educational research".

In support of this view Durrheim and Terre Blanche (2006) state the following:

> "... the background knowledge is what researchers make sense against regarding their observations. Background tells us what exists, how to understand it, and most concretely – how to study it. In the social sciences such background knowledge is called paradigms".

The theoretical paradigm informing this study was largely interpretive in nature, with research methods that seeks to capture 'thick descriptions' (Geertz, 1973) of qualitative data. Data were collected during workshops via semi-structured questionnaires, observation of teachers' activities during workshops and school visits, focus group interviews and discussions at the workshops, as well as during semi structured interviews. Activities completed by learners were assessed as artefacts to serve as evidence of curriculum development.

When defining the interpretive paradigm, Merriam (1998:7) observes that the researcher is an integral part of the context of what is being studied, and states that the researcher often calls himself a participatory researcher. This means that the researcher has a two-sided role, namely as researcher and as participant. It is also noted that the researcher figures as the primary instrument for data collection and analysis when conducting interpretive research. This information (data) is mediated through the researcher, rather than some other instrument such as a questionnaire or a computer (Merriam 1998:7).

Terre Blanche and Durrheim (2006:273-274) note that the researchers working within the interpretive paradigm assume that people's subjective experiences are real, that the experiences of others can be understood by interacting with them, and that qualitative research techniques should be used to collect and analyse information.

Gray (2004:31) observes that when viewing phenomena through the theoretical perspective of interpretivism, the world is too complex to be reduced to a set of observable 'laws'. He adds that generalisation is less important than understanding 'reality'. It follows that, in order to acquire an understanding, rather than listening to explanations or predictions, life experiences are of the utmost importance and crucial to the interpretive methodology.

With reference to this, Terre Blanche et al. (2006:274) do not have as goals the isolation and the control of variables, but rather the use and extension of the power of ordinary language and expression to help us understand the social world in which we live. In addition to this, they argue that interpretivists rely on first-hand accounts and try to describe observations in rich detail, sometimes engaging in evocative language to present their findings. Experiential data and accurate observations are thus deemed invaluable when engaging in the process of making sense of social realities.

Terre Blanche et al. (2006:277) therefore conclude that these first-hand descriptions of our social realities are subjectively formulated with reference to the relationship between researchers and subject. They also point out that an emphatic understanding of personal and social reality is made possible by this particular connection.

Terre Blanche et al. (2006:274) identify two of the key principles of interpretive research: firstly that the researcher is positioned as the primary 'instrument' by

which data are collected and analysed, and secondly that it involves understanding within context. They add that the meaning of human creations, words, actions and experiences can only be determined in relation to the contexts in which they occur, and hence that the commitment to understand human phenomena in context is central to interpretive research (Terre Blanche et al., 2006:276).

The context of teachers and their emergent practices, simultaneously shaped by their histories and the context within which they work, are regarded as influential factors impacting on teaching and learning by Adler et al. (2002:58). Remillard (2000:332) also shares this view by stating that teachers' beliefs, knowledge of teaching and learning, and knowledge of the subject matter impact on their decisions about what and how to teach.

Taking these facts into consideration, the particular contexts of the participating teachers were especially noted in an effort to understand and elaborate on the experiences of the teachers concerning the SWAP curriculum materials. The interpretive approach was therefore considered as most appropriate for the research conducted in this study.

3.3 Strategy and techniques

3.3.1 Research and Action Research

Action research as a method or process of research has been variously described in a plethora of literature works as recurrent cycles of enquiry comprising various stages or steps that include planning, implementation, evaluation and reflection. These steps set up the next cycle of planning. Ponte (2002) indicates that action research is often described in professional journals in terms of cycles and spirals of consecutive steps taken by participants, sometimes resulting in complicated schemes consisting of cycles of consecutive steps. These, she says, are usually variations of some of the following: formulation of a

problem; gathering and analysis of data concerning the problem; planning improvements based on the data; execution of plans; monitoring reflection on the outcomes, and reformulation of the problem.

The motivation for this decision was that the teachers were initially introduced to the resource. They were then asked to develop a plan on how to implement it; to observe the effects of the implementation, and finally to reflect on these effects as a basis for further planning. This fits the basic idea of action research as a process of planning, implementation and reflection, followed by a second round of planning with a view to improvement of the first arrangement.

Action research is defined by Kemmis and McTaggart (1988:5) as a form of collective self-inquiry, undertaken by participants in social situations in order to improve the rationality and justification of their own social or educational practices, as well as their understanding of these practices and the situations in which these practices are carried out. As early as the 1980s it became clear that the popularity of action research was growing, as the emphasis started to shift from academy-based to teacher-centred educational research. For the sake of clarity on the history, origin and current trends in action research, these notions should be explored first (McNiff, 1988).

The origin of action research is to be found in the seminal work of social psychologist Kurt Lewin in the 1940s. Keen on studying social issues, and also to provide people with an instrument to study their own relationships, he felt that the best way to move people forward was to let them engage in their own enquiries into their own lives. As the basis of his ideas he stressed the importance of democratic collaboration and participation. Lewin (1946) described action research as a spiral of steps, with four stages to each step, namely planning, acting, observing and reflecting. He did not intend his ideas to be used specifically in an educational setting, as his work made an impact on diverse areas of social life and then in education.

The value of this linking together of collective action and understanding was recognised by Stephen Corey, who applied the approach in a number of teacher-managed research projects. His book, *Action Research to Improve School Practices* (1953), was the first systematic attempt to define action research in education. After a decade of growth, the movement fell into decline. The separation of action and research from theory and practice came about, according to Carr and Kemmis (1986), as a result of the attention paid to the booming technological industry of the 1960s. Educational action research was replaced by the research, development and diffusion model, but lost credibility in the 1970s and 1980s because of the shrinkage of central funding and the general dissatisfaction with the top-down approach that characterised the Research, Development and Dissemination, (RD and D model), (McNiff, 1988).

The centre of activity shifted to Britain, and the impetus came from Lawrence Stenhouse. The influence of Stenhouse (1975) was crucial to the movement of action research in Britain. This was because he gave prominence to the teacher as researcher, and inspired teachers to develop such concepts. His central message to teachers was that they should regard themselves as researchers, as the best judges of their own practice, and that the natural corollary would then be an improvement of education. He maintained that "the idea is that of an educational science in which each classroom is a laboratory, each teacher a member of the scientific community."

After working with Stenhouse, John Elliot became the director of the Ford teaching project together with Clem Adelman (1973 – 75). The project developed courses that were directly in line with the thinking of Stenhouse. Elliot and Adelman were active supporters of teachers as researchers, and helped them to adopt a research approach to their work by working with teachers in class, not as observers, but as collaborators. Elliot agrees with the basic idea of sequential action-reflection steps running into cycles, as elaborated by Kemmis, but his

schema is more elaborate, allowing for greater fluidity between the stages illustrated in the following figure.

Figure 2: The action research process
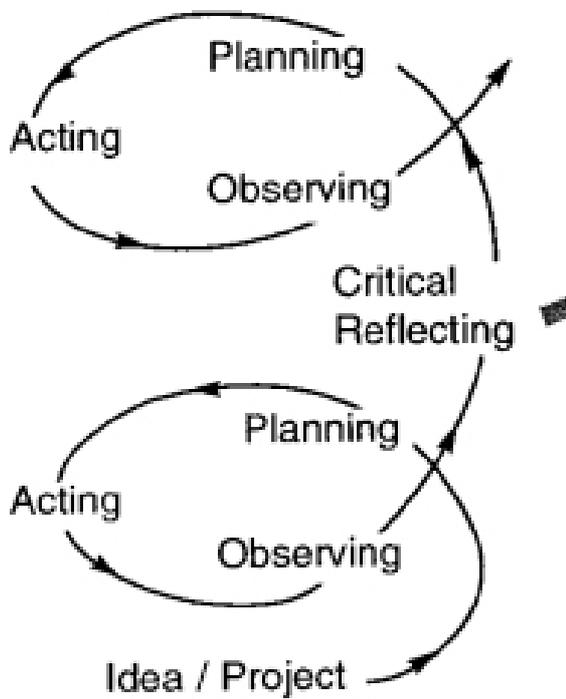
In Australia, action research has been an important part of the school improvement and educational research scene for more than a decade since the early 1980s. Stephen Kemmis has written profusely on the subject, and has

produced courses and materials on action research designed for practicing teachers. Kemmis bases his ideas on the original concept of Lewin, but he has refined it considerably. He has applied the idea exclusively to education and has, together with Wilfred Carr, encouraged the use of the term 'educational action research' (McNiff, 1988). Australian action research has been influential in articulating the theory and practice of action research, both in Australia and internationally (Henry & McTaggart, 1981; Carr & Kemmis,1986)

The process of action research is explained in the following terms in The Action Research Planner by Kemmis (1988:10-15). To do action research, a group and its members undertake to adhere to the methodology of action research. Attention has to be paid to the dynamic complementarity that links the four aspects or moments into a cycle, and ultimately into a spiral of such cycles. The four aspects or moments are the following.

- The plan: this needs to be developed from a critically informed action to improve what is already happening. The general plan must be flexible enough to adapt to unforeseen effects and previously unrecognised constraints. Critically informed action should be chosen because it allows practitioners to act more effectively over a greater range of circumstances; it must also take into account the risks involved with social change and the real material and political constraints within the situation.

- Action: the plan has to be implemented. Action should be fluid and dynamic, with the exercise of practical judgment. Acton should be deliberate and controlled, guided by planning, but not completely controlled by plans.

- Observation: the effects have to be observed. The purpose of observation is documentation, which must be planned, but not too narrowly, in order for it to be responsive and flexible.

- Reflection: the effects have to be reflected upon to serve as a basis for further planning. Reflection recalls action, but it is also active and takes

account of a variety of perspectives possible in the social situation. It is usually aided by discussion, and provides the basis for the revised plan.

In this investigation, the *planning* phase entailed the initial series of workshops where the learning resource materials were introduced to the participating teachers, who joined the project voluntarily. During this phase the links were made between the resources and the RNCS and tentative lesson plans were drafted by the teachers on the timing of implementation of the resource, how much time would be devoted to it, and where it would slot into the curriculum presented in the classroom.

The *action* phase was characterised by the implementation of the programme by the teacher with the researcher observing the engagement of the teachers and learners with the resource. Field notes and observations were taken down at this stage by the researcher for transcription and later reference. The *observation* phase partly took place during the action phase, where engagement with the resource was noted using a semi-structured observation schedule (see appendix i).

The *reflection* phase took place by administering two semi-structured interview schedules with teachers concerning their experiences with the implementation of the resource. The semi-structured interviews administered during the reflection phase were used to prompt teachers to reflect upon their experiences with the resource, and therefore ultimately to reflect on their classroom practice as well as the extent of their professional and curriculum development (see appendix ii & iii). This phase also served as a basis for a revised lesson plan, and was therefore characterised by the teachers producing a re-drafted lesson plan

Figure 3: Flowchart of the study

Learning support materials 'SWAP'

materials develop-ment

Professional development

School-based curriculum development

PLANNING

ACTION

OBSERVATION

REFLECTION
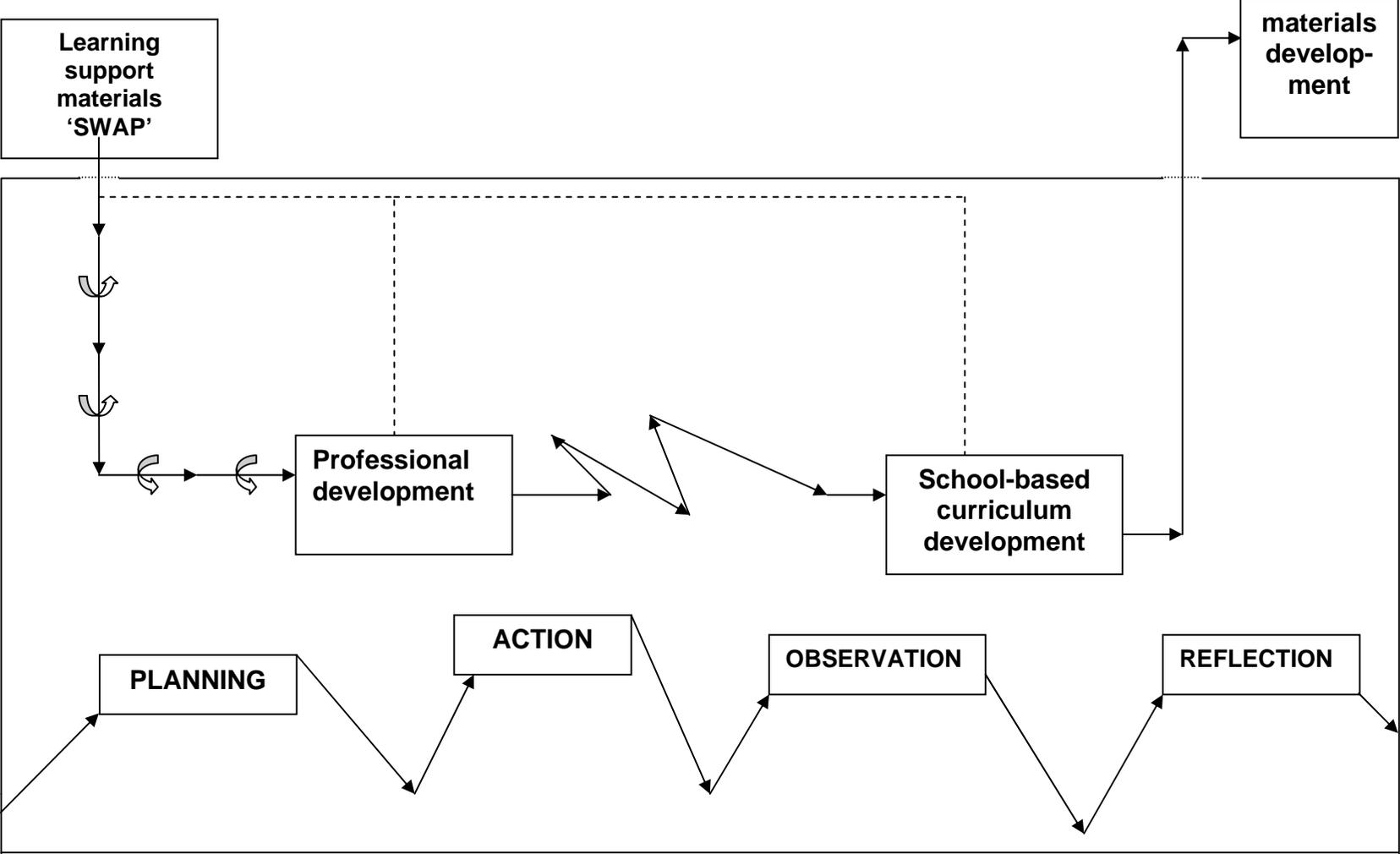
Table 2: Explanatory text to figure 3

The above flowchart provides an overview of the current investigation with respect to the process, goals and working relations between different concepts. Teachers were firstly presented with a learning support material known as SWAP, as indicated in the block on the top left corner of the chart. The curved arrows on the line connecting the learning support material and professional development illustrate the facilitative role that I played as researcher.

In order to affect the process of school-based curriculum development, it was fostered by participation in a professional development programme designed on the basis of the Action Research approach, which also acted as a 'safety net' for the entire study, as illustrated in the lower part of the chart. It also became evident in the initial phase of the investigation that the learning support material would have an influence on professional development, and that both of these would indirectly impact on the process of school-based curriculum development. This is illustrated by the broken line connecting the three previously-mentioned concepts.

Another observation, illustrated in the chart by means of arrows travelling back and forth, is that the process professional development to affect school-based curriculum development was not a linear one. As noted previously, the research approach of Action Research was employed to support the whole process.

This can be observed in the different aspects shown at the bottom of the chart: planning, which included workshops and initial lesson plans; action, which entailed the engagement with the resource by teachers and learners; observation of the learners and teachers, which overlapped with the action phase, and reflection, which was engaged in by two interview schedules and a revised lesson plan.

3.3.2 Scale

This study can be classified as small-scale, as it only involves one male and two

female teachers who are employed at three different schools. The focus was on the teachers, who seemed committed to participate in programmes proposing new methods of teaching. The two female teachers displayed a keen interest in participating, while the male teacher showed more interest after the programme was introduced. With reference to Kelly (2006:293), who observed that the ideal respondent characteristics differ according to the purposes of the study at hand, the participation of the specific teachers can be justified.

The male teacher and the one female teacher who participated in the study were long-serving teachers with experience in excess of twenty years. The other female teacher had five years of teaching experience, teaching Natural Science to Grade 7 only. All three teachers have been involved in the teaching of Natural Science, especially the Intermediate and Senior phase, for the largest part of their years of teaching.

The female experienced teacher displayed a keenness to experiment with the pedagogies and a principle contained in the programme, and was willing to communicate her experiences and meanings in an open and sometimes unstructured way. The other female teacher that participated was very well acquainted and proficient with different approaches to the teaching of Natural Science, probably owing to the fact that she had completed her training fairly recently. The male veteran teacher displayed a dogmatic pedagogy, descriptive of a previous method of teacher training, although he was keen to learn new methods of teaching and to experiment with them.

3.3.3 Interviews
The data-gathering technique termed as the interview, or in this case more specifically the semi-structured interview, was decided upon because it fits in well with the interpretive paradigm. Kelly (2006:297) observes that the interview is a more natural form of interacting with people, and to understand how people think and feel one should really get to know them quite intimately.

It has also been pointed out by Denscombe (2001:112) that the interview, as an information-gathering tool, lends itself to being used supplemental and in conjunction with other methods to add detail and depth. With regard to the challenges presented because of human interaction between the interviewer and the respondent, Gray (2004:13) argues that a well-conducted interview can serve as a powerful tool for eliciting rich data on peoples' views, attitudes and meanings that underpin their lives and actions.

Kelly (2006:307-308) identifies an advantage of this method of data gathering in the fact that the observation takes place while actions are actually happening, ensuring that the researcher is closer to the event. The disadvantage on the other hand is that even though it is a direct way of getting to know people's feelings and experiences, information usually comes to light after the facts have been established, and there is reliance on the interviewee's recollection of the experience.

Gray (2004:217) states that the semi-structured interview allows for probing views and opinions where it is desirable for respondents to expand on their answers. Two semi-structured interview schedules were thus prepared prior to the interviews that were conducted, to focus on the related topics of the research question (see appendix ii & iii). Their experiences and views, gained during the two interviews, were transcribed for the purpose of analysis.

All three teachers were interviewed at different locations, such as at their schools and at public places of gathering, and at different times, such as during their teaching and non-teaching periods. The duration of each interview was approximately one hour. All three of the participating teachers were comfortable with the answers to the questions from the interview schedules and demographic questionnaires being taken down verbatim, as well as with the fact that the

photographs were taken by myself in the classrooms and on the field trips.

3.3.4 Questionnaires

When a questionnaire is used as a data-gathering tool, people respond to the same set of questions in a predetermined order. A questionnaire may also be included as one of the tools of data production in conjunction with others when using the case-study approach, as pointed out by Gray (2004:187).

In this regard Gillham (2000:1-2) maintains that a multi-method approach is necessary when examining real-life questions. He rationalises this approach by stating that one approach is rarely adequate, and if the results of different methods converge, the findings can be presented with greater confidence. It is thus concluded that the questionnaire has its place in research methodology, but has more value when used in tandem with other methods.

Biographic questionnaires were used in this study to gather data concerning specific information on the participating teachers, as well as on the school context. A one-page questionnaire was employed to obtain background information on the teachers and the school context. Questions focused on the following:

- academic qualifications of the teachers, especially related to Natural Science subject matter knowledge;
- professional experience in terms of teaching Natural Science in the Intermediate and Senior (Grade 7) phase;
- the school context in terms of social indicators like the composition of the population of the catchment area of the school, the dominant religious groups and the socio economic status of the community.

3.3.5 Observations and field notes

According to Denscombe (2001:139), preference should be given to the direct evidence of the eye to witness events first hand, whereas in certain instances it is

best to observe what actually transpires. Gray (2004:238) agrees by stating that observation provides an opportunity to move beyond people's opinions and self-interpretations of their attitudes and behaviours towards an evaluation of their actions in practice.

Crucial disadvantages to the approach of observation are noted by Gray (2004:239):

1) interpretations of what is observed might be influenced by the mental constructs of the researcher;

2) if positioned among those observed, the presence of the researcher may influence the events;

3) while data gathered from observation are often rich in evidence, extracting themes may prove challenging.

In this study, semi-structured checklists were prepared before the actual observation of the teachers' and learners' engagement with the curriculum material in both the classroom and during the planned field trips (see appendix i). The events were recorded by myself, and transcribed on the same day of the observation.

3.3.6 Documentary sources

It is pointed out by Kelly (2006:316) that documentary sources are in some ways easier to do than interviews, as the researcher does not have to engage in the tiresome process of transcription, or literally 'thinking on one's feet' as in an interview. In this regard he states that documentary sources are very useful in all forms of qualitative research.

The teachers participating in this study were provided with teacher guides during the introductory workshops, and then requested to prepare their own lesson plans. The researcher provided no specific guidance pertaining to lesson planning, in keeping with the original notion that this would not be an intervention

with the goal of implementing a given recipe. Documentary sources also included the activities completed by the learners, to serve as artefacts of curriculum development.

3.3.7 Photographic evidence

Le Grange (2000:169-173) argues for the inclusion of photographs into case-study research, as it provides a meaningful insight into clarifying the particular context in which the teachers and learners have to function.

Pictorial accounts depicting the socio-economic context of the different schools, as well as those of the learners and teachers while engaging with the curriculum resources are included (see appendix iv) in this study.

Also included are photographs of the A1 worksheets completed by the groups of learners that were assigned to them. The researcher felt the necessity to include photographs, as these communicate the actual learning and teaching context.

3.4 Frameworks for analysis of data

3.4.1 Curriculum development

In the late 1970s it became fashionable in Australian schools to produce language policies across the curriculum. Boomer (1992:4) was of the conviction that these policies would be ineffectual if they were not to be embedded in the whole school by making changes to the administrative structure, its curriculum, and educational philosophy. He wanted to explore an issue that went behind a language policy, to the eternal triangle of education, namely the teacher, the child and the curriculum. To clarify this issue, he explores different notions on how to negotiate the curriculum.

Boomer (1992:4-5) starts out by asking whole school staffs the question "How do children learn?" adding to this question, "Under which conditions do children learn most effectively?" , and " Do we all learn in the same way?". Coupled to questions like these the author explores the first notion on navigating the curriculum which relates to *learning theory*, emerging in his terms as stating one's best-educated understanding of how people come to internalise new information or to perform new operations. The author states that the importance of formulating a learning theory is that if we are able to formulate our theory, it can be presented to the learners in terms that they might understand, so that they can try it out to see if it works in helping them to learn. From joint evaluation the theory can be modified and tried again. The result of this process will then be for teachers and learners to be able to collaboratively build learning theories.

This learning sequence begins with a challenge of some kind, which constitutes the first step; after this the learners need to group together and clarify what is already known by defining the problem and gathering resources. The next step will be seeking out further information and extending previous knowledge by using strategies like narrowing the field of enquiry and shaping a hypothesis. Step four entails interim trials, and eventually settling on a possible solution and putting it to the test by making errors, having success, modifying, consolidating and assessing. The final step in the sequence is learner reflection on and evaluation of the success of the venture. A curriculum model consistent with this learning model would also have five stages. The following section will deal with each stage and offer strategies for formal and informal evaluation (Boomer 1992:35-45).

A second analytical framework that was used for analysis of data generated concerning curriculum development by teachers, refers to a study done by Remillard (1999:315) to examine teachers' interactions with curriculum materials and whether these can contribute to reform in mathematics teaching. A model

emerged that offers a framework for exploring teachers' curriculum construction activities.

The model delineates three areas of the curriculum development process:
1. the *design area* that involves selecting and designing tasks,
2. the *construction area* involving the enactment of these tasks, and
3. the *curriculum mapping area* that determines organisation and content of the entire curriculum into which daily events fit.

3.4.2 Professional development
The framework used for examining the concept of teacher development in this study refers to research done by Bell and Gilbert (1994:483), who state that the concept of teacher development involves professional, personal, and social development. According to the model for teacher learning presented by Bell and Gilbert (1994:484), it is possible to identify three main types of development for teachers and their related phases, namely professional, personal, and social development.

Garet et al. (2001:919-920) propose some ideas on the effectiveness of a professional development programme, and provide a framework relating to features of an effective professional development programme. They highlighted certain 'structural features' and 'core features' in their model of professional development. The structural features entail the following:
1. the form of the activity,
2. the duration of the activity, and
3. the degree of emphasis on collective participation. (Garet et al. 2001:920-923).

The authors also examined three core features of professional development activities:
4. the degree to which the activity has a content focus,

5. the extent to which the activity offers opportunities for active learning, and

6. the degree of promoting coherence in teacher's professional development.

(Garet et al. 2001:923-929).

This framework served to some extent as an evaluation framework for the professional development process.

3.5 Validity and credibility

Credibility is achieved according to Van der Riet and Durrheim (2006:90,91), when the researcher continually notes discrepant evidence to the hypotheses that is being developed as a means of producing a rich and credible account. Triangulation, used as a means of identifying discrepant findings, is identified as one of the ways of doing this. The authors add that validity refers to the degree to which the research conclusions are sound, and the credibility of qualitative research is established while the study is being conducted.

This approach of triangulation allows the researcher to acquire a better understanding of the phenomenon by providing for different avenues and methods of investigation, and thus involves collecting material in as many different ways from as many diverse sources as possible, as maintained by Kelly (2006:287). In support of this point, Gray (2004:344) adds that through triangulation reliability is improved, if not guaranteed, by for example gathering information from multiple sources or by using multiple data gathering tools.

The findings of this study are supported by methodological triangulation, employing a combination of methods such as observations, interviews and questionnaires. In this regard, Gray (2004:33) argues that triangulation helps to balance out any of the potential weaknesses in each data-collection method, and the use of multiple methods also assists in the process of data triangulation.

3.6 Ethics

Strict adherence to the specific ethical considerations relevant to a study of this kind was observed. An invitation to participate on a purely voluntary basis was extended to the participating teachers, and they were informed of the purpose and nature of this study at the beginning of the introductory phase of the programme.

The participating teachers indicated that they did not have any qualms about having themselves or their schools identified, but in keeping with ethical considerations, pseudonyms have been used to protect the identities of those concerned.

This study was conducted to be beneficial to all those concerned, be they policy makers, researchers or educational practitioners in general, or in education in South Africa, but especially for teachers charged with the everyday practice of transforming and enhancing education.

CHAPTER 4

Data presentation

4.1 Introduction

In this chapter the data produced by the three elementary teachers' use of the same reform-oriented curriculum resource for science teaching and the process of enacting the curriculum are presented. The data presented in this chapter were developed and collected over a period of one year, and the procedures that enabled the data production were the documentation of the experiences of the educators in terms of their response to questionnaires, transcriptions of workshop activities, interviews, curriculum documents, and the observation of teachers while implementing the resource.

The focus of the research question was dualistic, firstly concentrating on gaining insight into how Primary School Natural Science teachers responded to the SWAP curriculum support materials during the workshops attended and the implementation phase; secondly an investigation into the potential of curriculum materials to provide opportunities for curriculum development by educators and possibly also development of a process of teacher development.

4.2 School context

These data were developed by observation and questions, with a view to develop a better understanding of the context where the research was taking place. Furthermore they provide a backdrop to the activities and actions engaged in by the teachers in the research process.

The names of the schools and the educators in this study are fictitious to protect the identities of those concerned. Two of the schools in the Cape Town metropolitan area were chosen from a cluster of schools that I worked with during a previous phase of research, and one in a rural town was chosen on merit of

previously and indeed currently disadvantaged groups. Two of the three teachers in the different schools were solely devoted to the Science Learning Area, and the third was the subject head of Science at her school.

All the educators hold fully accredited qualifications for teaching in South Africa. The school named One Primary is situated in the metropolitan area and has a learner enrolment of approximately 260 learners. Two Primary, also in the metropolitan area, has a learner total of approximately 1030, and Three Primary is located in a semi-rural area and has an estimated learner total of 580. All three of the schools that were chosen to participate in this research are moderately resourced, and it was evident that the teachers at these schools make a concerted effort to take part in voluntary processes like this one, in order to provide the best quality teaching to their learners.

Approximately one third of the learners attending the first school *(One Primary)* in the metropolitan area come from a farming community close by the school. Another third comes from an area that was a previously a squatter camp, but has now been converted into sub-economical housing units, and the rest of the learner's parents are live-in domestics at households in the area surrounding the school.

Learners attending the second school *(Two Primary)* in the metropolitan area all come from the community surrounding the school. The community that the school serves is composed of mainly middle to lower income families. Approximately sixty five percent of the learners come from Christian households, and thirty five percent is of the Muslim faith.

The rural school *(Three Primary)* community is characterised by a high incidence of poverty, as well as a high crime rate. Most of the families are single parents, and some of the learners live with their grandparents. The community is also

plagued by a high Aids rate, as well as a high teenage pregnancy rate. In terms of religion the Christian faith is predominant, although there is a substantial Rastafarian community to be found. Almost all of the learners in the three schools are of the Christian faith, and live in low socioeconomic conditions.

4.3 Educators' profile and background information

The three teachers participating in this study are stationed at the three different schools previously mentioned. To illustrate the level of professional experience achieved, especially as it relates to the teaching of Natural Sciences, and to elaborate on background information, particular details of each of the teachers are presented here. It should also be mentioned at this point that the educator at One Primary, who participated during the first workshops, called Mr Daries, was replaced by Mr Solomons at the beginning of 2007, who was briefed by both Mr Daries and me in terms of the goals and activities of the programme. The reason for the replacement, according to Mr Daries, was that his subjects of specialisation was not Natural Sciences, but rather music and languages, and he therfore requested to be replaced by Mr Solomons.

Educator 1 (One Primary): Frederick Solomons

Gender: Male

Years of teaching experience: a total of 41 years (with a break from retirement in 1984 until 2000, when he started helping out at the current school)

Learning area: Natural Sciences

Educator 2 (Two Primary): Charlene Davids

Gender: Female

Years of teaching experience: 5

Learning area: Natural Sciences, EMS, Arts and Culture and English

Educator 3 (Three Primary): Carol Abrahams

Gender: Female

Years of teaching experience: 22

Learning area: Natural Sciences and Technology

4.4 Gaining access, decision process and collaborative interaction

The decision process to involve the chosen schools in this programme followed a specific route. The reason for choosing the schools in the metropolitan area was that a good amount of rapport had already been established with the schools during a previous phase of research.

The first school (*Two Primary)* in the metropolitan area was chosen on the basis of merit, because of a previous experience with the science teacher there and a general positive culture of learning experienced while working within the school. The second school *(One Primary)* in the metropolitan area was chosen because of the peculiarity of the socio economic conditions that was to be found both in and outside the school (it is a poorly-resourced school in a very affluent community). The third school in the rural area *(Three Primary)* was chosen because it was poorly resourced according to an informed colleague, who was not employed at the school.

The headmasters and the teachers were approached at the end of the first term of 2006, and were made an offer to partake in an outreach programme, as well as research concerning science teaching support materials in the form of the SWAP (Schools Water Programme). All of the parties concerned agreed to participate, and dates were set for the initial workshops to be enacted.

The teachers' reasons for participation in the programme were explored at an interview when the initial implementation of the process was almost completed. These were their responses to the question "Why did you decide to partake in this programme?"

Educator 1: Frederick Solomons

"I feel that I am not on a high level concerning Science, and if there is a way for me to develop a love for Science I will use it."

Educator 2: Charlene Davids

"I feel that learning is a lifelong process, especially with Science. There is no sense in teaching outdated concepts in Science, because the knowledge changes all the time. The programme will help to get concepts across to learners. It will also enhance the learning experience and make it fun for everyone."

Educator 3: Charlene Abrahams

"I like challenges. To do something out of the ordinary. I feel that teachers and learners would be enriched, and that it would be good to expose learners to the environment that they live in. I also feel that it was a good opportunity to gain more experience for the future."

4.5 Data presentation: workshops; interviews; field notes; school visits

As mentioned in chapter 3, a process of action research was followed during this investigation. For this reason the following data are also presented in the way that they were gathered, namely adhering to the aspects of the process of action research.

In this investigation, the **planning phase** entailed the initial workshops where the learning resource materials were introduced to the participating teachers who joined the project voluntarily. During this phase, the links were made between the resources and the RNCS and tentative lesson plans were drafted by the teachers on the timing of implementation of the resource, as well as how much time would be devoted to it, and where it would slot into the curriculum presented in the classroom.

The **action phase** was characterised by the implementation of the programme by the teacher, with the researcher observing the engagement of the teachers and learners with the resource. Field notes and observations were taken down at this stage by the researcher for transcription and later reference.

The **observation phase** was partly done during the action phase, where engagement with the resource was noted using a semi-structured observation schedule.

The **reflection phase** was done by administering two semi-structured interview schedules with teachers concerning their experiences with the implementation of the resource. The semi-structured interviews administered during the reflection phase were used to prompt teachers to reflect upon their experiences with the resource, and thus ultimately to reflect both on their classroom practice and extent of professional and curriculum development

4.6 Two Primary

4.6.1 Initial workshops
The first two workshops with the schools situated in the metropolitan area of Cape Town had the goals of familiarising the teachers with the learning support materials, as well as linking the resource to the RNCS and the outcomes of the Learning Area of Natural Sciences.

The first workshop was held at the school named Two Primary, situated in the metropolitan area of Cape Town. Both the participating teachers from One and Two Primary attended this workshop, because it was logistically possible at the time. Ms Davids is the Science teacher from Two Primary. She told me that she left a job in the private sector to start teaching, and feels that it is a challenging job in another sense. I explained the SWAP process to her, and she immediately

had some questions concerning possible group sizes. I pointed out that this choice is at the discretion of the teacher, and that the suggested group size of the lab may be changed.

She teaches grade 7 only, and will therefore use only some of the labs. She made a preliminary decision to use the oxy-bac, nitrate and ph labs, and possibly the catchment and health risk lab as well. She asked some questions concerning the time frame to be used with the nitrate lab, as this takes approximately four weeks, and the experiments are to be done in class. We concurred that the time delay would be good, because it will serve as a tool for the students to recall what has been done, as well as keeping their curiosity peaked during the time delay of the two experiments in this lab.

She understood the concept of action research when I explained that I wanted teachers to collaborate concerning problems, and to reflect on their classroom practice in a critical manner. She was keen to start this process, as she felt that there is not enough collaboration between teachers.

Mr. Daries is the teacher from One Primary that presents the Science classes, although he noted that he does not have any science education training. He observed that this is a big hurdle for him to overcome especially in the classroom while doing experiments that fail often. Because of this uncertainty, he asked me to explain the learning support material in detail, which was done with success. He related that this resource would be a great help to overcome his sparse knowledge of science, as the programme is fairly easy to follow.

He was convinced that SWAP will provide him with the necessary confidence to do the experiments, and was even more confident when the workshop process was explained, i.e. the planning process, a school visit for support while engaging with the resource, and further support for the process of professional development. He teaches the grade 7 and grade 5 classes and stated that he

would like the grade 5 teachers to participate as well. After the workshop he remarked on the shortage of funds for the school of 270 learners, of whom only about 30 % pay their school fees, and related some innovative ideas about reusing the labs, for example stapling the results and pasting all of them onto one lab.

He has been permanently appointed, and because the teacher that was involved in an earlier phase, unrelated to this investigation, was disorganised, he had discarded everything in the classroom storage facilities.

He wants to stay in this position for two years or even less, and to start with the resource as soon as possible. He suggested that he would mention the project to the learners in the interim to peak their curiosity.

The second workshop was also held at Two Primary, and the same two teachers were once again present, namely Mr Daries from One Primary and Ms Davids from Two Primary. Ms Davids assumed a leading role, as it was obvious that she was much better prepared. The goal of this meeting was to find out where the teachers would like to slot SWAP into their curriculum planning for the year.

Mr. Daries did not have any specific ideas in this, as it is the first time he is teaching science. He also mentioned that his context is difficult in terms of continuity, as half of his learners are Afrikaans-speaking and from a farm labourer's background, and the rest speak isXhosa, and understand English, not Afrikaans. He mentioned that he had no resources at the school, and that he engaged only in the traditional 'talk and chalk' method in class. He also remarked on ill-disciplined learners, and did not think that a river visit with the learners is a good idea at all.

To solve this problem, I offered to do the first school visit while he observed, and then carry on with the rest. He could also give the learners parts of the

worksheets provided to do as homework assignments to peak their curiosity. Because Mr Daries is more conversant in English, he observed that he also experiences a language barrier with Afrikaans learners. He has not yet familiarised himself with the planning for the rest of the term, therefore he could not yet explain how the resource would fit into the curriculum planning.

Ms Davids noted that she wanted to include the resource in the research part of the matter and material section of the Natural Sciences curriculum. She explained that she wanted to follow the methodology of doing the practical and observation part of the chosen labs first, and then do the theory when the learners come back to class. In this way they would be able to approach the next lab with the theory and then do the practical. She had followed the same method in a previous study concerning litter and waste. She also pointed out that she wanted to show the learners the scientific process of research by using the resource, as she believed that it would meet all of the Assessment Standards and Learning Outcomes, i.e. conducting an investigation, interpreting the results, categorising information and so forth.

It was evident that the teachers engaged in a lot of collaboration during this session. This was especially evident when Ms Davids offered her planning file to Mr Daries and provided him with different contact numbers to find some resources for his school. She also mentioned that she did not mind sharing this information if it would lead to the enrichment of the learners. For logistical purposes and continuity it was decided that both of the teachers would present the resource to grade 7 only this year.

4.6.2 Initial lesson plan

The first lesson plan that I asked the teachers to draft (completed on 7 December 2006 in the case of Two Primary) constituted a pro forma of questions to the teacher related to curriculum choices, and the reasons for their choices. The answers of the teacher at Two Primary are listed below.

1. What will be done? Which SWAP activities will be used, and why?

The teacher indicated that the oxy bac, history and turbidity labs would be done. The reasons for this were that it would be easier in terms of time constraints. The grade 7 classes were too impatient. The previous year they had to grow African violets, and only 2 out of 120 learners had the patience to do it. Thus the nitrate lab would not be a good idea.

2. Which Learning Outcomes are addressed, and why?

The teacher pointed out that all three of the Outcomes for the Natural Sciences Learning Area would be achieved, and the following Assessment Standards were identified by her:

7.2.3 Interpreting: discuss in class what happened and why.

7.3.2 Patterns: the history lab would be important here, because other labs will have to consult this lab.

2.3.2 Inferences: they will compare the history lab in terms of what it looked like a long time ago. I.e. what the members of community said, and what pictures looked like from a long time ago, as well as what they looks like now compared to 15 years ago (maybe there were no resources available to the specific community in the past because of apartheid?). They may also infer that a new area will be built, called Lakeview, and that the community will want the area to be clean for real estate values to be maintained or increased in future.

7.1.3 Evaluating data: the bottom rating on the lab may be used for evaluation, and some of the concepts of the final lab may also be used.

Communicating findings: will be done by lab leaders doing presentations about their findings in front of the class.

Generalising: wherever pollution is present, it is not safe to drink the water, therefore, if we carry on like this we will be poisoning ourselves in the end (this will also lead to water not being a sustainable resource – Learning Outcome 3 is being addressed here).

7.1.1 Planning investigations: organising themselves into groups, and deciding who is to play what role during the enquiry.

Comparing: the labs need to refer to one another and work together.

Fairness: this may be attained by getting water from different sources, and comparing them.

Sustainable use: show the learners that the current use of water and pollution will lead to unsustainability.

3. How will you fit SWAP into your curriculum?

The teacher noted that the SWAP will be done during the phase where matter and material is dealt with, because it does not really fit into any of the other topics.

4.6.3 School visit and observation: Two Primary

The following illustrates the engagement of the teacher and the learners with the learning support materials (on 22 March 2007 at Two Primary) while on a visit to the river, as well as activities done in class before and after the visit to the river. No specific observation schedule was developed, but rather only basic questions

were formulated and field notes were taken while observing both teachers and learners (see appendix i).

The goals of this observation was firstly to adhere to the two aspects of the action research cycle followed in this investigation, namely implementation and observation, and secondly to examine whether the teacher did engage in the process of curriculum development as defined by Remillard (1999:314). Evidence for this process was ascertained by using the model developed by Remillard as an analytical framework. The observation of learners and teachers engaging with the SWAP application was conducted with the grade 7 class, divided into Groups of 5 or 6 learners engaging with the ph lab.

Teacher observation

Organisation: This was the learner's first experience with SWAP. The teacher was well organised, and explained the logistics of the excursion as well as the safety rules (do not drink water, do not step in water, stick to road rules, wear gloves, etc.). The learners were told to organise into groups in class, and to start by following the instructions on the lab. They were told about the SWAP excursion earlier in the week. Good discipline was maintained all the time, and one learner was sent back to class for his conduct.

Confidence: The teacher was confident all the time. She maintained good discipline while giving clear instructions on how to approach the lab, and how to take water samples when at the river and do the test. She asked them what ph was, and, when they did not know, referred them to the lab to read, asking some to report back. After this the test and the ph concept were recapped. After the samples were taken and the tests were done, she explained and led them to conclusions about how the connections between pollution, science and society are evident.

Integration to other Learning Areas and reaching of outcomes: It seemed that the teacher is Natural Sciences outcomes orientated. This may be because she teaches science only. The teacher wanted them to gather information that would allow them to draw comparisons, and led them to make connections between the environment, science and society.

Extra materials used: Only the labs were used.

Learner observation

Participation: They were disciplined all the time. They took samples made up from different types of water, those that they perceived to be dirty, and those perceived to be clean. Because of some rain they went back to class on the teacher's orders. While at the river the learners remarked that some people used the river as a toilet, and actually saw some derelict person doing this. Back in class the learners suggested that one of the learners from every group should read the instructions for testing and rating the findings (I observed that most of them had severe reading problems). They did the tests, drew the comparisons and came to some conclusions. Most learners do the tests eagerly, and compare results.

Curiosity: I observed that the initial curiosity peaked, but this waned fairly quickly with most of the students (the teacher said that there was a lack of learning culture in the school and among students, and that the teachers felt that this starts at home, as there is no stimulation or parent involvement). A minority group of learners are simply not interested at all – they will never even ask any questions. I felt that those learners have a 'mental block' to science (why?), an opinion with which the teacher agreed. Initially learners are curious about what is written in the labs, and what is inside the tin, also what the ph scale tells them, and what acid and base readings are.

Connections between science and society: Most of them do not make the connections between acid, and acid rain and pollution, even not when prompted in that direction (these learners are generally completely uninterested). There is not much awareness of the link between pollution and water quality, and that we should be cognisant of this.

General notes: Learners need to be more curious in a sustainable way. The social conditions of the learner are important, after a weekend they are not very receptive, and also after a holiday. Reasons (among others) for this, according to teachers, are the bad social conditions at home, for example the fact that learners engage in playing television and computer games to an excessive degree. Learners do not see the use for academics, and do not make the causal link between school and a better life, because they do not receive any immediate returns, when at home, it is obvious that permissive parenting techniques are also experienced by the learners.

4.6.4 Reflection: Interview

Interview schedule 1
This interview schedule was adapted from Boomer (1992:35-45), and conducted with the teacher from Two Primary on the first of August 2007. The goals of the questionnaire were to ascertain to which extent the participating teacher 'negotiates' the curriculum as termed by Boomer, and also therefore to what extent the teacher became a curriculum developer. The interview schedule may be found in appendix ii, and the answers from the teacher are listed below.

1. No, I feel that it was too early in the year, and the learners were not at the stage of asking questions, although they are more interactive now and are asking questions.

2. Yes, but we did run short on the worksheets.

3. Yes, they do most of the work themselves. This is good, because most of the teachers had a problem last year and this year, when learners just wanted their notes on the overhead, and did not want to do anything else. Now they do it themselves, and I think the whole culture of learning has changed. A lot of the learners previously said that the only reason why they came to school is to socialise.

4. I usually set the deadlines, but there is room for negotiation. I will usually reconsider if the learners say that they are having a heavy week.

5. Yes, when they get a certain mark for a task they usually come and ask questions on how to get a better mark for the next task.

6. I usually set the goals, but then we also negotiate about it, and learners sometimes set extra goals.

7. The groups decide who the leaders are to be, and decides how they are to be rotated.

8. No.

9. Yes, if one of the learners found that they missed out on something, they would ask others to explain it to them.

10. Yes, but they had to get used to it first, about after the first week.

11. I usually start the whole class with an overview. Later when they are in their groups, I will go around to each group to guide them, and then maybe one individual out of some six groups may need individual attention.

12. Yes. Because there is only one group in grade 7 doing this programme, they tend to talk to their mates.

13. Yes, most of the time they will help one another, even inter-group help is evident.

14. Yes, I am always looking of new ways of teaching, and for new resources, and try to establish how to make learning more interactive.

15. Yes, it helped with building confidence with the learners that were withdrawn. The real progress was that the learners actually started submitting tasks, but we needed to check up all the time.
16. The size of the worksheet makes it difficult to duplicate. An interesting point was that there were two spelling errors, and the learners actually picked it up.

Interview schedule 2: Two Primary

The second interview schedule was conducted during the same interview (on the same date) with the participating teacher at Two Primary. The questionnaire (see appendix iii) was constructed according to the three aspects of teacher development, namely professional, personal and social development, as identified by the research conducted by Bell and Gilbert (1994:483-497).

The goal of this questionnaire was therefore to examine to what extent the participating teacher developed, using the model proposed by the authors. The interview schedule has been included in the appendix, and the answers provided by the teacher are listed below.

1. Not really, in the same grade teachers consult with one another and discuss problems. If it cannot be resolved, the rest of the teachers of the grade are called in. If this is still a problem, the principal calls in a professional person. It does not seem to be the same situation as the other teacher from One Primary, who found himself in total isolation as a science teacher. I also do not like to see myself as a separate entity from the learners; I like to go around and see what they are doing. I feel that SWAP encourages them to learn in groups, and I can 'fit' into different groups.
2. I feel that I gave Mr Daries good guidance, and I like to share info, because it works both ways people will also share information with me.
3. I do that anyway.

4. Yes, I would like to refer back to the last comment in the no. 1 answer; it gave me some tools to adapt, taking the fact into consideration that I have different sets of learners every year, and have to adapt to them.

5. I will use it first, and then decide if it works, maybe change it a bit. I have the same philosophy with my learners as well: try it first before you say it does not work.

6. Yes.

7. I feel that learning is a lifelong process, especially with science. There is no sense in teaching outdated concepts in science, because the knowledge changes all the time. The programme will help to get concepts across to learners, it will also enhance the learning experience and make it fun for everyone.

8. Learning is a more interactive relaxed process, and it generally makes for a positive learning experience.

9. Yes, I feel that the knowledge did empower me to make better decisions and to plan better.

4.6.5 Re-planning: Revised lesson plan

After the initial engagement with the learning support materials in the classroom and at the river, the teacher was asked to re-draft the original lesson plans into a second revised lesson plan with the changes she deemed necessary. This document was handed in on 15 August 2007.

1. Learning Outcomes and Assessment Standards:

7.2.1 and 7.2.3: Recalls meaningful information, at the minimum recalls definitions and complex facts. Interprets information, interprets information by identifying key ideas in the text, finding patterns in recorded data and making inferences from information in various forms.

7.3.2: Understands the sustainable use of the earth's resources, analyses information about sustainable and unsustainable uses of resources.

2. Content and core knowledge: matter and material, the ph lab.

3. Assessment and resources:
Pictures, articles, reports will be used according to the teacher. Use of the history lab as background, she will provide the information here herself, because 5 out of 40 kids will make effort to find this information if she asked them to do it themselves. The Ph lab was engaged with here.

4. Assessment:
A translation task will be used here (this will be the formal assessment, because they cannot be assessed while working in groups and helping one another), as well as observation in class and a checklist (to see whether they grasped the necessary concepts). Concepts grasped are for example evident when the learner is able to distinguish between acids and bases. This will provide an idea on the learners' level of understanding of the lesson.

5. Learning Outcomes and Assessment Standards:
 7.1.2: Conducts investigation and collects data, organises and uses equipment or sources to gather and record information.
7.1.3: Evaluates data and communicates findings, generalises in terms of a relevant aspect and describes how the data supports the generalisation.

6. Content and core knowledge:
Life and living is one of the parts of content and core knowledge that may be used in this case. Photosynthesis and the concept of green plants using energy from the sun, water and carbon dioxide from the air to make food may also be used. This chemical reaction is central tot the survival of all organisms living on earth. The nitrate and oxy-bac lab will be used to illustrate these concepts.

7. Assessment and resources:

The oxy-bac and the nitrate labs will be used for the assessment, especially the nitrate lab, since they will be able to record data over a good few weeks, as well as conduct investigations and evaluate data.

8. Assessment:

Charts and a presentation will be used. The assessment will work in pairs with a chart to give an indication of what happened over this period, and then a presentation of the lab (to explain what the chart is about and what they did over the past weeks).

4.7 Three Primary

4.7.1 Initial workshops

The first two workshops at Three Primary had the same goals as those mentioned earlier, which were conducted with both one and Two Primary. The format of the workshops also correspond roughly with those documented earlier, with some subtle discrepancies, owing to slightly different questions posed by the teacher participating at this school.

The topic of the first workshop was the introduction of SWAP to the Intermediate Phase teachers at this school.

An explanation of how SWAP links to the Natural Sciences Learning Area outcomes was engaged in firstly, followed by a general introduction of the labs and of the teachers to the teacher's manual. No tests were physically done and the labs were only introduced with no detailed explanation as it appears in the manual on how to use the tests.

The teachers had the following questions:
- May teachers choose certain learners (good ones, bright?) to participate?

(The answer to this was that teachers may choose, but the whole grade may also participate which is preferable.)

- How long should the programme run?

(They were referred to the timetable in the manual, but it was noted that these were only guidelines and is not cast in stone, so that it may fit in with their timetable.)

- Would the manual explain to the teachers how to use labs within other subjects?

(It was explained that during the workshops this would become clearer as the labs were explained in turn.)

The teachers also asked one another whether they would be busy with the topic of water in the next term, to be able to work these labs into the syllabus? Some of them answered that they could (should?) be able to do it, even if these topics had already been done earlier in the year. At this point the leader teacher remarked that the tasks that the learners will do in the lab could also serve as Assessment Standards for evaluation. For example, making a net for the water life lab could serve as an assessment activity for the subject Technology. All of the teachers present also remarked how well the programme fits in with the three Learning Outcomes. At this point teachers observed that there may be spin-offs to other Learning Areas from this programme.

An explanation followed about the usual working order of the process, namely first a planning workshop, then an initial lesson plan drafted by the teacher, next a visit by myself to the school, to observe how the teachers and learners engage with the resource, after that a re-drafted lesson plan, and following this phase the teacher taking charge of the programme for the remainder of the investigation.

The second workshop at this school was devoted to more intensive explanation of the process, as well as training in how to engage with the resource. The workshop started out with an explanation on how the workshops would be done:

firstly training would be done for using the SWAP. Then the teachers may undertake a field trip to the river and use two of the labs. After this there would be a critical discussion of the possible ways to implement SWAP. Participating teachers would then work out lesson plans and explain how they think SWAP should be incorporated into the curriculum. Teachers would then implement SWAP in the classroom with me as an observer on how the learners and the teacher engage with the resource. A re-drafted lesson plan would be requested, and in conclusion reflective interviews concerning the process would be conducted.

During this workshop the methodology of both the nitrate and the ph test kits and labs were explained, discussions on how to use previous knowledge from within the learner's world to engage and introduce them to the scientific methods of the SWAP followed. Teachers noted at this point that they were very happy with the fact that the manuals and labs were available in Afrikaans. Once again there were some questions as to which grades the teachers should engage, and I explained that they should use their own judgment on this.

When asking them how they would plan a lesson for SWAP, and how they would incorporate it into the curriculum, they asked me to give them some time to have a meeting with all the teachers concerned (some were absent, attending athletics), and promised that they would have a written plan for me at the next workshop. This may have been because they understood that the next workshop topic would be about this planning.

At this point the teachers mentioned that the Palmiet River was called the Hugo's River when they grew up, and that they did not know why the name changed. They also thought that the learners should research this in the historical research lab. Teachers also remarked that the learners do not do any kind of research, and have to be spoon-fed all the time. They observed that the learners see research as a daunting task, reserved for clever people only.

However, they agreed that the SWAP labs would give the learners the confidence needed to do research on their own as soon as they come to the realisation that they can do research themselves by using the SWAP. According to the teachers the result would then be that the learners would then be able to investigate with confidence. Teachers also noted that they might be able to use the programme in a cross-curricular manner, and already there were some ideas to implement the resource into geography and history.

4.7.2 Initial lesson plan

The same questions as those asked to the other two teachers that participated were posed to the teacher at Three Primary. The teacher produced the following document on thirteen December 2006 when asked to draft an initial lesson plan for engaging with the learning resource.

1. Which SWAP activities will be used, and why?

The teacher will be working with grade 7, and will be using all the labs. The learners will be divided into groups for every lab. She wants the whole grade to know what they are busy with, and for everybody to see the big picture. She places a lot of emphasis on integration of science into other Learning Areas, and uses some of the activities to assess other Learning Areas.

2. Which outcomes will be reached and why?

According to the teacher all three outcomes will be achieved as well as the following Assessment Standards:

7.2.3 Learners interpret data gathered by using graphs about temperature differences and so forth.

7.1.1 Learners divide themselves into groups, and decide who does what.

7.1.2 Learners go to the river in order to gather data.

7.3.2 This may be linked to the earth and beyond part of the curriculum, because water is a resource on earth and the sun does play a role in the heating of water and so forth.

3. How will you fit SWAP into your curriculum?

SWAP will be most suitable for the part of the curriculum called 'Matter and Material'. However, we have been using the water life lab in the section on 'Life and Living', concerning the identification of animals. SWAP temperature measuring can also be used in the section 'Energy', for example convection streams and temperature differences.

4.7.3 School visit and observation

The school visit and observation (see appendix i) was done on the 24th of February 2007 at this school in the same way as at Two Primary, with the same goals in terms of analysis as stated previously.

Teacher observation

Organisation: Organisation was excellent. All the labs and testing equipment were packed out in class before learners and I arrived. Photos of previous visits to the river were on the wall. When the learners entered the class, the teacher told them to go into their lab groupings, which they did quickly. She made the announcement in class that the learners should only gather the necessary data for the test and then do it when they arrived back in class. There was good discipline, and the groups had leaders already assigned who were called to the front of the class to report on their findings after the river visit.

Confidence: The teacher was very confident, and commanded a dignified presence in the neighbourhood through which we walked on our way to the river. She interacted with the learners and the cleaning staff at the river, and also in a clear and concise with the inhabitants of the area way with a high regard for the safety of the learners, especially those having to do the interviews with the

inhabitants. She kept the group together at all times, and clearly had a good knowledge of the different labs. She encouraged the learners to question their findings and maintained good discipline in groups while they were doing their tasks.

Integration: She felt that all 3 Learning Outcomes were achieved, and also integrated it with a Learning Outcome of Technology by using the making of the net for the water life lab for it. Another integration would be into the 'Energy' section of the Natural Sciences curriculum, by using the streams in the lab as part of convection streams, which falls under 'Energy'. She will also use the reflection of the learners when back in class as an Assessment Standard for Languages, and the drawing of the river in the historical research lab as an evaluation tool for Art.

Learner participation: The organisation into the groups was quick and orderly, as was the fetching of the labs and testing instruments. The history group added some of their own questions, which had been typed up by the teacher and administered by those learners. The sample taking at the river was done in an orderly way, but with much interest, with instructions from all of the class members of all the labs to the leaders.

Curiosity: There was much speculating about the best way to take samples and what the tests might show. The teacher gave some ideas about the water quality, and the learners rushed to every next test to gather the data. At the river the water life lab caused the most excitement, as the learners found the searching and finding of the animals interesting. Most of the other groups started taking part in this lab after they gathered their lab data. The crabs were especially fascinating. There were also many questions to myself and the teacher concerning the findings, and the reasons for them. Learners also speculated on their own that the tests should be taken in different parts of the river, and some of them wanted to proceed further up the river, to which the teacher replied that

they would do this next time. The teacher had to give some help to the group reading the temperature of the water, as they did not know how to read the instrument.

Reflection in class: After the river visit the teacher asked every group leader to reflect in front of the class about their experiences at the river. It was interesting to note that, except for the names of the labs, the learners took their own names for the participants of the lab, like the scorpions and worms and so forth. They shared their findings and conclusions about the river and what might be done about this state of the river, like clean-ups, benches, camping grounds and so forth. They noted that some of the questions were difficult for the squatters along the river banks to understand. The teacher noted that she would like to find out more about the name of the river, as it had been recently changed.

The following two interviews (see appendix ii & iii) are identical to the ones conducted with the teacher at Two Primary, namely that Interview one had the goal of ascertaining to which extent the participating teacher 'negotiates' the curriculum as termed by Boomer, and also therefore to what extent the teacher became a curriculum developer. The specific goal of Interview two was, as mentioned, to find out whether the teacher had subsequently developed personally, professionally and socially, as proposed by Bell and Gilbert (1994:483-497).

4.7.4 Reflection: interview

Interview schedule 1
The following two interviews were done on the 25th of July 2007(see appendix ii).

1. Yes.
2. Yes.
3. Yes, because it is something different.

4. Not really, I mostly set the deadlines.
5. Yes, some of the brighter students did, and also ask more questions that I maybe did not think about.
6. I usually decide.
7. I decided on a leader, and defined the roles within the groups.
8. Yes, and if I did not use it, I always explained why, for example when it is dangerous to do something.
9. Yes, they tend to give one another instructions, and if they missed something they will ask, and the other learners would show those that fell behind.
10. Yes, they started to be aware about the river in their community for the first time, and started asking questions about the conditions.
11. I would start in class with the whole class to introduce a lab, at the river the groups take over, and sometimes at the river I would take an individual to one side to explain something.
12. Yes. Their schoolmates and parents.
13. Yes, they would tell the learners that did not see something if they ask about it.
14. Yes, the programme helped to introduce a different concept in learning, I am not operating in the same groove anymore.
15. Yes, it helped them to think about science problems, and how to solve it, they have acquired new thinking skills, asking questions and thinking about it.
16. None.

Interview schedule 2: Three Primary

(Refer to appendix iii.)

1. It is not that much of a problem, because they have classroom visits by other colleagues with a science background, as well as a senior staff member attending.

2. She likes to share, and being the subject head for science shares the newest information at staff meetings with other staff. Other colleagues also sometimes ask advice from her.

3. Yes. She usually takes part in programmes after school.

4. She has found that the learners take in more information when doing practical things, and remembers the facts for a longer time. She still asks questions about observations at the river three weeks ago, and everybody remembers. She has also found that group work is a good option, as the learners help one another constructively. She has found that they learn easier from one another, and also tend to rather believe their classmates that the teacher in some instances.

5. Yes. If she sees that something works in a class, she will also apply it in another class. She usually starts the class with a controversial question to get learners to think.

6. Yes. Because she must always be on top of developments in the field of science teaching, she has to be aware of opportunities like the science week, which she has to integrate into the curriculum.

7. She likes challenges, and doing something out of the ordinary. She felt that teachers and learners would be enriched, and that it would be good to

expose learners to the environment that they live in. she also felt that it would be a good opportunity to gain more experience for the future.

8. She feels that the relations have developed positively, because the learners have reacted in an enthusiastic manner by asking questions and looking for answers. They started to think for themselves. Another reason for the better relations is that she became known to the people in the neighbourhood of the school, and they (learners and community) started to see her as part of the community, not just teaching and then packing up and leaving at closing time. She could also start exercising better discipline, because she has became known to many of the parents as a righteous person.

9. She does feel empowered, because if another opportunity like this comes along she will know that she has the skills to do it successfully. She feels that when something good comes from an opportunity like this, it is contagious to other staff members, and that they might start doing it as well. Learners are also empowered, because they see that they are able to do things like research.

4.7.5 Re-planning: Revised lesson plan

After the initial engagement with the learning support materials in the classroom and at the river, the teacher was asked to re-draft the original lesson plans into a second revised lesson plan with the changes she deemed necessary. This document was presented to me on the 8th of August 2007.

1. Content focus: Matter and Material

2. Learning Outcomes:
Outcomes 1, 2 and 3 will be achieved.

3. Assessment Standards:

1.1.1 and 1.1.2 and 2.2.1 and 3.1.2

4. Integration:

Languages Learning Outcome 1 and technology Learning Outcome 1

Previous knowledge:

The learners did pay a visit to the river beforehand to do some observations.

Knowledge content:

Needs assessment – a testable question about the river is drafted by the learners.

Activities:

Learners are divided into groups of six. Every group drafts a couple of questions about the river. A testable question is then drafted as well as a 'hypothesis'.

Assessment:

Informal group assessment.

Resources:

The river, a camera, and stationery.

Enrichment:

The learners take the lead in the investigation.

4.8 One Primary

4.8.1 Initial lesson plan

The fact should be pointed out at this stage that the teacher at One Primary attended the initial planning workshops at Two Primary and was then replaced by Mr Solomons who was briefed both by Mr Daries and me concerning the process to be followed. For this reason there is no replication of documents necessary concerning this topic. The initial lesson plan was also drafted by this teacher in the same format as the other two participating teachers and presented to me on 26 April 2007. His answers to these questions were the following.

1. Which SWAP activities will be used, and why?

The Ph lab and the turbid lab will be done. This choice because of time constraints

2. Which outcomes will be reached and why?

Learning Outcome 1: Plans investigations, conducts investigations and collect data, evaluates data.

Learning Outcome 2: Constructing scientific knowledge: recalls meaning information, categorises information, and interprets information.

Learning Outcome 3: Describes problems and similarities in problems and solutions in their own and other societies, suggest ways to minimise the negative effects on the environment.

The use of the SWAP labs will enable the teacher to reach all the outcomes.

3. How will you fit swap into your curriculum?

The labs will fit into the earth and beyond part, and the matter and material part.

4.8.2 School visit and observation

The school visit was paid on the 29th of May 2007 and observation (see appendix i) was once again done in the same manner as at the other two schools, with the same goal of analysis as mentioned previously.

Teacher observation

Organisation: The teacher was well organised for the class. The turbid lab was the chosen lab to do, and the necessary instruments were already made and placed on the table for the four different groups. The previous lab that was done was pasted on the board and completed. The teacher decided for logistical reasons on the crossing of two major roads that only the group leaders should go and take samples to be brought back for analysis by the rest of the class.

The teacher could unfortunately not make the trip to the river owing to a heart condition that does not allow him to do this. He had obviously made some preparations for the class, as all the learners knew what turbidity was. The class was orderly, and the group leaders came to take their test instruments in an orderly way, and lined up outside the classroom to be accompanied by another teacher and myself. Back in class he asked the groups to organise themselves. Most of the learners could see the no. 2 on the test, and he then explained that it was polluted. He also referred back to the other test, and asked why the water was polluted. He led them to the conclusion that even when water seems clean it may not be clean at all.

Confidence: The teacher is confident, except for the heart problem issue. He had briefed them about the test. He seemed slightly too process oriented, and did not use the text in the lab itself at all. He did say afterwards that he would use parts

of the lab like the rating at the end in another class; it seemed that he would be using parts of the lab in different classes.

Integration: He referred to the results of the other tests to illustrate that the water is polluted in different ways. He said that he would split up the labs and use them as separate tasks. He also felt that he would integrate them with Social Studies, for example the impact that the river has on the community.

Learner observation

Participation: The learners at the river were eager to start doing the tests immediately and also collected samples as quickly as possible.

Curiosity: Learners were all curious, and as they observed the test results, some of them differed in opinion with the teacher. I feel that he could have fostered this sense of investigation and curiosity and disagreement a bit more, as scientists should disagree somewhat about results.

They participated well in reaction to his probing questions, and came to the conclusion that the water is slightly polluted. He still paid no attention to the text of the lab itself. They also concluded that the water should be cooked to become clean. Older learners did not participate, but just observed and paid attention without disturbing the class.

Connections between science and society: Although the teacher facilitated the learners to make connections between since and society they did most of the thinking and conclusions by themselves. They concluded that society is responsible for the pollution. They also made connections between the rivers and the streams, and where the clean water in their taps comes from.

The teacher then related some experiences that he had while on tour in the Valley of a Thousand Hills, where the local community had to walk long distances

for clean river water. He then linked it to people that do not have access to any water except river water, even in the cities, and who may fall ill when this water is polluted. Other links were also made by the learners as to other uses for water, like farming and so forth, and why it should be clean for these purposes.

General: The teacher mentioned an interesting fact when showing me how he would plan his work schedule around SWAP in the curriculum. On the specific form for the learning schedule of the school there are two places where the Assessment Standards are to be filled in, one in words and one in code form as per the Department of Education. While showing me this, he said that most of the time he just fills in the words and not the codes, because not even the headmaster is familiar with the codes, and that the headmaster is usually content with this.

The following two interviews (see appendix ii and iii) are identical to the ones conducted with the teacher at the other two primary schools, namely that interview one had the goal to ascertain to which extent the participating teacher 'negotiates' the curriculum as termed by Boomer, and also therefore to what extent the teacher became a curriculum developer. The specific goal of interview two was, as mentioned, to find out whether the teacher thus developed personally, professionally and socially, as proposed by Bell and Gilbert (1994:483-497).

4.8.3 Reflection: Interview

Interview schedule 1
Both of these interviews were done on the first of August 2007
1. Yes
2. Yes
3. It is challenging, not too easy or too difficult for the learners.

4. They do have opportunities to work collaboratively on the deadlines, but just to a certain extent, otherwise they will never submit tasks.
5. In general not, maybe one or two.
6. I usually tell them.
7. The group decides who the leader is, and who the tester will be.
8. Yes, I did use some of the materials especially in terms of the turbid lab, as the learners brought the rest of the materials for this lab.
9. Yes, from the start they did this.
10. I have to lead them to the questions most of the time.
11. They do most of the work in groups.
12. Yes, very much, even the parents are told, and then they ask me about it at parent evenings.
13. Yes, but there is a real danger when some of the learners want to be in a group together, and not in another group. All of the teachers here usually ask for class tests when they want to see what the learner really knows, because there is always helping in the groups.
14. Yes, I did learn about some other approaches in science teaching, especially the hands on approach which works better than lecturing.
15. Yes, the practical approach was very good, those that were there remembered everything well when tested.
16. No.

Interview schedule 2
1. Because we only have one grade 6 and one grade 7 class, it is difficult to have peer evaluations, although we are not completely isolated, because we do have informal get-togethers where we speak about issues, especially in terms of problems with specific learners.
2. Yes, I did tell the other teachers about participating in SWAP, and what it is about.
3. Yes.

4. Yes, I found out that the practical hands on approach works best with them.

5. Yes, I feel that I learn every day, and I now have experience about the hands on approach, and will use it. I think the primary curriculum is fairly easy in terms of what is expected of the teacher.

6. Yes, we are currently doing this, and we are forced by the department to do it.

7. I feel that I am not on a high level concerning science, and if there is a way for me to develop a love for science I will use it.

8. Positive, the learners are more relaxed with me as their teacher, and in science the relationship is different than with the other subjects, so it is important that the learner should be more relaxed in the relationship.

9. Yes, the class goes easier, and I can give feedback to other teachers and talk about my own experiences in an informed way. Daily experiences are valuable for other teachers if you can share it with them.

4.8.4 Re-planning: Revised lesson plan

The participating teacher at this school was also requested to re-draft his lesson plan with all the adaptations, while considering his experiences during the initial exposure to the learning resource. This re-drafted lesson plan was handed in on the 14th of August 2007

1. Learning Outcomes and Assessment Standards:

Learning Outcome 1: Plans investigations, conducts investigations and collect data, evaluates data.

Learning Outcome 2: Constructing scientific knowledge: recalls meaning information, categorises information, and interprets information.

Learning Outcome 3: Describes problems and similarities in problems and solutions in their own and other societies, suggests ways to minimise the negative effects on the environment.

2. Content and core knowledge: Matter and material, Earth and Beyond

3. Assessment and resources: Written assignments, question and answer sheets (the labs), write an explanatory paragraph, a rubric to be used for self assessment. Group assessment as well as assessment by the educator will take place. Resources will be prepared labs, turbid testers and Ph testers.

4. Enrichment: Integration with social sciences on how the rivers affect the community and society

CHAPTER 5

Data analysis

5.1 Introduction

The two tasks carried out in this chapter are the following:

- Identifying whether the findings of this research support the notion that SWAP materials can assist teachers in implementing the RNCS recommendations in the teaching of Primary School Natural Sciences.
- Ascertaining if sufficient evidence provided by this research indicates that using the materials will result in a process that will foster teacher development.

To analyse the data gathered concerning teachers' curriculum development, the process was guided by frameworks adapted from Remillard (1999), as described in chapter 2, and Boomer (1992) also referred to in chapter two. The framework developed by Bell and Gilbert (1994:483-497), highlighted in this chapter, was utilised to guide the analysis of data concerning teacher development.

5.2 Conceptual frameworks used for interpretation and analysis of data

Interpretation of the data gathered during this study was done by using frameworks which were developed in relation to other studies as guiding tools for the current process of analysis. These frameworks were deliberately chosen because issues related to this investigation emerged to a large extent within the original studies.

5.2.1 Curriculum development

In chapter 3 of his publication, Boomer (1992:32) attempts to map some parts of the complex course of the curriculum in action, and also suggests some strategies for informally evaluating the learning that is taking place. He contends that teachers are up against challenges and constraints every day, and must 'navigate the curriculum' in order to accommodate these challenges and constraints.

He further notes that there is a traditional 'apartness' in the classroom, as teachers teach, and learners learn. He then follows suggesting an alternative approach to curriculum in the sense that it is no longer a pre-packaged course to be followed, but a jointly enacted composition that grows and changes as it proceeds (Boomer, 1992:32).

Boomer (1992:33-35) proceeds to consider two important aspects when planning a curriculum, namely learning and the curriculum itself. When considering learning, he stresses that when planning a curriculum for the year, the learning process should be kept in mind. A model consisting of five stages for what seems to occur naturally when individuals intend to learn, is suggested as a basis for planning and evaluating any programme to be enacted with learners.

Boomer (1992:35-36) then proceeds to propose a formula for composing or planning the curriculum consistent with this learning model, also consisting of five stages which follows logically from the preceding model. At all of the five stages teachers may want to informally evaluate their progress by using the provided checklists. A detailed version of this model, as well as the formula for composing a curriculum, may be found in the literature review in chapter two.

The analysis of the curriculum development process followed by the teachers in my research was guided by the formula for composing the curriculum, as well as

the checklists provided at the end of each stage that offered a strategy of informal evaluation (Boomer, 1992:35-45).

After examining the context of the three teachers participating in my research, taking into consideration curricular and time constraints, I constructed a shortened interview schedule (see interview schedule 1) consisting of certain questions extracted from the checklists provided at the end of each stage. As part of my research project I will illustrate to what extent the participating teachers are '*deliberately* striving to collaborate and negotiate with children' in the process of developing the curriculum (Boomer,1992:32).

Stage one

The first stage proposed by Boomer (1992:35-38) summarises the planning of a section of work. This stage consists of the seven elements of the curriculum and several steps in the planning phase to be attended to. As mentioned previously, after examining the context the decision was made not to pay extensive attention to the planning stage as per Boomer's suggestions, except for the planning activities during the first workshops.

The justification for this decision was twofold, firstly that this was a bounded case study involving three schools and three teachers, and secondly because the programme can be labelled 'self-contained' in terms of the seven elements of a curriculum plan and the other planning considerations mentioned by Boomer (1992:35-37).

Stage two

The second stage of the formula for planning a curriculum as proposed by Boomer (1992:39-41), examines the factors influencing the degree of negotiation (e.g. age, experience, school policy) and the reasons for negotiating. One of the important reasons for negotiating, according to the author, is that if the learners

are engaged in the planning of the course, the likelihood of their 'owning' the tasks will increase.

The question was asked during the interview on whether the learners were allowed to contribute to the planning of the course. The teachers at One and Three Primary answered that the learners were allowed to participate in the planning of the programme, while the teacher at Two Primary answered that it was too early in the year for them to participate in the planning of the programme. From these answers it may be concluded that the teachers at One and Three Primary allowed the learners to participate in the planning corresponding to the ideas of Boomer (1992:39).

At this stage some negotiation activities are also suggested. The activities attended to in the questionnaire were whether the learners and the teacher should decide on deadlines together, and whether the learners decided on goals in addition to those set by the teacher.

The teacher at One Primary answered that the learners do have opportunities to work collaboratively on the deadlines, but only to a certain extent, and in general the learners did not set extra goals. The teacher at Two Primary stated that she usually set the deadlines with some room for negotiation, and the learners set extra goals for themselves in terms of achieving better marks. The teacher at Three Primary said that she mostly set the goals, and that the brighter learners set extra goals.

These statements indicate that only certain 'brighter' learners set extra goals at the three schools, and that the teachers usually set the deadlines while collaborating with the learners to a small extent. It may be noted here that the amount of collaboration with learners does not correspond completely to the notion of negotiating with learners during curriculum planning as proposed by Boomer (1992:40).

A final concept applicable to this study, which was attended to in this stage, was whether the teacher valued the contributions made by the learners, or explained why the contribution was not used.

The understanding of 'contributions' by the teacher at One Primary were materials brought to school by the learners. He replied that he used the specific device that the learners were asked to bring to school. At Two Primary no contributions were used, as there were none, according to the teacher. The teacher at Three Primary used some of the contributions, and explained why some of them were not used, e.g. a dangerous activity. The only teacher thus marginally corresponding to the idea on using contributions by learners as stated by Boomer (1992:40) was the one at Three Primary.

Stage three

According to Boomer (1992:41) this stage of the programme should be characterised by the commitment of the learners to achieve the contracted outcomes, and the classroom should take on the character of a workshop with various groups and individuals at work on their activities.

The questions used from the checklist at the end of the stage were the following:

- Were the learners showing and teaching each other things?
- Were the learners asking questions?
- Were whole-class, small-group or individual approaches used depending on circumstances presented by the teacher (Boomer, 1992:41-42)?

 The teacher at One Primary answered that the learners were showing one another things from the beginning, while the two teachers at two and Three Primary said that the learners showed and taught one another things especially when one fell behind from the progression of the group. From this answer it can

be concluded that the learners at the three schools were showing and teaching each other things as noted by Boomer (1992:41).

In terms of whether the learners were asking questions, the teacher at One Primary answered that he usually had to lead them to ask the necessary questions. The teacher at Two Primary said that the learners first had to get used to the new way of classroom activities, and then started asking questions and having discussions after the first week or so. At Three Primary the teacher answered that the learners were beginning to ask questions once they became aware of the conditions in their community. During the interview it became evident that the questioning behaviour by the learners at Two and Three Primary correlated with the notion of Boomer (1992:41).

The teacher at One Primary said that learners did most of the work in groups, while the other two teachers used all three methods mentioned, depending on the goal of the activity. These answers are indicative of the fact that the two teachers at Two and Three Primary were most closely following the strategies suggested by the checklist at the end of stage three, as proposed by Boomer (1992:42).

The last notion concerning this stage that the teachers were questioned on was on whether the learners told individuals outside of the classroom about their activities. The teacher at One Primary answered that they indeed did tell others about the programme, and that the parents even asked him about the programme while at the parent-teacher meetings. Because there was only one grade 7 class participating in the programme, the teacher related that they had especially told the other grade 7 learners about the programme. The teacher at Three Primary remarked that the learners told their peers at the school, as well as their parents.

Stage four

Boomer (1992:42) observes that this is the stage where the learners test, shape and show what they have achieved and know. The learners should show peer-to-peer disciplining, a growing intensity of concentration, asserting themselves with more immediacy toward the product, and a general absorbing into tasks by the learners.

The crucial activity during this stage, after analysis of the checklist provided, was perceived to be whether learners are sensitive to the meanings made by others, and when advice and help is given, it is given in a sense of comradeship. The question used from the checklist provided was therefore whether the learners were comrades in learning activities.

The teacher at One Primary understood this question in light of the possible pitfalls and dangers, as when certain learners always want to be in the same groups, and the fact that the real potential of the individual learners is not shown because of helping behaviour by their peers. At Two Primary the teacher remarked that the learners helped one another in an understanding way, and that even inter-group helping was evident. The teacher at Three Primary answered that the learners were helpful in a kind manner, especially when a learner fell behind or did not see something, and then asked his group members about it.

Stage five

This stage can be done through informal discussion and reflection as well as by means of a formal method of assessment. Questions can be asked about the 'journey', on issues like whether the class achieved what they intended to achieve. Questions about the product, skills, and using media may be whether the products compare favourable to those made previously, which aspects are to

be improved, and if the products will be used and valued in future (Boomer 1992:43).

Three questions from the checklist were asked at this point during the interview:

a) Did the teacher become a better teacher because of partaking in the programme?

b) Did the learners become more effective in learning?

c) Are there any suggestions for the modification of the programme?

On whether the teachers became better teachers, all three of the participating educators remarked that they acquired new skills in teaching that they felt worked well for them. In terms of the second question the teacher at One Primary observed that the learners had found that the practical method was conducive to their recalling of facts. The teacher at Two Primary remarked that the learners started submitting assignments, and it helped build confidence in withdrawn learners. At Three Primary the teacher felt that the learners had gained new thinking skills in terms of solving scientific problems.

Only one teacher (at Two Primary) suggested, when asked about suggestions for modification, that the A1 worksheets made the copying process difficult, and that it could be replaced by for example A3 sheets.

When considering the findings of this study, some inferences can be drawn in conclusion of the question on whether the teachers did 'negotiate the curriculum', as termed by Boomer (1992).

The teacher at One Primary allowed the learners to participate in the planning of the curriculum, but only allowed marginal involvement by the learners when it concerned the setting of deadlines for assignments. He also noted that the learners were indeed showing each other things when engaging with the activities, and also telling others outside of the classroom about the project they

were involved in. He did observe though that he had to lead the learners to a large extent when it came to asking questions relating to the activities and process. This teacher also related that he used different teaching strategies, like whole-class, group and individual activities, depending on the goal that he wanted to achieve.

The educator at Two Primary argued in terms of participating in planning the curriculum that it was too early in the year for the learners to engage in this, as they were not completely aware of what the project was about. She noted that the learners were telling others about the project, and that they also showed each other subtle points about the activities. The teacher also observed that the learners only started asking questions after approximately five weeks, familiarising themselves with the activities. She also used all three approaches in her classroom, as the previous teacher did, depending on the goals to be achieved.

The teacher at Three Primary allowed a considerable amount of participation in terms of planning the curriculum, but also retained the veto vote on the setting of deadlines for assignments, but still with some collaboration with the learners. Her learners also showed one another things concerning the activities, and were telling others about the project they were participating in. she also made the interesting observation that the learners only started asking questions about the activities they were engaging with when they became aware of the conditions within their communities. This educator also used all three different approaches of teaching with her class.

An important finding observed in this penultimate aspect of the research was that all three of the participating teachers felt that they became better teachers since they developed new skills concerning teaching strategies, and that the learners also became better, as they gained new thinking skills and realised that they could also conduct research.

In a study done by Remillard (1999) to examine teacher interactions with curriculum materials and whether these can contribute to reform in mathematics teaching, a model emerged that offers a framework for exploring teachers' curriculum construction activities.

The model delineates three areas of the curriculum development process, constituting the design area that involves selecting and designing tasks, and the construction arena involving the enactment of these tasks. The third arena, namely the curriculum mapping area in which the previously mentioned two arenas are situated, determines the organisation and content of the entire curriculum into which daily events fit (Remillard, 1999:315).

The model that Remillard (1999:315) proposed informed this study for the purpose of analysis of the data, since it corresponds to some extent with the current study tasked with the investigation of whether SWAP materials can assist teachers with implementing the RNCS recommendations in the teaching of Primary School Natural Sciences. I was guided by the different aspects of each arena identified by Remillard (1999:315) in making sense of the teachers' curriculum decisions and activities.

Remillard (1999:322) states that the three arenas delineate distinct aspects of the curriculum development process. However, her findings suggested that the choices that teachers make in each of the defined arenas are not always done in serial or in isolation. In support of this claim she notes that a teachers' task selection usually includes intentional or de facto curriculum-mapping decisions, and that the enactment of any task may lead to further task selection with possible adjustments to the curriculum map.

As a section of the analysis of my study, I describe the three teachers' engagement with the curriculum development process while taking into

consideration these three arenas. Over the one-year span of the study, I worked collaboratively with the three teachers while tracing their curriculum development activities by extracting data from lesson plans, classroom observations, semi-structured interviews and field trips.

The information that was acquired from this process reflecting the teachers' engagement with the curriculum development activities was organised into a logically coherent narrative for the purpose of analysis, and also as a basis for discussion. Because of the obvious similarities, this analysis was thus specifically guided by the framework designed by Remillard (1999:315).

The curriculum design arena

Remillard (1999:322) refers to the first realm of the curriculum development process as the design arena, which involves the selection and design of tasks for the learners. According to the author, a crucial component of the design arena of curriculum development is the process of selecting, altering or constructing tasks to present to the learners.

The initial phase of the SWAP programme was characterised by introductory workshops, where the participating teachers familiarised themselves with the text material in the manuals. Possible links were established that could be made between the content of the programme and the Natural Sciences themes and outcomes. During these workshops the teachers also made choices concerning which of the various activities on offer within the manual would be enacted with the learners.

The teacher's assumptions about content (what learners should learn), and pedagogy (how they should learn it) is mirrored in this process. These choices are thus influenced by their pedagogical ideas, ideas about learners and their learning, as well as the teaching context and available resources (Remillard, 1999:323).

One Primary

The approach of the teacher at One Primary in terms of task selection was examined, and it illustrates a singular approach namely, namely using the tasks exactly as they were presented in the curriculum materials given to the participating teacher. This approach of drawing tasks directly from the text book, and then presenting them to the learners, was termed by Remillard (1999:323) as the appropriating of tasks.

Two other components that influenced the teacher's role in curriculum development, are firstly the different classroom and school contexts, and secondly the role that the text book material played in task selection (Remillard, 1999:327). In terms of the school and classroom context, the headmaster of One Primary situated in the metropolitan area seemed distant during the introduction and never enquired as to the progress of the programme in his school. Discussions between teachers, which might lead to reflection on classroom practice, and ultimately curriculum development, also only happened on an ad hoc basis, namely when they had informal gatherings in the staff room.

Another component identified was the one of the role that the textbook played in the choice of task selection (Remillard, 1999:327). The teacher felt that some of the different tasks offered would only fit into a certain theme of the prescribed curriculum, namely the theme concerning matter and material, and hence justified his choices in this way. This haphazard choice of tasks illustrates the point that Remillard (1999:328) made concerning the fact that the characteristic of choice within the text facilitated the variation in reading of the text, and the construction of different relationships with the text by teachers.

Two Primary

The approach of the teacher at this school concerning the activities in this arena, namely selection, altering or constructing tasks, was by and large the same as

the teacher at the previous school, because she appropriated the tasks to be done without alteration of the tasks or constructing new ones. It is thus evident from her choices that this teacher followed the same approach of appropriation of tasks, as identified by Remillard (1999:323).

The next component that played a role in curriculum development was the influence of the classroom and school contexts (Remillard, 1999:327). It seemed that this teacher's school supported the approach that the teacher followed in seeking out new curriculum materials. However, negative and positive factors played roles in this context. The headmistress at the school only entertained a brief introduction concerning the researcher and the programme while in a meeting with another party, and never enquired as to the progress of the programme in her school. On the positive side, the teacher stated during an interview that a system of teacher peer review of classroom practice was in place. This activity led to formalized group discussions which might foster reflection on classroom practice and possibly curriculum development.

The role of the text in curriculum materials, and the influence of this upon selection of tasks became evident in this study. The teacher at this school chose the tasks to be done haphazardly, by selecting only certain tasks to be enacted during the programme. She justified her decision by stating that, according to her experience, the learners would not have the patience or the resolve to do some of the longer tasks. Once again this haphazard choice of tasks illustrates the point that Remillard (1999:328) made concerning the fact that the characteristic of choice within the text facilitated the variation in reading of the text, and the construction of different relationships with the text by teachers.

Three Primary
The choices of the teacher at this school on task selection illustrate a distinct approach from the other two teachers in this study. She drew tasks directly from the materials provided and used all of the tasks in the curriculum material, stating

the reason for this is that she wanted all of the learners participating to see the big picture concerning what they were busy with. In contrast to the approaches of the other two educators, the teacher at Three Primary decided to use all of the activities on offer. This difference in approach is indicative of what Remillard (1999:324) terms as the different ways of reading the text.

The next important component influencing curriculum development observed in this arena was the role of the classroom and school contexts in the task selection process. It appeared that the school and especially the headmaster supported the approach of using curriculum support materials. The headmaster introduced himself warmly, made an effort to attend most of the workshops outside of school hours, made apologies when he was not able to attend, and periodically enquired as to the progress of the programme. According to Remmilard (1999:327) the teaching context does play a role in the teachers' task selection process, especially when professional development is supported at a school, as is obviously the case at this school.

The curriculum construction arena

A second arena of curriculum development is the construction arena, in which teachers and learners transform planned tasks into actual classroom events. This arena is comprised of all the interactions in the classroom, planned or unplanned, that influence, shape, or contribute to the enacted curriculum. Two types of teachers' task enactment are identified, namely reading learners' performance on tasks, and improvising in response (Remillard, 1999:328-329).

Reading learners' performances include observing and listening to learners in order to guide the process of ongoing assessment of their understandings, difficulties and progress. The process of responding to learners' experiences with the tasks involve a form improvisation or 'on-the-spot' curriculum construction. These may involve presenting new tasks, or deciding to continue or conclude work on a task (Remillard, 1999:331).

One Primary

Engaging with the activities in the construction arena by the teacher was evident at One Primary. At One Primary the teacher engaged in reading the performances on the tasks that the learners were struggling with, for example concluding on levels of pollution and the findings of the tests as well as the connections between science and society, in the sense that people are responsible for pollution. The teacher was observing and listening to the learners in order to assess their understandings, struggles, and progress with the material, which corresponded with the activity described by Remillard (1999:329).

The teacher also improvised in response by engaging in on-the-spot curriculum construction, as defined by Remillard (1999:331). The strategy he decided on was one of asking probing questions about the findings of the tests, and then leading the learners to conclusions concerning the links between science and society. He did this by relating stories of his own observations while on a field trip in KwaZulu Natal, concerning the scarcity of clean water in the rural areas, and the plight of the local community because of this situation.

Two Primary

The teacher at this school engaged in the central activity of curriculum construction by engaging in the activities of task enactment. When the rain began upon the learner's arrival at the river while on the field trip, she instructed the learners to only do some quick observations and collect the necessary water samples from the river to be analysed when back in the classroom. Remillard (1999:331) refers to this activity as a form of improvisation or on-the-spot curriculum construction

While the tests were being done in the classroom, she analysed and examined the tasks that the learners struggled with (e.g. connections between science, pollution and society) and led them to the conclusions that she felt they should

have made, namely that society is responsible for the pollution of water. The action that can be observed here is the one that Remillard (1999:329) refers to as reading learners performances.

Three Primary

This teacher also engaged with the central activity of the curriculum construction arena when she adapted tasks to facilitate learner's work with them. She read the learners' performances, as this action is referred to by Remillard (1999:329), on the tasks while on the field trip and assessed their understandings, struggles and progress. An example of this was when she assigned learners who lagged behind in public speaking skills to be the spokesperson for their groups, reporting their findings to the rest of the class after the tests were conducted.

When all of the groups became excited about one of the tasks to be done, she encouraged the whole class to participate in the task after completing their specifically assigned tasks. This action of the teacher may be deemed as improvisation or on-the-spot curriculum construction, as identified by Remillard (1999:331).

Further improvisation, as defined by Remillard (1999:331), on this teacher's part included deciding on whether to conclude or continue the work on a task. An example of this was when the learners speculated on doing the tests on different parts of the river, and the teacher concluded the task by suggesting that this can be done during the next field trip.

The curriculum mapping arena

Remillard (1999:334) states that the curriculum mapping arena is less distinct than the other two arenas. The reason for this is that curriculum mapping actually occurs through decisions related to task selection and enactment.

She also notes that the model includes this third arena, as the outcomes of daily

decisions constitute an analytically distinct aspect of curriculum development. The reason for this is that the decisions that teachers make that shape their curriculum maps tend to go unnoticed, because they are often by-products of decisions about daily classroom events (Remillard, 1999: 334).

In addition, Remillard (1999:334) relates that teachers map the curriculum when they decide how or whether to use the structures provided by the curriculum support materials. Two categories of decisions can be identified in this arena. Firstly, the topic determination that designates the broad categories into which the curriculum is divided and secondly content determination which entailed the skills addressed in the topic, the timing of the topic which the task would fit into, and the amount of time to be devoted to it.

During the initial phase of the study that consisted of workshops on how to link the activities and the content of the SWAP to the principles of the RNCS and Natural Sciences topics, these essential mapping activities were discussed. At the conclusion of these workshops the teachers were asked to integrate the chosen activities with the Natural Sciences topics by means of lesson plans, and performed these tasks quite adeptly.

In the constructed lesson plans, and during the interviews, the teachers identified some of the activities on offer in the programme that they considered could be appropriately categorised for the achievement of all three of the RNCS Natural Sciences outcomes for grade 7. However, it should be noted that the teachers only decided to apply the chosen activities to the topic of matter and material for this year, as their learning programmes for the year had been already formulated, which restricted extensive mapping activities. Other topics suggested for next year included 'Earth and Beyond', 'Life and Living', and 'Energy and Change'.

One Primary

The teacher at One Primary decided to skip the bulk of the materials provided for reasons already stated, and also decided not to integrate it with other areas of the curriculum. The time he spent on the programme was also far less than the teachers at the other two schools.

According to Remillard (1999:334), analyses of the two teachers in her study's mapping decisions suggested two categories of decisions, namely topic and content decisions. The teacher at this school used the Natural Sciences topic of matter and material to inform his decision on which of the activities on offer to include in his curriculum. It can hence be concluded that this teacher's decisions is heavily determined by the topic to be paid attention to. Referring to Remillard (1999:334), it can also be concluded that the resource may rather have reinforced this teacher's beliefs about the topics, than influenced them.

In terms of the content decisions, this teacher made his decisions independent of the resource, by once again using the topics set by the official curriculum documents to guide the decision on which activities on offer to engage with. It should be noted thus that during a discussion about the achievement of the RNCS Natural Sciences outcomes by the chosen activities, the teacher related that he felt that all three of the outcomes would be achieved by the chosen activities.

Two Primary

The teacher at this school also decided to skip the bulk of the activities, but did spend more time on the activities than the teacher at One Primary. This teacher was also led by the topic of the official curriculum, namely 'Matter and Material', in choosing the specific activities to enact. According to Remillard (1999:335), it can once again be concluded that the resource may have reinforced this teacher's beliefs about the topics, rather than influenced them.

In terms of the decisions on content, it should be noted that this teacher also made her content decisions based on her own assessments of her learners (e.g. not having the patience for long activities), which corresponds to the point made by Remillard (1999:335) on content decisions by teachers using assessments of her learners to guide decisions. Yet again it was observed that during a discussion on the achievement of the RNCS Natural Sciences outcomes, she stated that all of the chosen activities would achieve the outcomes.

Three Primary

This teacher decided to use all of the activities the programme had on offer, stating as a reason that she wanted the learners to see the big picture about the activity that they were engaging in. Taking this into consideration, it is obvious that this teacher's decisions about content especially were not influenced by the topics of the set curriculum. In view of this, the converse about Remillard's (1999:334) statement that the resource may have reinforced their beliefs about the topics rather than influencing them, can be concluded here.

When considering the foregoing analysis using the framework proposed by Remillard (1999), it became evident that the teachers engaged with the resources in different ways within the three arenas of curriculum development identified. It may also be inferred that the following factors impacted their conduct in the different arenas.

1. While engaging with the activities in the curriculum construction arena it seemed that all three teachers were led in their decisions by their perceptions of the learner's engagement with the resource, especially in terms of what they felt the learners should know and be able to do at critical stages of engagement with the activities offered by the resource.

2. In the curriculum design arena all three participating teachers used the approach termed by Remillard (1999) as 'appropriating tasks'. An interesting

factor was that all three teachers used the themes of the official curriculum as a criterion to choose some of the activities on offer in the resource. The driving factor in the decision-making process here was thus that the chosen activity should fit into the themes prescribed by the curriculum.

3. Some identical occurrences were observed in the curriculum mapping arena with all three participating teachers, since their decisions on content were driven by the specific themes of the Learning Area prescribed by the official curriculum as mentioned previously. It needs to be noted here that the resource used by Remillard(1999) in her study had the same topics as those held by the teachers, and therefore reinforced their beliefs on the topics.

The resource used in my investigation had themes different to those in the set curriculum, and still the teachers decisions were driven by the themes of the curriculum. It may thus be concluded that the teacher's decisions were driven quite strongly by the curriculum, and that they used the resource to only reinforce their beliefs about these themes, rather than influence them.

With regard to curriculum development, Carl (2002: 3) states that teachers face tremendous challenges, several of which are related to the curriculum. These challenges may manifest at various levels and in various areas, i.e. from national level to within the classroom. Moreover, one of the objectives of school reform efforts is to ensure that schools become places of excellence for all students. As a consequence, this creates certain challenges for teachers, and in turn demands a certain level of teacher empowerment in order to achieve this vision of excellence in a diverse society with diverse needs (Carl 2002: 3).

The teacher must be a development agent who is able to develop and apply the relevant curriculum dynamically and creatively (Carl 2002: 16). Therefore, as a curriculum change agent, the teacher must have at his/her disposal specific curriculum skills and knowledge that enable him/her to be effectively involved in

the classroom and outside of it (Carl 2002: 16). For teachers to acquire the knowledge and skills they need, this process necessitates some form of training/education. Carl (2002:269) agrees with Remillard (2000: 347) that teachers are in need of some form of training, "… as it is unrealistic and unreasonable to expect that teachers should train themselves".

With regard to decentralisation, Reddy (2000: 3.1.3-3.1.4.) indicates that South Africa has adopted deliberate policies of decentralisation and has encouraged schools to take a greater part in curricular decision making. He states that recent policy documents encouraged individual schools and teachers to develop curricula to meet their classroom needs, in other words, curriculum development should be teacher-driven and school-based.

School-based curriculum development is, according to Reddy (2000: 3.1.4.), often seen as the reversal of earlier modes of curriculum change where generalised concepts were foisted onto schools. In terms of SBCD, each school developed concepts which were tailored to its specific context. In other words, each school would develop its own version of the core curriculum in relation to or in terms of meaningful interchange with its own environment, in keeping with the requirements of the given communities (Reddy 2000: 3.1.4.).

According to Reddy (2000: 3.1.8), the appeal for teacher participation in curriculum development in South African policy documents finds a largely disempowered teacher corps. It follows that both teachers and schools need to be prepared for a shift from centralised curriculum development to more localised processes. With regard to empowering schools and its teachers to effect this shift adequately, Reddy (2000: 3.1.8) suggests that teachers must be given proper opportunities and support to undertake this task, since "… there can be no curriculum development without teacher development" (Kelly in Reddy 2000: 3.1.8.).

5.2.2 Teacher development

From the research conducted by Bell and Gilbert (1994) a model emerged which delineates indicators for professional development of teachers. Their research describes the findings of a three-year project on teacher development, in which some science teachers were developing their teaching to take into account learners' thinking and constructivist views on learning.

According to the authors, three main types of development for teachers were identified, namely professional, personal and social development. The three different aspects of teacher development are explored as highlights of each type of development, and this is the proposed framework used to guide the analysis of data in this section of the chapter.

The current research shows some similarities with the investigation of Bell and Gilbert, in the sense that the interaction of the three teachers with the SWAP materials is examined to ascertain whether sufficient evidence is provided by this research to indicate that using the materials will result in a process that will foster teacher development. To make sense of the teacher development process I constructed a questionnaire based on the three categories of teacher development proposed by Bell and Gilbert (1994:485), to gauge the different facets of development achieved by the participating teachers.

The strategy that was followed in the current investigation can be explained in the following manner. The action research cycle that was used as the methodology for this study is perceived as the 'safety net' supporting the process of fostering teacher or professional development in order to affect school-based curriculum development by the participating teachers, and ultimately materials development.

The first aspect of the action research cycle was the planning phase, where teachers were introduced to the learning support material during the initial

workshops. Links were also made to the RNCS outcomes for Natural Sciences, and the teachers were asked to plan how and when they would fit the resource into their curriculum by drafting a lesson plan to be implemented. The second aspect of the cycle was the implementation or action phase, where the teachers were asked to present a lesson based on their planning done beforehand. During this phase there was some overlap with the next phase, termed the observation phase, since the researcher was observing the teachers while implementing their planned lesson.

After observing the teachers, the penultimate aspect of the action research cycle consisted of an interview, where reflection was done in the form of two semi-structured interviews. During the interview all three teachers remarked that they learned that a new approach in learning works well, namely the hands-on experiential learning method. In support of this, the teacher at Three Primary stated during an interview that she found that the learners take on more information, and readily recall it when using the strategy of experiential learning.

 At Two Primary the teacher claimed that participating in the programme provided her with new skills to adapt to different learners. The teacher at One Primary related that he found that the practical hands-on approach works best. When comparing these statements to an adapted list of indicators for professional development by Janse van Rensburg and Le Roux (1998), it is evident that the teachers have found 'new ways of doing' since the programme provided them with new skills and approaches to their classroom practice.

At the completion of the reflective interviews, which partly served as the basis for re-planning, the teachers were requested to re-draft their original lesson plans for further discussion based on their experiences with the resource during the first attempt at presenting it as a lesson. They handed these second drafts in to me on approximate pre-arranged dates with different time spans for each teacher, as logistics played a role in their re-drafting activities. When examining the re-

drafted lesson plans a degree of successful teacher development became evident, since the second lesson plans were revised and new pedagogies were being used.

On comparing the original and revised lesson plans, I found that the teacher at One Primary placed more emphasis on assessment and the different methods of executing it, as well as an additional part on enrichment by using other Learning Areas. At Two Primary the teacher emphasised the use of the programme in other topic areas of the Natural Sciences Learning Area, and also identified more Assessment Standards and methods to be used.

One Primary

Personal development

Initial personal development

According to the authors, the teachers were aware and accepting of a professional dissatisfaction or problem (Bell and Gilbert, 1994:485). The teacher at One Primary commented on his reasons for joining the programme. He stated that the reason for joining the programme was that he knew that he was not on a high level of teaching science, and that if the programme gave him a chance to be better able to cultivate a love for science among the learners, he would want to do it.

It thus emerged that his feelings of not having the necessary confidence and pedagogical strategies to implement the new curriculum may have been the professional dissatisfaction he experienced, which can be seen as analogous to the notion of dissatisfaction described by Bell and Gilbert (1994:485).

Secondary personal development

As the development continued, teachers further developed in different personal ways. This second phase dealt with the feelings and concerns of behaving differently as teacher in the classroom. The most important of these feelings,

according to the teachers, were their relationships with the learners as stated by Bell and Gilbert (1994:488). This teacher felt that there was a positive influence on this relationship, because the learners were more relaxed in class when they were participating in the programme.

He was also of the conviction that a relaxed classroom atmosphere was a positive outcome. He stated the reason for his comment to be that it is important for learners to be relaxed in a science class, since the relationship between teacher and learner is different in a science class to those of other classes. The reason for this is that experiments and a type of explorative learning is done in a science class, where a more relaxed personal relationship is necessary. These statements indicate that this teacher also felt that the relationship with the learners is of importance in the same way as noted by Bell and Gilbert (1994:488).

Third-stage personal development

Towards the end of the programme, the teachers' comments indicated that they were feeling more empowered to be responsible for their own development (Bell and Gilbert, 1994:492). At the end of the programme conducted during my study, the teachers were questioned on whether they were feeling more empowered to be responsible for their own professional development after the completion of the programme.

The teacher at One Primary stated that he did feel more empowered. He commented that he was now able to relate, in an informed way, to other teachers about his professional development while participating in the programme. He felt that telling other teachers what you are involved in now, is more important to them than telling about his past experiences. From the previous statements it does seem evident that the findings of Bell and Gilbert (1994:492) is duplicated in the current study, as he also developed a sense of trust in the programme and the new teaching that he started to use while participating in the programme.

Social development

Initial social development

According to the authors, the teachers in their study were all aware of the problem of their isolation in the classroom, being the only adult in the classroom with little feedback, support and critique available to them (Bell and Gilbert, 1994:486).

In this study varying degrees of the mentioned problem was observed. In One Primary the teacher stated that peer visits to the classrooms, which were done in the other two schools, were difficult with only one grade 6 and one grade 7 class in this school. This is a sentiment echoed in the original study by Bell and Gilbert (1994:486). However, he did state that the teachers usually conducted informal discussions in the staffroom to talk about common problems and issues experienced.

Secondary social development

According to the original model, as the programme continued the teachers indicated that they were valuing collaborative ways of working, and they felt more comfortable with sharing information in the group in which they were involved (Bell and Gilbert, 1994:490).

In this study the question was posed whether the teachers would share feedback and suggestions if they were working in a collaborative group setup. The teacher at this school felt that he would share information, and also stated that he had already told other teachers about his experiences with the programme. This statement is indicative of the same findings as those of Bell and Gilbert (1994:490).

Third-stage social development

The question was posed in this study whether the participating teachers would work with other teachers on a similar project outside of school times. This

teacher related that he would initiate a programme like this after school hours, and that it is expected of them to do this by the Department of Education. In the original study, the authors also state that as the teachers developed more, they started initiating activities with other teachers, working collaboratively outside of the programme time (Bell and Gilbert, 1994:493).

Professional development

Initial professional development

In the original study the teachers were encouraged to adopt the role of teacher-as-researcher, and it was found that the activities helped the teachers to find out more about their learners' thinking and learning (Bell and Gilbert, 1994:487).The questions that were touched upon in this section were those of whether the teacher became a researcher by finding out more information about their learner's thinking, and whether the activities in the programme led to this outcome.

The teacher at One Primary answered that he did learn more about the methods to be used in which learners learn best, which he stated was the method of hands-on experiential learning. This statement demonstrates that the teacher did indeed find out more about the learning and thinking of the learners, by taking on the role of teacher-as-researcher as noted by Bell and Gilbert (1994:487).

Secondary professional development

Bell and Gilbert (1994:491) state that the teachers participating in their study were starting to reflect on their classroom practice, both as to whether the practices worked and whether the actions taken matched their new theoretical ideas. They were also starting to take into account their learners' thinking, broadening their repertoire of teaching strategies, and using the new ideas in new contexts.

The teacher at One Primary stated in an interview that he had gained new

experience in the hands-on approach, which he also found out to be a powerful learning and teaching strategy, and that he would use it from then on in other contexts also.

Third-stage professional development
At the end of the research, the authors found that teachers took initiative to continue their development after the end of the programme by facilitating teacher development programmes themselves (Bell and Gilbert, 1994:493).

On the question whether the teacher would continue to engage in professional development at his school, he answered that he would, and that he is currently doing it because the Department of Education expects it of him.

Two Primary
Personal development
Initial personal development
According to Bell and Gilbert, the teachers were aware accepting of a professional dissatisfaction or problem (Bell and Gilbert, 1994:485). A professional dissatisfaction that this teacher mentioned during an interview was that the learners usually did not want to do any activities, and just waited for the teacher to put the notes up on the overhead for the learners to take it down. Some the learners even mentioned that the only reason they came to school was for social reasons.

The personal dissatisfaction as described by Bell and Gilbert (1994:485) in this case was that the teacher felt that the learners were not taking part in any activities, not submitting tasks, and thus not learning. At the completion of the programme she mentioned in an interview that the learners were starting to take part in activities and were submitting their tasks, not only in her class, but also in other classes. She felt that the learning culture had changed, that the concepts were getting across to the learners because of the activities of the programme, and that the learning process was enhanced and made into a fun experience for

everyone.

Secondary personal development

According to the teacher at Two Primary, the relationship between the learners and the teacher was positively affected. She remarked that, because of the participation in the activities of the programme, learning had become a more interactive process, that it became more relaxed, and turned into a positive experience for everyone.

This statement made by the teacher was indicative of the fact that the most important of these feelings and concerns of behaving differently as teacher in the classroom were their relationships with the learners as stated by Bell and Gilbert (1994:488).

Third-stage personal development

On feeling empowered to be responsible for her own professional development, she answered that she felt that participation in the programme provided her with skills to plan, and to make better decisions. Once again this remark corresponds with the findings of Bell and Gilbert (1994:492), namely that towards the end of the programme the teachers' comments indicated that they were feeling more empowered to be responsible for their own development.

Social development

Initial social development

The researchers found that isolation of the teacher in the classroom with no feedback or support was perceived as problematic (Bell and Gilbert, 1994:486). This was in fact not the case in Two Primary, as the teacher stated that there were discussions between subject teachers as well as with the rest of the teachers of the same grade. If the specific problem could not be resolved, the headmaster was notified in order to call in professional aid.

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Secondary social development

The findings of the original study state that the teachers felt more comfortable to share information as the programme progressed, as more trust was developed between the participants (Bell and Gilbert, 1994:490).The teacher at this school displayed a sharing commitment toward the colleague from One Primary that attended a workshop with her.

She provided access for him to her planning files for the year, and also gave contact details on finding more science teaching resources. She stated that the reason for this was that she perceived his complete isolation as a science teacher at his school. On the question whether she would share information and feedback when working on a programme, she remarked that she shared the information with her colleagues because she feels that they would share information with her as well.

Third-stage social development

The teacher at this school stated that she already worked collaboratively with teachers outside of school times on similar programmes hence this activity cannot only be ascribed to the participation in this programme. This statement replicates the finding in the section of the original study by Bell and Gilbert (1994:493), where it is noted that participating teachers started to initiate the same kind of activities with other teachers outside of the programme times.

Professional development

Initial professional development

The initial professional development of the teacher at this school appeared to have happened in terms of her engaging in the role of teacher-as-researcher, especially concerning her teaching methods. During the interview she stated that the programme provided her with some new 'tools' to be able to adapt to different classes and learners ways of thinking and doing things, and that she could go

around and 'fit' into the different groups while they were working.

From these statements it was evident that she found out more about the learners thinking and learning, as well as about her own teaching methods. These findings correlate with those noted by Bell and Gilbert (1994:487), in the sense that the activities helped the teachers to find out more about their learners thinking.

Secondary professional development
The findings of Bell and Gilbert (1994:491) were that the teachers participating in their study were starting to reflect on their classroom practice, both as to whether the practices worked and whether the actions taken matched their new theoretical ideas.

The teacher at this school obviously reflected upon her own classroom practice, as she mentioned that she would try a different teaching strategy first and then change it a bit after the first attempt. Her repertoire of teaching strategies also grew, as she mentioned that she was now able to adapt to different contexts.

Third-stage professional development
On the question of whether the teacher would continue to initialise professional development programmes in her school, she promptly answered 'yes'. This short answer, and the convincing way in which it was stated, yet again replicated the findings of Bell and Gilbert (1994:493), noting that at the end of the research, teachers took initiative to continue their development after the end of the programme by facilitating teacher development programmes themselves.

Three Primary
Personal development
Initial personal development
A professional dissatisfaction or problem identified by the participating teachers, was noted as a reason for joining the programme by Bell and Gilbert (1994:485).

The teacher at Three Primary noted that she seemed to be stuck in a rut, operating in the same way day after day in the classroom, and that participating in the programme provided an opportunity to try out other strategies. This may have been the dissatisfaction that she realised, and it correlates with the findings of Bell and Gilbert (1994: 485).

During this interview to explore her motivation for joining this programme, it became evident that she also had the interests of the learners and her colleagues at heart. She noted that participating in a programme like this would possibly also enrich her colleagues and that it would be positive for the learners to be exposed to the community they live in.

Secondary personal development
Concerning the effect of participation in the programme on the relationship between the learners and the teacher, she responded that she felt that the relations have developed positively, because the learners have reacted in an enthusiastic manner by asking questions during the activities and looking for answers by themselves.

The teacher also remarked that the learners started to think for themselves. Another type of positive relationship that also emerged is the fact that the teacher became known to the people in the neighbourhood of the school. The teacher was forthwith perceived as part of the community, and not just as teaching and leaving at school closing time. These statements are thus indicative of the fact that the teacher perceives the relations with learners to be as important as the findings of Bell and Gilbert (1994:488) on the same topic.

Third-stage personal development
On the question about feeling empowered to be responsible for her own development, the answer was that she did feel empowered in the sense that if an opportunity similar to this programme presented itself she would be able to

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master it. An extra dimension that may be added to this model became evident through the teacher's comment in this interview about the learners becoming empowered too, because they came to the realisation that they too can do research.

Another facet of personal development that the researchers pointed out in the original study was that teachers learned to trust the new teaching over a period of time (Bell and Gilbert, 1994:492). This was evident in the fact that they found learners to recall knowledge explored with the new way of teaching more readily. This type of occurrence, namely remembering facts better owing to the practical method of teaching, was also noted by the teacher during this interview.

Social development

Initial social development

The teacher at this school did not percieve isolation in the classroom with a shortage of feedback and support as problematic. The reason stated was that because they have classroom visits by other colleagues at the school which have a science background as well as a senior staff member attending during these visits. It thus emerged that the findings, in this case, of the current study do not replicate the findings of Bell and Gilbert (1994:486) concerning isolation of the teacher.

Secondary social development

In terms of sharing information in a collaborative manner, the point that emerged from the field notes was that the teacher in this school shared the information on a regular basis with her colleagues. She stated that being the head of the science department, she dispensed advice to her colleagues and shared information with them at staff meetings. From this it is evident that the teacher is as likely to share information with a group as the teachers were in the study of Bell and Gilbert (1994:490).

Third-stage social development

On the question about whether she would work collaboratively with other teachers outside of school times, she replied that she usually takes part in programmes outside of school times. This teacher also seems to echo the sentiments of the teachers in the study of Bell and Gilbert (1994:493) in terms of working collaboratively outside of school times.

Professional development

Initial professional development

During an interview the teacher at Three Primary stated that she had found the learners to recall information gathered when doing the activities of the programme more readily. She ascribed this to the fact that the learners remember facts better when following a practical approach to learning, as the one used in the activities of the programme. This view correlates with the one noted by Bell and Gilbert (1994:487), in the sense that the teachers came to learn more about the thinking and learning of the learners, and that the teachers also started to assume a role of teacher-as-researcher.

Secondary professional development

The teacher at Three Primary went on to relate that she perceived this new method of teaching had worked in her class, and that she would also apply it in other classes. The experience of Bell and Gilbert (1994:491) is duplicated in this study, as the teachers in their study also reflected on classroom practice and were planning and generating new teaching activities from a consideration of the new theoretical ideas.

Third-stage professional development

In terms of the subsequent professional development as described by Bell and Gilbert (1994:493), the teacher stated that she does initiate teacher development programmes all the time, as she is the head of the science department at the school and feels that she needs to partake in these activities.

From this investigation it emerged that the following trends can be identified in terms
of the three aspects of teacher development as proposed by Bell and Gilbert (1994):

One Primary

Considering personal development, this teacher noted that he was not on a high level of science teaching and would accept any new strategies to be a better science teacher. He also observed that the classroom climate became more relaxed because of the type of engagement with the activities, and that as a teacher he felt more empowered after completing the programme, since he could now relate with other teachers in a more informed way.

His social development may be perceived in terms of the school having only one grade 6 and one grade 7 class, and thus discussion between teachers were limited to informal staff room anecdotes, with the result that isolation in the classroom was a problem according to him. Further social development was evident in the sense that he was keen on sharing information, and had already started working with other teachers concerning professional development.

This educator came to the realisation that a powerful learning mechanism and teaching strategy was the hands-on practical approach, and thus it may be concluded that he also developed professionally since he reflected about his classroom practice, and on how learners learn best.

Two Primary

The personal dissatisfaction noted by this educator was that the learners did not actively take part in class, and did not submit assignments. However, according to her, this changed because of the programme with the classroom taking on a more relaxed atmosphere and learning becoming an interactive process. She

also felt that she developed personally in the sense that she became empowered to make better pedagogical decisions in future.

In terms of social development she noted that isolation in the classroom was not an issue, as the heads of departments and other teachers had a peer review system in place. It was also observed that she was willing to share a lot of information with colleagues, and was already working collaboratively with other teachers.

She also noted that she had developed in a professional way since she reflected on her teaching strategies, and found that the programme had provided her with new skills and tools to be adaptable with new and different teaching strategies.

Three Primary

The personal dissatisfaction experienced by this teacher was that she taught in the same way every day, with more or less the same materials and ideas as well. At the completion of the programme she noted that this monotony was broken, and new methods were engaged with. She also observed that not only did the relations with the learners prosper, but those between her and the school community as well. She also felt more empowered since she now knew that if another professional development programme was offered she would be able to master it.

When considering social development, she noted that isolation in the classroom was not a problem, since she was the head of the Natural Sciences Department and had a peer review system in place. She also observed that she does share information with her colleagues, and takes part in similar programmes after school hours because of her office at the school.

She felt that she did develop professionally, since she learned much about how the learners learn best, and because of this realisation also reflected on her own practice and started to engage in planning of new teachings.

As a form of evaluation of the programme related to the professional development of the participating teachers, the course of the SWAP programme was examined after its completion. The goal was to ascertain if the same features were applicable to the course of the programme, and whether the teachers indeed developed professionally in terms of the proposed characteristics proposed by Garet et al. (2001:919-920). An analysis of the characteristics of the professional development was done specifically in terms of the following indicators:

- Structural features, namely
    a) the form of the activity,
    b) the duration of the activity, and
    c) the degree to which the activity emphasises collective participation.
- Core features, namely
    a) the degree of content focus,
    b) the extent of active learning opportunities provided, and
    c) the degree to which the activity promotes coherence in teachers' professional development (Garet et al., 2001:919-920).

The findings of Garet et al. (2001:915-916) indicate that the abovementioned core features have a significantly positive effect on teachers' self-reported increases in knowledge, skills and classroom practice. It is also through these core features that the structural features mentioned significantly affect teacher learning.

Structural features
The form of the activity

The authors note that the most criticised form of professional development is the 'workshop', in the sense that it does not provide for fostering meaningful changes in the teachers' classroom practice (Garet et al., 2001:920). In the case of the 'SWAP" programme the workshop approach was necessary during the first phase of introduction and the discussions on the linking of the Natural Sciences outcomes and Assessment Standards.

The authors thus note that there is a growing interest in 'reform' types of professional development, such as study groups or mentoring and coaching. They also state that these reform types of professional development may be more likely than traditional forms to make connections with classroom teaching (Garet et al., 2001:921).

After the first introductory phase of the programme, the teachers were left to plan their own lessons and were then observed while implementing the programme. After the observation during school time, interviews were conducted for the teachers to reflect on their classroom practice.

When reviewing the method of 'workshopping' and reflection, it could thus be concluded that the programme showed characteristics of both the workshop as well as reform oriented type of professional development.

Duration of the activity:
According to Garet et al. (2001:921), almost all the literature on teacher learning and development calls for professional development that is sustainable over time. They therefore note that activities that extend over time are more likely to allow teachers to try out new practices in the classroom and obtain feedback on their teaching.

The process of the SWAP programme correlated with this finding, in the sense that teachers participated in the programme during the course of one year

(including the planning period), were first introduced to the materials by workshops, then left to plan the process themselves, and after presenting the programme participated in reflective interviews.

Collective participation

The authors note that there is a growing interest in professional development that is designed for groups of teachers in the same school, department, or grade level. They then mention some potential advantages of professional development designed for groups (Garet et al., 2001:922).

One of these potential advantages is that teachers, who are from the same school, are more likely to share curriculum materials (Garet et.al, 2001:922). The findings of my study correlates with this point, as all of the participating teachers mentioned that they would share the information gained from participating in the programme.

Another advantage is that professional development may help contribute to a shared professional culture, where teachers develop a common understanding of instructional goals, methods, problems, and solutions (Garet et al., 2001:922). This notion also became evident in my study when the head of the Natural Sciences department of the school called One Primary, remarked that a programme like this is along with its' principles is 'contagious' to the rest of the staff at the school.

Core features

The degree of content focus

In this feature, Garet et al. (2001:923-934) state that the emphasis of activities of professional development programmes varies in terms of the following:

a) Some activities are intended to improve the teachers' knowledge of subject-matter content. The SWAP programme attends to this concerning specific scientific tests and the interpretation of the results.

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b) Some are designed to improve teaching practice. The programme does this in an indirect manner, as the teachers noted during the reflective interviews that the group learning experiences which the programme advocates, have a positive outcome.

c) Activities vary in the goals for student learning that they emphasise. The programme attends to this by helping teachers to improve science process skills like research skills in learners.

d) Finally, activities vary in the emphasis they give to the ways learners learn. In the participation of the programme the teachers found that the way learners learn best is by a hands-on experiential manner, and noted this in the reflective interviews conducted.

Garet et al. (2001:924) then claims that a number of authors argue that professional development requires a dual focus on both knowledge of subject matter content and an understanding of how learners learn specific content. In retrospect it may then be concluded that the SWAP process did focus on the first notion mentioned, but to a lesser extent than on the second one.

Promoting active learning

In the framework proposed by Garet et al. (2001:925), it is stated that opportunities for active learning for teachers can take a number of forms; including the opportunity to observe expert teachers and to be observed teaching, and to plan how new curriculum materials and new teaching methods will be used in the classroom.

It can be concluded that the process followed with the research provides for both of the learning opportunities mentioned to be met. After being left alone to draft the lesson plans for implementing the programme and its principles in the classroom, the teachers were observed by the researcher while presenting the class, followed by a reflective interview.

Fostering coherence

This third core feature of professional development was assessed in three ways by the authors (Garet et al., 2001:927):

1) The extent to which it builds on what the teachers have already learned. It appeared that the teachers already knew from previous courses taken that group work and experiential learning could be used successfully, but was not aware of how to execute these theories in practice. As the teachers stated, the SWAP process did assist them with it and hence built on their previous learnings.

2) Emphasis on content and pedagogy aligned with national frameworks and assessments. During the SWAP process the principles put forward by the programme was first linked with the outcomes of Natural Sciences, and then the teachers were asked to show how they would align it with the necessary Assessment Standards.

3) Professional communication with other teachers who are trying to change their teaching in similar ways. This also became evident when the teacher at One Primary noted that she would communicate the SWAP to her colleagues, and the teachers at the other two schools said that they had already spoken to colleagues concerning the programme and its' principles.

The ongoing nature of the programme, as well as the opportunities for participation, were positively received and made for a programme that was both useful and enjoyable. Also the content focus linking to where teachers are and what they already know also worked well as a professional development process. Overall the SWAP process is related positively to the processes described by Porter et al (2001) and reflects positively on the process as a professional development exercise. This is also confirmed in the analysis according to the Bell and Gilbert (1999) framework used earlier and which is summarised below.

Some concluding remarks are presented below as a conclusion to the discussion related to the professional development analysis earlier.

In this study evidence of teacher development was forthcoming in all three aspects developed by Bell and Gilbert (1994). All the teachers were volunteers, thus accepting that they wanted to do something about their practice in the period of change. The fact that this was an unofficial programme and thus without any coercion from the Education Department makes the attendance more striking. The socio-political context was one of uncertainty during which teachers were being retrenched and redeployed to other locations and districts.

The inadequacy of in-service training provided by the Education Department was one of the reasons people gave for joining this research process. Many teachers spoke negatively of the INSET programmes provided by the Education Department. What was striking to me was teachers' willingness to attend workshop sessions after normal school hours. I perceive this as evidence of commitment to improving practice and of taking responsibility for personal and professional development.

CHAPTER 6

Conclusion and reflections

6.1 Introduction

The goal if this investigation was to ascertain to what extent the presentation of curriculum support materials to teachers participating in this study would have on the activity of school-based curriculum development by these teachers, possibly fostering a process of professional development.

The common perception among teachers is that curriculum is something outside of their concern and control, not connected with their daily experiences of classroom teaching. It has also been argued that teachers are merely translating the ideas of external curriculum developers into the classroom context, and that a deficit approach, where teachers are perceived as lacking in curriculum knowledge, is followed by most teacher development programmes. From this approach it followed that the knowledge gap should be filled by 'how-to' guides and recipe approaches to curriculum planning (Johnston 1993:473-474).

6.2 Curriculum processes for teachers

However, an alternative view of curriculum, similar to the one used in this investigation, has been presented in the form of the task of deliberation. This approach stands in stark contrast to the technical or mechanical process of curriculum planning, since the guiding principle is perceived to be that teachers' decisions are guided by personal practical knowledge (Johnston 1993:473). The guiding factor of personal practical knowledge in deliberation figured strongly in this study, when one of the teachers observed that her choice of activities to be engaged in was based on her experiences with the learners' impatience while participating in the programme.

According to Johnston (1993:479), the deliberative process is characterised by a process of gradual clarification of thought by the teacher. The similarity of the current investigation with this notion can be found in the fact that the participating teachers started thinking differently about their pedagogy and the way that learners learn. This point was evident when the participating teachers noted that learners readily recalled information gained by experiential learning and group work.

The point is also made by Johnston (1993:480) that the process of gradual clarification may have been a product of conversational interactions. A similar process was also fostered in this investigation during facilitation of the learning resource materials and the activities engaged with, and supported by the action research method to effect professional development and ultimately curriculum development.

The implications of the original study noted by Johnston (1993:481), were that links exists between curriculum decisions and the process of deliberation where teachers are actively involved in the process of deliberation, as well as the context of teaching. In the current study these points also came to the fore, in the sense that deliberation was the explicit method used when teachers were allowed to freely choose the activities of the programme to be engaged with, and that teachers cannot be de-linked from their context (policy, school and teacher education contexts).

Further implications for materials design was that text books should not regard curriculum decision making as a logical, sequential process, but should rather consider the teachers' 'own' values, allowing them to consciously reflect on their teaching and classroom practice (pedagogy) (Johnston 1993:482). The current investigation also attempted to have teachers engage in the activity of reflecting on their pedagogy, since they were allowed to experiment with new methods of teaching and proving to themselves that group work and experiential learning can be applied successfully.

6.3 Curriculum, materials, and professional development intersection

6.3.1 The extent of curriculum development

The basic design of the process followed during this investigation was informed by the principles of action research. The strategy proposed was that the participating teachers draft an initial lesson plan indicating how the learning resource material will fit into their planning for the teaching of Natural Sciences, followed by the action research phases termed firstly 'implementation', and then 'observation'. Following this, an interview was conducted with teachers consisting of two semi-structured interview schedules, as a tool for reflection and to serve as a basis for further planning. After these phases were executed, the teachers were asked to re-draft the lesson plans, implementing changes that they deemed necessary after their first attempt.

I concluded from the abovementioned activities that the teachers engaged with a process that I termed 'partial curriculum development'. This conclusion is based on the facts that teachers decided on certain activities to be engaged in, planning their lessons without extensive guidance from the facilitator, and then modifying their initial lesson plans after they tried the new pedagogies and learning strategies. Support of the abovementioned term '**partial** curriculum development' is based on the fact that the teacher actually did not engage in developing entirely new curriculum materials.

6.3.2 Curriculum materials and curriculum development

To illustrate the role of the curriculum materials in the process of curriculum development the nature of the curriculum materials used needs to be examined. Because the materials were designed to offer many choices through the loosely connected collection of tasks, it was perceived by teachers as not being prescriptive, and all three teachers found certain aspects appealing and useful. This view of curriculum materials concur with those observed by Remillard (1999:

328), namely that curriculum materials were designed to offer many choices in order to meet the approval of a range of potential purchasers/users.

Following from this observation it is obvious that the materials did not explicitly address the process of decision-making by the teachers, creating an advantageous situation since teachers were left to draw on practices they were most familiar with. When thus reviewing the process of curriculum development through the selection of tasks, the planning and modification of lessons, and the support of free choice from the curriculum materials, it can be concluded that the curriculum materials did play a significantly positive role in the process of curriculum development.

6.3.3 Professional development

The process of professional development was perceived by me as being a prerequisite at the beginning of the study for the engagement in the ultimate activity of curriculum development. Even though this was not a linear process, it was indicative that new skills gained in terms of trying out new pedagogies and learning more about how learners learn had an obvious influence on the skills of developing curriculum by participating teachers. When applying the indicators for professional development adapted from Janse van Rensburg and Le Roux (1998), it does appear that a certain extent of professional development was attained. This was especially evident when teachers engaged in new ways of doing by trying out new pedagogies, and coming to new understandings in terms of how the learners learn best.

A valuable insight gained, and worth mentioning, was that the strategy of action research functioned as a 'safety net' that allowed for the implementation of the learning support materials, and also fostered the whole process of professional development which ultimately led to the activity of curriculum development.

The whole process can be seen as a triadic relationship between materials development, curriculum development and professional development. In this process the relationship between the three elements mentioned can be described as mutualistic. The materials, SWAP kits, provided ideas and pedagogical suggestions that teachers could try to implement. These provided ideas for developing learning units, in essence a curriculum development exercise and process. When engaging with the above two processes teachers are in effect putting new ideas at classroom level and maybe even adapting suggested materials to suit their particular contexts. This represents professional development. This mutualistic process is summarised in the figure below.
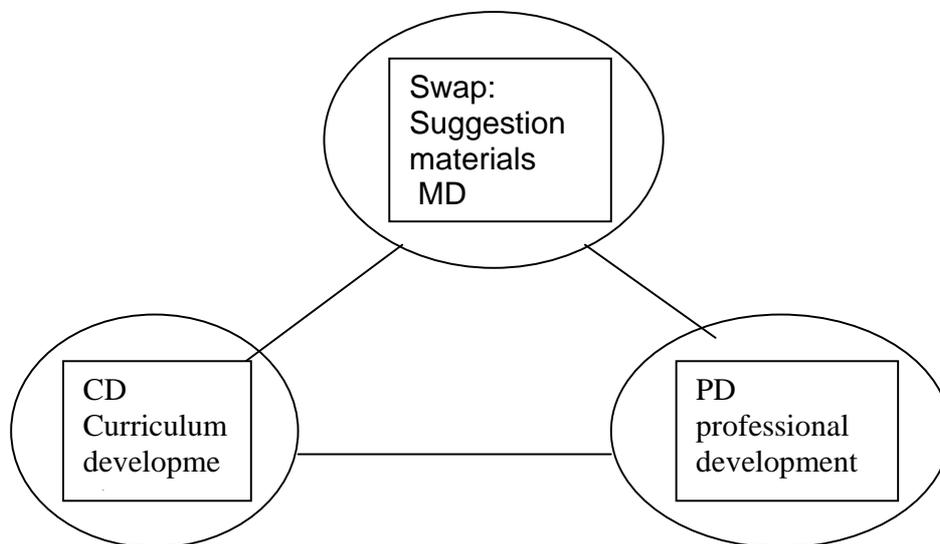

Figure 4: Triadic relationship between materials development, curriculum development and professional development

6.4 Limitations of the study

Certain limitations and challenges were experienced during the period of the research. The first related to implementation of the programme in terms of time constraints imposed by the set curriculum, according to the participating teachers. The participating teachers, as reflected in their initial lesson planning,

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regarded the programme as fitting in only with one of the topics in the Natural Sciences curriculum namely 'Matter and Material'. Another activity that had some impact and that deserves mentioning in terms of the result being even more time constraints, was the activity of a six-week protest by teachers concerning salary structures.

The second limitation was that the participating teachers gave this researcher an impression of being weary of implementing yet another learning resource material, and attending more workshops with the possibility of more workload. It also should be noted that the teachers appeared to first try out the programme in an experimental way on a small scale to find out whether it works, before incorporating it fully into their curriculum.

The third limiting factor was that the teachers participating were not educated in the methods of Outcomes-based Education (OBE), and seemed to not have faith in the new pedagogies that included for example experiential learning and group work. However, in retrospect the programme was perceived as the one that provided them with the skills to implement these new pedagogies in the classroom with success.

6.5 Opportunities for further research

Further opportunities may be described as research fostering a more sustainable effort over a longer period of time, constituting the aspects of action research, and even adding different learning support materials. A higher degree of validity may also be possible if a further investigation could be conducted on a larger scale involving more schools, and also closer links to be established with the educational structures and authorities.

6.6 Personal reflections: methodology and process

When visiting an academic bookstore one would find a substantial body of knowledge on guidance during post-graduate studies. The text provides a how-to

recipe on research, and also defines the time, duration and activities one should engage in to achieve 'personal and academic growth'.

However, while engaging with the realities of the practice of teaching during this investigation, the larger part of the literature mentioned above was rendered useless to me. However, the purpose of my text here is not to completely discredit these publications, since I do perceive it to have a place in the endeavour of research. To clarify my standpoint on this, I will state that my perception of guides to post-graduate studies to be analogous to a Global Positioning System (GPS). Very much like the GPS system, the guides can only provide the 'academic' traveller with a roadmap to the destination, but cannot predict unforeseen circumstances along the journey like erratic behaviour of other travellers, or the conditions of the travelling surface, for example.

Because of these confounding factors inherent to the practice, I found that research cannot be a dogmatic, clear-cut, and I dare say tidy process. With special reference to methods not being able to fully capture the untidy realities of the real world, my experiences resonate with this fact as stated by Le Grange (2007:421). During my investigation I was confronted with realities like anger over poor pay increases and the ensuing strikes by teachers lasting a total of six weeks, as well as pressure on teachers because of the time constraints of the set curriculum, and an array of other policy constraints impacting on their practice.

Some reflections that I wish to note here are the ones on my interactions with the social and physical context, as well as those with the participating teachers. In my experience the physical contexts of one and Three Primary were the most obviously under resourced ones, with the school labelled Two Primary having the basic classroom equipment and also a computer room furnished with about twenty computers. In terms of social context, Three Primary seemed to be the worst off, situated within a community ridden by all sorts of social evils including crime, child and alcohol abuse and AIDS, to name but a few.

Interaction with teachers were pleasant at all times, and I found myself in the privileged position of being able to see both their educational and social world through their eyes in conducting informal conversations with them 'off the record'. Their narratives seemed to be different, but in a sense all alike. They were all three individuals that did their jobs to the best of their capabilities because they dearly love what they do and wanted a better future for all their learners through education. Throughout the year I experienced their frustrations with learners and policy alike, but still they did not hesitate to pursue the best education for their learners, and did this in a fervent way through opportunities like the one this learning support material and process provided them.

Finally, I wish to echo the observations of Law (2004:152) concerning suggestions about a focus on process (which entails a focusing on analysis rather than beginning research with a theoretical framework derived from text) during research, rather than the Euro-American method of favouring product. In this regard I want to note that I unknowingly proceeded to do my research from the outset without a theoretical framework aiming to be concluded as valid or invalid at the end of the investigation, and this qualified without a doubt as the most insightful process of personal and academic growth ever. My observation that I wish to note here is that, because I did no start research with a theory derived from text, I am convinced that the data is rich beyond comparison, and that the conclusions drawn are valid.

6.7 Personal reflections

Upon reflecting on this investigation, I feel that it was beneficial that I did not keep a journal while conducting this study as I would have mostly documented emotions like anger, frustration and disappointment, which may lead the reader to think that negative emotions were the only ones aroused. On the contrary, this kind of emotion was only present during the first half of this research. The latter half was characterised by immense personal and intellectual growth, since I felt

that I had met different people during this latter half, although they were the same people. The reason for this is that personal bonding occurred on a higher level, and relationships metamorphosed form being that of researcher/subject to reciprocal relations of mentor/student, changing back and forth constantly.

With reference to personal growth, my promoter awoke me from these 'dogmatic slumbers'. To elaborate on this I need to explain the context of my studies.

During the initial phase of my investigation, I read extensively on the subject of research methods, and also discussed this topic with various people. On conclusion of these readings and discussions, I was convinced that valid research was to be conducted in a dogmatic manner, reminiscent of the basic tenets of the positivist research tradition. Most fortunately, I unknowingly conducted my research under the watchful and acutely critical eye of my promoter, without explicitly attempting to prove or disprove a previously decided upon theory. My intellectual and academic 'growth spurt' as it were, transpired during the latter phase of my study. This was evident in the fact that I had realised that the theoretical frameworks that I employed as tools for analysis, were only partially applicable to reality without being disproved in their entirety.

I felt that this occurrence provided the circumstances conducive to genuine growth for myself, since I gained the skills to fill in these 'reality' gaps, which in my view were missing in theories.

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Appendix i

Observation Schedule for school visit

Teacher observation:

Organization

Confidence

Integration to other learning areas and reaching of outcomes

Learner observation:

Participation

Curiosity

Connections between science and society

General notes

Interview schedule 1:

1. Can the learners contribute to planning of the program?
2. Are there sufficient resources?
3. Is the program and activities challenging to the learners?
4. Does thee teacher and the learners decide on deadlines together?
5. Do the learners set goals for themselves additional to those of the teacher?
6. Do all parties decide together on how to reach goals?
7. How is the division of labor decided upon?
8. Did the teacher use some of the materials and suggestions by learners, and if not was the reason explained?
9. Are the learners showing each other things?
10. Are the learners asking questions?
11. Does the teacher teach the whole class/small groups/individuals depending on the circumstances?
12. Are the learners telling others about their program?
13. Are the learners comrades in learning?
14. Did the teacher become more effective in teaching because of partaking in the program?
15. Did the learners become more effective in learning?
16. Are there any suggestions for modification of the program?

Appendix iii

Interview schedule 2:

1. Do you see isolation in your classroom (no feedback etc.) as problematic?
2. If you were working collaboratively on a program, would you share feedback suggestions for problem solving etc.?
3. After completing this program, would you work with other teachers on a similar project outside of school times?
4. Did you find out more about student learning in this program?
5. Will you be using the new theoretical ides by applying it to the classroom practice?
6. Will you continue to do curriculum development in your school, or even facilitate a PD program?
7. What would you say are your reasons for joining this program?
8. What is the effect of the resource on learner-teacher relations?
9. Do you now feel more empowered to be responsible for your own PD after this program?

Appendix iv