Teacher Knowledge, Attitudes and Practices in the Implementation of the new Swaziland Junior Secondary Science Curriculum

BY

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DECLARATION STATEMENT

I hereby certify that this piece of work is entirely my own work. It is original except for the work of others and sources that have been acknowledged. The material contained in this report has not been submitted previously for assessment in any formal course of study.

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ABSTRACT

In this study the mixed methods research design was used to determine the knowledge, attitudes, and practices of secondary school science teachers in the implementation of the new Swaziland Junior Secondary Science Curriculum (SJSSC). The interactions between the teachers' knowledge, attitudes, and classroom practices were also investigated. A total of 37 Form-1 Science teachers from 20 purposively selected schools in the Manzini region of Swaziland participated in the study. The 20 schools were located in urban, peri-urban and rural settings. The teachers responded to a survey questionnaire and a few selected teachers were interviewed and then observed teaching the new curriculum in their classrooms.

The data for the study were analysed using both quantitative and qualitative techniques. The findings for the study showed that teachers generally have good basic knowledge of the curriculum. A majority hold positive attitudes towards it. However, the classroom practices for almost all the teachers are inconsistent with the requirements and demands of the curriculum. Generally, the teachers' knowledge was not transferred to their classroom practices largely because factors such as inadequate school physical resources, large class sizes, and traditional teaching methods appeared to still influence the classroom practices and mediate the relationship between the teachers' knowledge and their classroom practices.

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CHAPTER ONE

INTRODUCTION AND BACKGROUND

1. 0 Introduction

Swaziland has recently introduced a new science curriculum for the junior secondary school level, the new Swaziland Junior Secondary Science Curriculum (SJSSC). This new curriculum embraces new teaching and learning approaches such as learner-centred teaching, and science teaching based on societal issues. With the implementation of this new curriculum, as is to be expected, there were certainly some demands placed on teachers such as the need to have the relevant knowledge and skills, and changing classroom practices in accordance with the requirements of the curriculum. My experience as a teacher and curriculum designer is that in many cases, teachers do not always welcome educational change and align their practices with the change demands. Rather, they resist change and tend to retain the traditional ways of doing things, or mixing the old with the new. Hence, the interest of the study was an attempt to gain some insight into what is it teachers know, do, and feel about the new curriculum in Swaziland.

1.1 Background

The education system in Swaziland consists of four levels: seven years primary, three years junior secondary, two years senior secondary school, and four years tertiary (7-3-2-4). At the junior secondary level, science education is integrated, that is, there is one unitary programme that combines the three science disciplines: physics, chemistry, and biology. This study was concerned with the new science curriculum at that level, the Swaziland Junior Secondary Science Curriculum (SJSSC).

For well over three decades (since 1974), science at the junior secondary level (Forms 1-3) in Swaziland is taught as the Swaziland Integrated Science Programme (SWISP). The curriculum materials of SWISP consist of a teaching syllabus, Teacher's Guide, and a Pupil's Workbook. The Teacher's Guide and Pupil's Workbook are activity-based. Both text materials use the 'cook-book' approach, in which the procedures for practical work are given and pupils are expected to follow the recipe in doing science laboratory work. This approach as a whole has been problematic in Swaziland and criticized in the sense that it alienates learners by making science learning not meaningful and fun to them (Dlamini & Dlamini, 2003; Gilbert, 2006; MOE, 1985).

From the 1980s, the government of Swaziland began to express concern about the applicability and relevance of its education and curricula. A commission named National Education Review Commission (NERCOM) was set up to review the education system of the country. In its report, the commission found that the education of the colonial and even post-colonial days had been almost irrelevant to the lives of the learners, and less applicable to the demands and goals of the Swazi society (Ministry of Education (MOE), 1985). The commission then recommended increasing the socio-cultural relevance of the curriculum, as this would hopefully improve performance and motivation. In other words, learners should be taught science through realities that are familiar to them and embedded in their culture.

In 1999, new educational policies were formulated namely, the national policy statement on education (MOE, 1999b) and the policy on science education (MOE, 1999a). The policy statement on education, among other things, stresses the need for education to become relevant to the learners' everyday life. Expanding on the principle of relevance, the national policy states that science education should draw on the environment and experiences of the pupils themselves (MOE, 1999a). It further stipulates that science should be presented and assessed in a way that allows the pupils to see its direct relevance to their lives. The principle of relevance is in accord with what has been suggested in recent times. Science educators have argued that science should be presented in such a way that the students see its relevance (Holbrook, 2003, 2005; Stears & Malcolm, 2005; Teppo & Rannikmae, 2003, 2004). Relevance means contextualising the teaching of science (MOE, 1999a), that is, teaching science through situations or issues that are familiar or potentially familiar to the learners. This approach will hopefully make learners more motivated and interested in doing science.

In 2002, the context-based approach was adopted in the development of junior secondary level science materials in Swaziland. The Swaziland National Science Panel which is a body mandated by the ministry of education to oversee science education in the country tasked a team of writers and reviewers comprising science educators, secondary school teachers, curriculum developers, and science inspectors to embark on this writing project (MOE, 2005c). The involvement of teachers in the development of curriculum materials was seen as something positive, precisely because they are the ultimate implementers of the curriculum in the classroom. According to Bennett & Lubben (2006), involving teachers in the planning, writing, and trial phases of curriculum development assures that the design of the curriculum will try to reflect the realities of life in the school classroom. It is assumed that teachers bring their rich experience regarding instructional ideas, their classroom reality, and their professional needs in the curriculum development process (Hofstein & Kesner, 2006). Therefore, to involve them at the initial stages of the Swaziland Junior Secondary Science Curriculum meant that they were part of the process before the implementation. This is a bottom-up approach aiming at increasing the teachers' ownership, thus reducing their anxiety regarding the adoption of unfamiliar content, new materials, and new pedagogical approaches (Hofstein & Kesner, 2006).

After the writing team had finished drafting the curriculum materials for Form-1, the materials were piloted in a few selected schools in the four regions of the country for about two years, in 2004 and 2005. The trialling period afforded teachers and schools an opportunity to provide feedback, which was then incorporated before the final version of the materials was published.

1.2 The Swaziland Junior Secondary Science Curriculum (SJSSC)

In 2006, the new Swaziland Junior Secondary Science Curriculum was introduced in all schools in the country starting from Form 1. The new curriculum materials consist of a teaching syllabus, Science In Everyday Life (SIEL) Teacher's Book 1, and Science In Everyday Life Learner's Book 1. The following sub-sections outline the characteristics of the new SJSSC in terms of its aims, philosophy, teaching and assessment methods, and the organization of the content of the SIEL materials.

Aims of the Curriculum

The six aims of the new SJSSC are that at the end of the three-year course the learners should be able to:

- 'to use the scientific concepts to address social issues and maintain a healthy lifestyle in their environment;
- develop the culture of using the scientific approach to carry out investigations and show innovation in the creation of scientific objects;
- develop scientific skills, confidently apply them to solve problems and communicate scientific information with growing proficiency;
- understand, interpret and apply basic science concepts and principles;

- recognise the usefulness of science as a starting point for science-based careers and
- recognise and appreciate the importance of living in harmony with the environment by demonstrating the use of resources in a sustainable manner both individually and in the community' (MOE, 2005b, p. 2).

The Philosophy of the Curriculum

The new curriculum is based on a constructivist approach to science teaching and learning (MOE, 2005a). From the constructivist perspective, knowledge is actively constructed by the learner him/herself using prior knowledge experiences (Holbrook, 2003). The learners learn through two complementary processes of assimilation and accommodation. During assimilation the learners interpret each new event within the context of their existing knowledge. When they cannot easily interpret a new object or event in terms of their existing schemes, they modify their knowledge as a result of the new event, which is accommodation (Ormrod, 2000). In other words, the environments to which people belong influence their views of the world around them and, therefore, influence what they know and how they know. With the constructivist paradigm, teachers no longer see themselves as transmitters of knowledge but as mediators of knowledge and facilitators of learning while learners take responsibility of their own learning (MOE, 2005a).

Recommended Teaching Methods for the Curriculum

With the new curriculum teaching is expected to become more learner-centred and skills based. Teachers are encouraged to use teaching methods and techniques that would accommodate learners of mixed abilities; view the learners as creative, imaginative, knowledgeable, skills-oriented, inquisitive, curious, and having different learning styles (MOE, 2005a). It is true that no one method can be prescribed to the teacher, however, methods and techniques that emphasize problem solving and active participation by the learner such as group work, laboratory investigations based on real life problems, classroom debates on controversial issues, field trips, project work, and role-play/drama are recommended (MOE, 2005a, 2005c). A learner-centred approach is described as one that uses the student's existing knowledge, skills, interests and understandings, derive from previous experience in and outside school as the starting point. It nourishes and encourages the natural curiosity and eagerness of all young people to learn to investigate and to make sense of a widening world by challenging and meaningful tasks (MOE, 2005a). A learner-centred approach also empowers students to think and take responsibility for their own learning. In addition to this, it involves students as partners rather than as receivers of educational growth. That is, learners should work together with the teacher to find information.

The change of the science curriculum from a more teacher-centred to a more learner-centred teaching approach, places new demands on the teacher to effectively implement the curriculum in the classroom. In other words, it requires change in practice at the level of the teacher (Fullan, 2001). The teacher must have comprehensive knowledge of the curriculum; knowledge of how to use various teaching resources including the library; and provide for more learner-learner and learner-material interactions in the classroom. The paradigm shift seems rather significant for secondary school teachers and may be a challenge not only for experienced teachers who are used to the traditional approach to teaching and learning, but also for new teachers who have not been taught through the constructivist approach in their training (Aldous, 2004; Davis, 2003; Odgers, 2003).

Assessment of the Curriculum

At the time of doing this study, there were no assessment guidelines accompanying the new curriculum. However, the policy on science education states that the curriculum should be assessed in a way that would allow learners to see its direct relevance to their lives (MOE, 1999a). That means teachers are required to use context-based assessment. In context-based assessment, the assessment items are based on everyday situations and learners’ experiences. They demand learners to apply the science they have learnt in solving science–related everyday life problems. The recommended assessment tasks include practical work, project work (individual or group) as well as conventional tests and examinations (MOE, 2005c; 2005a).

Outline of the Form 1 Science Course

The Form 1 ‘Science In Everyday Life’ course is made up of the following themes (named using everyday language to make them more accessible to learners):

- What is science?;
- Safety;
- Measuring things correctly;
- What is life?;
- Too small to see;
- Healthy living and
- Organisms in their natural environment.

Each theme forms a chapter in the ‘Science In Everyday Life’ materials. The organization and layout of these materials is such that the purpose and methods used in each chapter to develop a set of science concepts and skills among learners are tabulated in the Teacher’s Book. The scientific ideas to be covered in a chapter are subdivided into manageable units that may cover one or many lessons. The approximate time allocated to a unit is given in lesson periods. Each period is equivalent to 40 minutes, totalling four hours per week for science lessons (MOE, 2005c).

Each unit is made up of four parts: the context, “over to you”, practical activity, and “find out”.

The context – a local event, which is familiar or potentially familiar to the learners found at the beginning of a unit or activity. The event could be a social, environmental, or economic issue including technological or industrial applications of science. Contexts are given in the Learner’s Book in a variety of formats such as a storyline, picture, diagram, dialogue or role-play. These set the scene for learner’s active and interactive participation, which is then followed by a set of questions referred to as “Over to You”.

“Over to You” – questions given in the Learner’s Book immediately after the context that require learners to think for themselves by interpreting or speculating about various issues embedded in the context. The learners come up with tentative explanations, which should be reinforced by a practical activity.

Practical activity - After the speculations, learners are frequently required to execute a practical activity. The possible procedure for the activity may be devised by learners individually, done as a group effort or be guided by the teacher. Each unit usually ends with a "find out" activity.

"Find Out" – takes the form of an assessment where based on the practical activity learners are given more exercises embedded in everyday life experiences showing the socio-cultural relevance of science. These exercises further strengthen learners' participation and are carried out inside or outside the classroom.

Each chapter closes with a summary of ideas learners should have gathered from all the units. This is followed by an end-of-chapter set of questions for learners to try out as individuals, in groups, and finally as a class discussion. Through such an organization and layout of the materials, the curriculum developers hope that the learners would be encouraged to develop an inquiry-based and activity-based approach to science learning, rather than be passive and excessively dependent on the teacher and others. Thus, science is perceived as a reality in their own circumstances, rather than as the activity of scientists who are far removed from their own lives (MOE, 2005c).

1.3 Problem of the Study

What could be regarded as an issue in the implementation of the new Swaziland Junior Secondary Science Curriculum was that the Form 1 science teachers had only a one-day professional development workshop before the nationwide implementation of the new curriculum. These workshops were run on a regional basis. They were organised by the ministry of education and facilitated by members of the writing and reviewing team. In these workshops, members of the team gave an overview of the new curriculum, the context-based approach, and demonstrated one lesson from the Learner's Book 1. The questions that arise are: whether the one-day professional development workshop was enough to equip the secondary science teachers in Swaziland with the necessary knowledge and skills to teach the new science curriculum? What attitudes have the teachers developed towards the curriculum? Given this one-day workshop, how would the teachers put the philosophy of the curriculum into practice in their classrooms? In other words, the problem of this study was to determine how prepared teachers are for the new curriculum in terms of their knowledge of the aims, teaching methods, and assessment procedures, their teaching styles and classroom practices to accommodate the new philosophy and approach, and how effectively or otherwise the new curriculum is being implemented in the classroom.

The issues raised were addressed in the light of various arguments by scholars in the field about teacher professional development in science education reform (Bennett & Lubben, 2006; Guskey, 2002; Jeanpierre, Oberhauser & Freeman, 2005; Onwu & Mogari, 2004; Powell & Anderson, 2002; Scholtz, Watson & Amosun, 2004). Powell & Anderson (2002), for example, maintain that one- or two-day workshops that provide overviews of new curricula are an unacceptable approach to professional development when considering the support necessary for the implementation of a new curriculum. The reason is that the curriculum materials usually require a revised conceptual understanding of science content, knowledge of the research on how students learn, and the pedagogical content knowledge to use the materials effectively. The researchers further state that for teacher change to occur, curriculum reform must be accompanied by intensive and comprehensive professional development for the implementers of the new curriculum. Such professional development will help transform teachers' ideas about and understanding of subject matter, teaching, and learning of science.

To illustrate the above arguments, in a South African context, Onwu & Mogari (2004) showed that among other things, teacher change in Outcomes-Based Education-related classroom practices for some teachers occurred because firstly, in the continuous professional development workshops the teachers saw and experienced what they were expected to do in Outcomes-Based Education classrooms. Secondly, the teachers had the opportunity to analyse their real classroom experiences during their follow-up cluster meetings. They also saw the need to adapt to the new way of doing things because with the continued exposure to activities of the programme they began to understand learner-centred teaching. Such teacher experiences did not take place in the Swaziland context and therefore, there is likelihood that the teachers' classroom practices may not necessarily reflect the intentions of the curriculum developers. It is doubtful if the teachers in Swaziland fully understand what the new curriculum demands are and really see the need to change the way they do things in the classroom given the one-day workshop that they had. Other factors which influence teacher change highlighted by these researchers are the climate of expectation, change in learners, and involvement of parents.

It has been observed that there is usually a gap between the intended and teachers' classroom practices which comes as a result of teacher resistance, reluctance, lack of knowledge, and lack of physical resources, among other things (Davis, 2003; Rogan, 2004; Rogan & Grayson, 2003; Spillane, Reiser & Reimer, 2002). In some cases this is because policymakers concentrate on the initiation stage and neglect the implementation stage and consequently, low outcomes result from poor implementation of what was essentially a good idea (Rogan, 2004; Rogan & Aldous, 2005; Rogan & Grayson, 2003). In other words, good ideas are not always translated to the reality of the classroom. Therefore, it was necessary to explore the teachers' classroom practices in the implementation of the new SJSSC to see if they reflect the intentions of its developers.

Some researchers (Cohen, 1990; Davis, 2003; Powell & Anderson, 2002; Treagust & Treagust, 2004) have shown the crucial role played by teacher knowledge in the way a teacher teaches in the classroom. They claim that the ideas teachers hold about teaching and learning are central to their ideas about practice and most of the findings indicate that changes in teacher practice will normally require change in knowledge (Powell & Anderson, 2002). Without changes in knowledge, changes in practice are likely to be superficial, they assert.

According to the literature, another influential component of teacher behaviour is teacher attitude (M. Schwartz, 2006; Souza Barros & Elia, 1998; Zacharia, 2003). For example, Zacharia (2003) emphasizes that teachers' attitudes, which are a function of their beliefs, influence the teacher's behaviour and practices in the classroom. The findings of his study revealed that teachers with positive attitudes towards science taught an adequate amount of science and used hands-on, student-centred approaches while those with negative attitudes taught the subject poorly. Many other researchers (Garcia, 2003; Liu & Edwards, 2003; Moroz & Waugh, 2000; Reis & Galvao, 2004; Treagust & Treagust, 2004; van der Ryst, Jourbert, Steyn, Heunis, le Roux, & Williamson, 2001; Ward, Vaughn, Uden-Holman, Doebbeling, Clarke, & Woolson, 2002; Zacharia, 2003) hold the view that there is a relationship between knowledge, attitude and practices. Liu & Edwards (2003) report a positive relationship between the variables as they found out those parents who were more knowledgeable and who had positive attitudes also talked more with their children about sexual education. Some studies (Garcia, 2003; Treagust & Treagust, 2004) report a positive relationship between science teachers' knowledge and classroom practices, but others (Powell & Anderson, 2002; Reis & Galvao, 2004) argue that knowledge does not always translate into practice. It is important to understand why teachers teach the way they do (Gwimbi & Monk, 2003). In the context of Swaziland, the study looked at the teachers' knowledge, attitudes, and practices, the interactions between these variables as well as the facilitating or inhibiting factors in implementing the new curriculum.

1.4 Statement of the Problem

The problem of this study was to determine teachers' knowledge of, attitudes towards and practices in the implementation of the new Swaziland Junior Secondary Science Curriculum. The study also tried to find out the interactions, if any, between teachers' knowledge, attitudes and classroom practices.

Research Questions for the Study

The problem statement gave rise to the following research questions, which the study addressed:

1. What is Form 1 science teachers' knowledge of the aims, teaching methods and assessment procedures of the new Swaziland Junior Secondary Science Curriculum?
2. What are the Form 1 science teachers' attitudes towards the new Swaziland Junior Secondary Science Curriculum?
3. How do the teachers go about contextualising science teaching (in line with the philosophy of the new curriculum) in their classrooms? What are the constraints, if any, in the teaching environment in implementing the SJSSC-related knowledge?

1.5 The Rationale

With the inception of the new Swaziland Junior Secondary Science Curriculum, in 2006, it would be interesting at the early stage to get some idea of what are the teachers' (as implementers of the new curriculum in the classroom) SJSSC-related knowledge, attitudes, and practices. As a starting point, I wanted to determine if the teachers are implementing the new curriculum as intended by its developers and whether they have the necessary conceptions and understandings of the curriculum as well as their feelings about it. The present study also tried to gain more insight into the reality of classroom practices in relation to the knowledge, and attitudes of the teachers whilst implementing the curriculum.

1.6 Significance of the Study

The significance of the study is that the findings will hopefully provide information to the ministry of education officials about the implementation of the new curriculum in the classroom. The study will provide some baseline data about teachers' knowledge of the aims of the new curriculum, its instructional and assessment methods. In-service programmes will therefore be more effective if they are based on accurate, up-to-date information about what teachers know and feel about the curriculum and what they do in their classrooms. It will also establish whether teachers have and use the instructional materials needed for this new curriculum. It will further indicate the level of teachers' implementation of the new curriculum including factors that hinder or facilitate its implementation. The study will make recommendations for possible interventions.

1.7 Overview of the Study

The study used the mixed methods – both quantitative and qualitative approaches in a survey design to investigate the new SJSSC-related knowledge, attitudes, and classroom practices of Form 1 science teachers in Swaziland as subjects. The study is presented in five chapters. The first chapter provides an introduction and background to the research problem, the research questions and significance of the study. Chapter two is concerned with relevant literature focusing particularly on knowledge, attitudes and practices (KAP) - related curriculum studies and empirical issues on the context-based approach to science teaching. It also discusses the theoretical framework used for the study. Chapter three is about the research design and methodology. It includes the criteria for the selection of the sample, the development and validation of the instruments, the pilot study, and the administration of the main study. Chapter four presents the results of the study. Lastly, chapter five presents the discussion of the results, conclusions, and recommendations. The terms and acronyms used in the study are defined as follows.

1.8 Definitions of Terms

The following terms are operationally defined as used in this study:

The context-based approach: a method of teaching science using learners' experiences and/or social issues as starting points for lessons and lesson activities.

Teacher Attitude: the teachers' positive (favourable), neutral, or negative (unfavourable) feelings and response towards the implementation of the new Swaziland Junior Secondary Science Curriculum, as determined by a Likert-type questionnaire.

Teacher Knowledge: teachers' understandings and knowledge of the aims, teaching methods and assessment procedures of the SJSSC.

Teacher Classroom Practice: what teachers know, what they say they do, and how they do in the classroom as they implement the new curriculum.

Profile of Implementation: what the teacher does in the classroom in terms of classroom interactions, science practical work, and context-based teaching as he/she attempts to teach the new SJSSC as determined by the theoretical framework used in the study.

Capacity to Support Innovation: the in-school factors which are able to support, or hinder, the implementation of the new SJSSC within the theoretical framework used for the study.

1.9 Acronyms

ACIS: The Commercial and Industrial Association of Sofala

AIDS: Acquired Immune Deficiency Syndrome

CREDE: Center for Research on Education, Diversity and Excellence

HIV: Human Immuno deficiency Virus

JC: Junior Certificate

KAP: Knowledge, Attitudes and Practices

KABP: knowledge, Attitudes, Beliefs, and Practices

LISSIT: Linking School Science with Industry and Technology

MOE: Ministry Of Education

NERCOM: National Education Review Commission

SIEL: Science In Everyday Life

SJSSC: Swaziland Junior Secondary Science Curriculum

SPSS: Statistical Package for the Social Sciences

SWISP: The Swaziland Integrated Science Programme

The next chapter discusses the literature review.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter reviews existing literature related to the present study. It presents an overview of first, the notion of context-based approach to science teaching, secondly, relevant studies on context-based curriculum implementation. Furthermore, related studies on knowledge, attitudes and practices in the context of programme implementation; and the relationship between teachers' knowledge, attitudes, and practices are highlighted and reviewed in justifying the need for the study. Lastly, the conceptual framework for the study is presented.

2.1 The Context-Based Approach

The context-based approach is a method or strategy adopted in science teaching, where some familiar or potentially familiar local events or focal events embedded in the specific cultural settings are used as the starting point for the development of scientific ideas for learners (Bennett, Lubben & Hogarth, 2006; Gilbert, 2006; MOE, 2005c). These events are referred to as 'contexts' and they can be social, economic, environmental, or technological and industrial applications of science. According to Bennett & Lubben (2006), the context-based approach was born in the 1980s from a concern widely held by teachers and science educators about current practice and its effects on the uptake of science subjects beyond the period of compulsory study. It was felt that school science needed to become more appealing, to be more relevant to young people's interests and their daily lives, and to involve them in a wide range of learning activities in which they could actively engage. The majority of studies on context-based work have been done in the United States, the United Kingdom, the Netherlands, and Canada with other studies carried out in Germany, Ireland, Israel, Scotland, Swaziland, and Taiwan (Bennett, Lubben et al., 2006).

In a context-based course, the ideas and concepts selected, and the contexts within which they are studied, should enhance young people's appreciation of how science contributes to their lives or the lives of others around the world; or how it helps them to acquire a better understanding of the natural environment. In other words, lessons should begin with aspects of the learners' lives, which they have experienced either personally or via media, and should introduce ideas and concepts only as they are needed, that is, on a "need to know" basis (Bennett & Lubben, 2006; Bennett, Lubben et al., 2006; Gilbert, 2006). This provides an increasing involvement of learners in the teaching-learning process as they will see the point of what they learn every step of the way (Westbroek, Klaassen, Bulte & Pilot, 2003). If students are more interested and motivated by the experiences they are having in their lessons, this increased engagement might result in improved learning (Bennett, Lubben et al., 2006). In the same vein, Lavonen, Juuti, Uitto, Meisalo, & Byman (2005) concluded that when a student is interested she/he develops a close relationship with the subject matter and studying leads to deep learning, which in turn allows application of the achieved skills and knowledge in new situations (transfer).

Advantages of context-based approach

Reviews of literature on the context-based approach in science teaching (Bennett, Campbell, Hogarth & Lubben, 2006; Bennett, Hogarth & Lubben, 2003; Bennett, Lubben et al., 2006; Murphy & Whitelegg, 2006) have found that:

- there is some evidence to support the claim that context-based approaches motivate pupils in their science lessons;
- there is evidence to support the claim that such approaches also foster more positive attitudes to science more generally than conventional courses;
- There is mixed evidence on the impact of context-based approaches on subject and career choices;
- there is good evidence to support the claim that the context-based approaches do not adversely affect pupils' understanding of scientific ideas or they provide as good a development of understanding as more conventional approaches. There is more limited evidence to suggest that understanding is enhanced;
- context-based approach makes extensive use of student-centred learning strategies;
- there is some evidence to suggest that performance on assessment items is linked to the nature of the items used, i.e., students following context-based courses perform better on context-based questions than on more conventional questions and
- there is moderate evidence to indicate that context-based approaches promote more positive attitudes to science in both girls and boys and reduce the gender differences in attitudes.

In addition, Bennett, Grasel, Parchmann & Waddington (2005) pointed out that using the context-based approach provided students with a chance to become more self-regulated in their studies, think critically and also weaker students do better on the context-based course than on a conventional one. Other advantages of the context-based approach are that it increases accessibility. This means that it diminishes the notion that 'science is difficult' as the majority rather than a few elite learners access science; increases students' problem solving skills; and fosters pride and confidence as well as greater school achievement (CREDE, 2002; Dlamini & Dlamini, 2003; Putsoa, Dlamini, Dlamini, Dlamini, Dube, Khumalo et al., 2003). Furthermore, other scholars have shown that using the context-based approach helps address the problems facing science education which have been identified as: curricula being overloaded with content; isolated facts and students not developing coherent schema; lack of transfer; lack of relevance; and inadequate emphasis (Gilbert, 2006; Pilot & Bulte, 2006). It would be interesting to know whether the teachers implementing the new context-based science curriculum in Swaziland would have the same views about the new approach to science teaching. The next sub-section highlights some of the disadvantages of the context-based approach.

Disadvantages of the context-based approach

Although many reports exist about the success and advantages of using the context-based approach in science teaching, there are still concerns as other studies highlight its disadvantages or cases where it was not welcomed or favoured. Bennett, Grasel, et al. (2005) found out that teachers viewed the context-based course as more burdensome in terms of workload on students and challenging for teachers to implement. The students in the context-based course were not only dealing with the same content as other students studying chemistry in conventional courses, but were doing it in terms of contexts, some of which were intellectually demanding. In this work, some of the context-based teachers were concerned that students might not see the point of the question if it is embedded in a story.

Moreover, Parchmann, Grasel, Baer, Nentwig, Detmuth, Ralle, and the Chik project group (2006) pointed out that the context-based approach may lead to a feeling of getting lost in the context, probably because teachers tend to put more emphasis on the realization of a good context than on the development of basic concepts. Similarly, reporting on a survey of context-based chemistry education in the United States, A. T. Schwartz (2006) concluded by indicating that sometimes emphasis on context can obscure rather than clarify chemical concepts and interfere with their generalizability and transferability to a wide range of contexts; and that the contextual approach can result in redundancies and/or omissions in the content of the chemistry that is taught, which may cause difficulties in subsequent chemistry courses.

Furthermore, in Swaziland, Dlamini & Dlamini (2003), using a large sample of learners who completed a questionnaire, investigated the views of Grade Seven and Grade Nine learners about contextualisation. Surprisingly, these researchers found out that most learners preferred the non-contextualised approach over the contextualised one. These investigators argued that learners preferred to be taught in a way that left no room for mistakes and misunderstandings and were concerned about knowing the 'right' thing for examination purposes. It also has been observed that not all teachers are willing to teach science using contexts and teacher willingness to begin teaching from a social perspective is limited to those who recognise its relevance value (Rannikmae, 2002). Finally, Campbell, Lubben & Dlamini (2000) found out that using context-based approach to teach science does not automatically make learners use their science knowledge to solve everyday life problems. Despite these disadvantages, the context-based approach has been adopted in many countries and a number of studies exist on the implementation of context-based science curricula as discusses in the following section.

2.2 Implementation of context-based science curriculum

Implementation of context-based science curriculum in Swaziland

Following small projects ("The Matsapha Lessons" and "Linking School Science with Industry and Technology [LISSIT]), in which a few units or lessons from the old curriculum, SWISP, were contextualised and tested in some schools in Swaziland, a few studies (Campbell et al., 2000; Dlamini & Dlamini, 2003; Putsoa et al., 2003) have been carried out on the contextualisation of science teaching in the country. But all these studies used learners as subjects. The research literature indicates that the failure or success of curriculum implementation depends, to a large extent, on the teacher in the classroom (Davis, 2003; Dekkers & Mnisi, 2003; Namsone, 2002; Pinto, 2005; A. T. Schwartz, 2006; M. Schwartz, 2006; Souza Barros & Elia, 1998; Waugh, 2000). "Teachers are the filters through which the mandated curriculum passes. Their understanding of it, and their enthusiasm, or boredom, with various aspects of it, colours its nature" (M. Schwartz, 2006, p. 449). Hence, the curriculum enacted in classrooms usually differ from the one developed by experts. Presenting teachers as the chief agents for implementing any new instructional policy, Cohen

(1990) maintains that students will not learn new mathematics unless teachers know it and teach it. The present study was an attempt to investigate what the teachers, as key role players in curriculum implementation, know, feel, and do in implementing a context-based curriculum that has been implemented nationwide in Swaziland.

Implementation of context-based science curriculum outside Swaziland

Drawing from other authors Aldous (2004), pointed out that there is insufficient information on the process of curriculum implementation: the extent to which teachers carry out innovations as intended by the developers, how they go about moulding the innovation to their context, the strategies that they use during the innovation process and how their pupils respond to the innovation. However, a number of recent studies exist on the implementation of context-based science curricula (Bennett, Grasel et al., 2005; Bennett & Lubben, 2006; Hofstein & Kesner, 2006; Parchmann et al., 2006; A. T. Schwartz, 2006). These studies have been carried out in countries outside Africa including the United Kingdom, Netherlands, Israel, Germany, and Taiwan. Generally, the researchers report successful implementation of the context-based science curricula though in some cases (Parchmann et al., 2006) the findings indicated that there was need for increased teacher support such as providing more guidelines for the teachers implementing the curriculum.

Two common reasons the researchers give for the successful implementation of the context-based science curricula are first intensive, comprehensive and on-going teachers' professional development, which would enable teachers to obtain appropriate content and pedagogical background. Secondly, teachers' involvement in the planning and development of the curriculum, which would make teachers feel some sense of ownership and reduce the anxiety regarding the adoption of unfamiliar content, new materials, and new pedagogical approaches. According to Bennett & Lubben, (2006), an in-service programme of support for teachers provided throughout the development and implementation of new curricula would minimize the mismatch between what is intended and what happens in practice. Such programmes would also enable teachers using the materials to meet members of the development team and other teachers using the programme to gain familiarity with the approaches, and share experiences of use. It is not clear whether Swaziland, being a developing country, would afford to conduct such workshops for the teachers implementing the new curriculum.

Hofstein & Kesner (2006)'s study carried out in Israel found out that the length of the in-service workshops attended by the teachers had some effect on the learners' understanding of chemistry. Students who learned industrial chemistry in classes in which the teachers underwent intensive workshops (focusing on varied-type teaching and learning techniques focusing on the teachers' development of pedagogical Content Knowledge), developed a better awareness of the social implications of chemistry studies, and that chemistry provides a significant contribution to their preparation as future citizens and for possible careers in chemistry (compared with student populations who studied Industrial Chemistry in classes in which the teachers experienced only rather short in-service training courses). In Germany, Parchmann et al. (2006) also attributed the success of the curriculum implementation to the equipment in the schools, which was sufficient regarding the demands of different activities in the curriculum materials.

What could be observed from the above studies was that most of them were carried out in developed countries and outside Africa. There was need therefore, to investigate the implementation of a context-based science curriculum in a different context where the teachers had a one-day orientation workshop and find out whether the school physical resources would be sufficient to support the implementation. The questions are raised in line with Rogan & Grayson (2003)'s argument that, training modifies teachers' beliefs, knowledge and skills to a greater or lesser extent, so that when they return to the classroom they may be motivated to try out the practices to which they have been exposed. In the end, however, only those practices that fit with the social and material constraints of the school environment will survive, be repeated and become part of the teacher's pedagogic repertoire. This view resonates with what Spillane et al. (2002) contended that even if teachers construct understandings that reflect policymakers' intent, they may lack the necessary skills and resources to put those understandings into practice. The present study extends the scope of existing studies by investigating the implementation of a context-based science curriculum in an African context, where school physical resources and large class size are usually a problem (Onwu & Stoffels, 2005). The review of the above studies also revealed a dearth of knowledge in terms of how teachers implement a new science curriculum in relation to their knowledge of and attitudes towards the curriculum.

2.3 Knowledge, Attitudes, and Practices (KAP) Studies

A number of HIV/AIDS-related knowledge, attitudes, and practices (KAP) and knowledge, attitudes, practices, and beliefs (KAPB) studies have been carried out in different parts of the world (ACIS, 2005; Adrien, Cayemittes, & Bergevin, 1993; al-Owaish, Moussa, Anwar, al-Shoumer & Sharma, 1999; Amirkhanian & Kelly, 2001; Chan, Khoo, Goh & Lam, 1997; Liu & Edwards, 2003; Nachega, Lehman, Hlatshwayo, Mothopeng, Chaisson, & Karstaedt, 2005; Prybylski & Alto, 1999; van der Ryst, Jourbert, Steyn, Heunis, le Roux, Williamson, 2001).

For example, the results of a very recent KAPB study (Nachega et al., 2005) conducted in Soweto, South Africa, indicate that the subjects had good knowledge of the cause of HIV/AIDS, modes of transmission, and importance of antiretroviral treatment adherence. However, adherence to the treatment was low despite the good knowledge. Similarly, also in South Africa, a cross-sectional study was conducted to assess the level of HIV-related knowledge, as well as high-risk behaviour and attitudes towards HIV, in a group of 339 South African National Defence Force recruits (van der Ryst et al., 2001). The recruits completed a self-administered questionnaire. The findings show that the recruits had a good level of knowledge regarding HIV/AIDS, although some had misconceptions regarding HIV/AIDS and its transmission. Many of them still practiced high-risk behaviour, such as not using condoms with casual or new partners. In other words, the good level knowledge did not necessarily translate into good behaviour. The researchers concluded that efforts towards initiating behaviour changes in military recruits should be intensified, and education programmes should be adapted based on the study results to facilitate achievement of this goal.

Other KAP/KAPB studies reviewed include those that have investigated subjects' knowledge, attitudes and/or beliefs, and practices in relation to other issues such as: breast and cervical cancer (Steven, Fitch, Dhaliwal, Kirk-Gardner, Sevean, Jamieson, & Woodbeck, 2004); prostate cancer (Steele, Miller, Maylahn, Uhler, & Baker, 2000); and tobacco and smoking cessation knowledge (Albert, Ward, Ahluwalia, & Sadowsky, 2002; Ward, Vaughn, Uden-Holman, Doebbeling, Clarke, & Woolson, 2002).

In the United States of America, for example, Ward et al. (2002) explored physicians' knowledge, attitudes and practices regarding a widely implemented guideline, the Agency for

Health Care Policy and Research smoking cessation guideline. A random sample of 879 physicians, which had implemented the guideline two years previously, was used for the survey. Although there were models stating that a ‘knowledge-attitude-behaviour’ sequence is important in modifying physician practice patterns, the findings of the study did not support such models. The models maintained that before a practice guideline can affect patient outcomes, it first affects physician knowledge, then attitudes and finally practice behaviour. The physicians’ self-reported practices did not match their self-reported knowledge and attitudes. A majority of the physicians reported engaging in primary behaviours that were recommended by the smoking cessation guideline, even though many reported little familiarity with the guideline and many did not know if they agreed with it or not. The physicians expressed negative attitudes but nevertheless practiced in a manner consistent with adherence to the guideline. In addition, this study also showed that other factors might have greater influence over physician adherence to the guidelines than physicians’ lack of familiarity or positive attitudes towards the guideline would suggest. These included the existence of an audit-plus-feedback system and organizational barriers.

On the other hand, other studies (Amirkhanian & Kelly, 2001; Liu & Edwards, 2003) found a positive relationship between the subjects’ knowledge, attitudes, and behaviours. Amirkhanian & Kelly (2001) found out that participants had low levels of AIDS-related knowledge and only 6% of their respondents reported consistent condom use, and 78% reported that they never or seldom used condoms. Similarly, Liu & Edwards (2003) conducted a cross-sectional, multi-site survey of 841 Chinese parents on their knowledge, attitudes and practices about sexual education for adolescents in the family. The findings of the study showed that the majority of parents had reasonably accurate knowledge about sexual issues and positive attitudes towards sexual education. The parents who were more knowledgeable and who had more positive attitudes talked more with their children about sexual education.

The review of the KAP/KAPB studies helped in providing the methodology for the present study. One limitation noted is that almost all the reviewed KAP studies used only a survey questionnaire as a research instrument, thus relying on the participants’ self-reports. The present study overcomes the limitation through the use of both in-depth interviews and classroom observations that would give direct evidence and first-hand information of what is happening in the classroom. What could also be observed from the reviewed KAP studies was that almost all of them were on behaviour. Moreover, their findings are inconclusive concerning the relationship between knowledge, attitudes and practices. Given these diverse findings about the relationship between knowledge, attitudes, and practices, it was therefore necessary to carry out a study that would further investigate the relationship between the variables. It would be interesting to know whether the teachers who participated in the present study would have good knowledge of the new curriculum, and if so, would that knowledge translate into expected classroom practices.

2.4 Teachers' knowledge, attitudes, and practices

Guskey (2002) points out that programs are systematic efforts to bring about change in the classroom practices of teachers, in their attitudes and beliefs, and in the learning outcomes of students. Implementation of these programmes or science reforms requires considerable adaptation of teachers' knowledge, beliefs, attitudes, and intentions to align requisite practices with the philosophy of science reform (Powell & Anderson, 2002; Zacharia, 2003). Some researchers (Aldous, 2004; Guskey, 2002) argue that teachers resist change because entrenched classroom habits defeat reform while in some cases rather than resisting change, teachers embrace it and find new ideas and materials that work in their classrooms (Cohen, 1990).

According to Cohen (1990), a case study of a mathematics teacher in California revealed that the teacher mixed the old with the new, meaning that her lessons contained some important elements that the new framework embraced, but also they contained others that it (the framework) branded as inadequate. To illustrate, she had adopted innovative materials and activities, but she used the new materials in traditional ways. For instance, she used them as though mathematics contained only right and wrong answers (right answers were not explained, and wrong answers treated as unreal), and conducted the class in ways that discouraged exploration of students' understanding, rather than as a field of inquiry in which people figure out quantitative relations. Furthermore, the teacher used many activities that involved concrete experiences and her class was organised to promote cooperative learning (the students' desks and tables were gathered in groups of four and five, so that they could easily work together, each group had a leader to help with various logistics chores, and the location and distribution of instructional materials often were managed by groups rather than individually), but the class was conducted in a highly structured and typically teacher-centred fashion, the main instructional group was the whole class.

Cohen (1990) attributed the teacher's mixing of the old and new ideas partly to her limited knowledge of mathematics which prevented her from even a glimpse of many things she might have done to deepen students understanding. According to this researcher, the teacher knew mathematics as a fixed body of truths, rather than as a particular way of framing and solving problems, questioning, arguing, and explaining seemed quite foreign to her knowledge of the subject. This scholar continues to argue that as teachers and students reach out to embrace a new instruction, they reach out with their old professional selves, including all the ideas and practices comprised therein. The past is their path to the future. Therefore, some kinds of mixed practice could not be avoided. He asserts that such mixtures are quite common in instructional innovation though they have been little noticed.

Recent studies (Treagust & Treagust, 2004) in science education report similar results. In their study, which investigated science teaching practices in Indonesian rural secondary schools, Treagust & Treagust (2004) through the use of case studies found out that with the exception of those classroom practices of one of the teachers, teaching science was a chalk- and talk- activity dominated by the teacher as the source of knowledge. The practices for the exceptional teacher were a mixture of both student-centred and teacher-centred approaches. For example, this teacher managed his classroom effectively organizing students into groups based on their academic abilities, linked concepts to be taught to the students' prior knowledge or daily occurrences; he used various questioning techniques and teaching methods, but sometimes used enriched traditional approaches where he lectured to students with some questioning here and there, and played as the main source of information giving notes. The rural schools were characterized by lack of physical resources (few textbooks, poorly equipped science laboratories, no electricity) and lack of qualified teachers, which were viewed as constraints. The study also found out that there was a relationship between teachers' knowledge, beliefs, and practices as the teacher who had 'good' practices possessed more content knowledge and relatively stronger beliefs in his ability to teach.

On the other hand Zacharia (2003) found out that there was a relationship between teachers' classroom practices and their attitudes. The results of his study revealed that teachers with positive attitudes toward science were found to teach an adequate amount of science and to use hands-on, student-centred approaches. On the other hand, teachers who held negative attitudes taught science poorly. He adds that teachers who were comfortable with science did not only devote more time to teaching it, but taught with more creativity. He further states that teachers with negative attitudes toward science pass them to their students through their actions.

Powell & Anderson (2002) however, argue that changes in practice do not necessarily result simply from providing teachers with new knowledge. They suggest that there is a complex relationship among knowledge, beliefs, and practices that is unique for each teacher. According to them, if teachers' beliefs and knowledge are aligned with those of the new curriculum then teachers' practices are likely to be consequential, but sometimes teachers practise what they do not yet understand cognitively or believe in whole-heartedly; while at other times their beliefs, knowledge, and practices are consistent. In support of this claim, Fullan (2001) pointed out that the relationship among classroom practices of teachers, change in their attitudes and beliefs, and change in the learning outcomes of students is detailed and highly complex and numerous factors can slow down the change process. In the same vein, others see the classroom contexts as one key factor influencing teacher change and contend that many innovations fail because they are poorly adapted to the classrooms (Gwimbi & Monk, 2003; Pinto, 2005; Rogan & Grayson, 2003; Scholtz et al., 2004; Spillane et al., 2002). There seems to be consensus among researchers that change is a gradual and difficult process for teachers requiring extra work, thus learning to be proficient at something new and finding meaning in a new way of doing things requires both time and effort (Davis, 2003; Guskey, 2002; Powell & Anderson, 2002).

From the literature reviewed, it is clear that for a new science curriculum to be successfully implemented, that is, teachers' classroom practices to reflect intentions of curriculum developers, teacher's knowledge, attitudes and other factors such as professional development and the availability of school resources have a critical role. It thus became important to investigate how the teachers implementing the new science curriculum in Swaziland are incorporating the new instructional practices in their teaching and in doing so, what are the constraints and facilitators. The present study, therefore, extends the scope of existing studies by determining the teachers' knowledge, attitudes, and practices in the implementation of a new context-based science curriculum in a developing country. And by further investigating the interactions between the variables as well as hindering and facilitating factors. The theoretical framework used for the study is presented in the next section.

2.5 Theoretical Framework

The present study investigated teachers' knowledge, attitudes, and practices in the context of curriculum implementation. From the literature reviewed, it is clear that there is a complex relationship between teachers' knowledge, attitudes, and classroom practices in the context of implementing an innovation. However, the study used Rogan & Grayson (2003)'s theory of curriculum implementation, proposed with particular reference to the natural sciences in developing countries, as the theoretical framework. The theory has three constructs: Profile of Implementation, Capacity to Support Innovation, and Support from Outside Agencies. The theory was considered as particularly appropriate for the present study because its profile of implementation looks at implementation in terms of learner-centredness and the teaching of science based on issues in the society, as envisaged by the new SJSSC. The Profile of Implementation is shown in Table 2.1 on the next page.

Table 2.1: Profile of Implementation for the Natural Sciences

Level	Classroom Interaction	Science Practical Work	Science in Society	Assessment
1	**Teacher**: Presents content in a well-organised, correct and well-sequenced manner, based on a well-designed lesson plan. Provides adequate notes. Uses textbook effectively. Engages learners with questions. **Learners**: Stay attentive and engaged. Respond to and initiate questions.	Teacher uses classroom demonstrations to help develop concepts. Teacher uses specimens found in the local environment to illustrate lessons.	Teacher uses examples and applications from everyday life to illustrate scientific concepts. Learners ask questions about science in the context of everyday life.	Written tests are given that cover the topic adequately. While most questions are of the recall type, some require higher-order thinking. Tests are marked and returned promptly.
2	**Teacher**: Textbooks are used along with other resources. Engages learners with questions that encourage in-depth thinking. **Learners**: Use additional (to textbook) sources of information in compiling notes. Engage in meaningful group work. On own initiative, offer a contribution to the lesson.	Teacher uses demonstrations to promote a limited form of inquiry. Some learners assist in planning and performing the demonstration. Learners participate in closed (cook-book) practical work. Learners communicate data using graphs and tables.	Teacher bases a lesson (or lessons) on a specific problem or issue faced by the local community. Teacher assists learners to explore the explanations of scientific phenomena by different cultural groups.	Written tests include at least 50% of the questions that require comprehension, application and analysis. Some of the questions are based on practical work.
3	**Teacher**: Probes learners' prior knowledge. Structures activities along "good practice" lines (knowledge is constructed, is relevant, and is based on problem solving techniques.) Introduces learners to the evolving nature of scientific knowledge. **Learners**: Engage in minds-on learning activities. Make own notes on the concepts learned from doing these activities.	Teacher designs practical work in such a way as to encourage learner discovery of information. Learners perform 'guided discovery' type practical work in small groups, engaging in hands-on activities. Learners can write a scientific report in which they can justify their conclusions in terms of the data collected.	Learners actively investigate the application of science and technology in their own environment, mainly by means of data gathering methods such as surveys. Examples here might include an audit of energy use or career opportunities that require a scientific background.	Written tests included seen or unseen 'guided discovery' type activities. Assessment is based on more than written tests. Other forms of assessment might include: Reports on activities undertaken; creation of charts and improvised apparatus; reports on extra reading assignments.
4	**Teacher:** Facilitates learners as they design and undertake long-term investigations and projects. Assists learners to weigh up the merits of different theories that attempt to explain the same phenomena. **Learners:** Take major responsibility for their own learning; partake in the planning and assessment of their own learning. Undertake long-term community-based investigations projects.	Learners design and do their own 'open' investigations. They reflect on the quality of the design and collected data, and make improvements. Learners can interpret data in support of competing theories or explanations.	Learners actively undertake a project in their local community in which they apply science to tackle a specific problem or to meet a specific need. An example might be on growing a new type of crop to increase the income of the community. Learners explore the long-term effect of community projects. For example, a project may have a short-term benefit but result in long term detrimental effects.	Learners create portfolios to present their 'best' work.

Table from Rogan & Grayson, 2003, p 1183-1185

The Profile of Implementation is an attempt to understand and express the extent to which the ideals of a curriculum are being put into practice (Rogan, 2004). It has the following four dimensions: the nature of the classroom interaction (what the teacher does and what the learners do); use and nature of science practical work; incorporation of science in society; and assessment practices. For each dimension there are four levels. Level one on all four dimensions describes a well-organised, teacher-centred lesson. This means that level one does not necessarily describe the lowest type of practice in existence or possible to find, but rather a good transmission type lesson. In moving through the levels, on all four dimensions, there is an increasing emphasis towards learner-centred approaches, and away from teacher-centred ones, but the profile does not imply progression from one level to another. That is, the higher levels are inclusive of the lower ones. The four dimensions are to a large extent independent of one another. For instance, the classroom interaction approaches may be at level three in a given situation, but the assessment practices may be at level one implying that the teachers' assessment practices are still more traditional.

Capacity to Support Innovation

According to Rogan & Grayson (2003), the construct, Capacity to Support Innovation (Table 2.2 on next page), is an attempt to understand and elaborate on the factors that are able to support, or hinder, the implementation of new ideas and practices in a system such as a school. They argue that not all schools have the capacity to implement a given innovation such as a new curriculum to the same extent. The possible indicators of the Capacity to Support Innovation are grouped into four: namely, physical resources; teacher factors; learner factors; and the school ecology and management.

Table 2.2: Profile of the capacity to support innovation

Level	Physical resources	Teacher factors	Learner factors	School ecology and management
1	Basic buildings-classrooms and one office, but in poor condition. Toilets available. Some textbooks-not enough for all	Teacher is under-qualified for position, but does have a professional qualification.	Learners have some proficiency in language of instruction, but several grades below grade level.	Management A timetable, class lists and other routines are in evidence. The presence of the principal is felt in the school at least half the time, and staff meetings are held at times. Ecology School functions, i.e., teaching and learning, occur most of the time, albeit erratically. School is secure and access is denied to unauthorized personnel.
2	Adequate basic buildings in good condition. Suitable furniture adequate and in good condition. Electricity in at least one room. Textbooks for all. Some apparatus for science.	Teacher has the minimum qualification for position. Teacher is motivated and diligent. Enjoys his/her work. Teacher participates in professional development activities. Teacher has a good relationship with and treatment of learners.	Learners are reasonably proficient in language of instruction. Learners attend school on a regular basis. Learners are well nourished. Learners are given adequate time away from home responsibilities to do school work.	Management Teacher attends school/classes regularly. Principal is present at school most of the time and is in regular contact with his/her staff. Timetable properly implemented. Extramural activities are organised in such a way that they rarely interfere with scheduled classes. Teachers/learners who shirk their duties or display deviant behaviour are held accountable. Ecology Responsibility for making the school function is shared by management, teachers and learners to a limited extent. A School Governing Body is in existence. Schools functions all the time, i.e., learning and teaching always take place as scheduled.
3	Good buildings, with enough classrooms and a science room. Electricity in all rooms. Running water. Textbooks for all pupils and teachers. Sufficient science apparatus. Secure premises. Well kept grounds	Teacher is qualified for position and has a sound understanding of subject matter. Teacher is an active participant in professional development activities. Conscientious attendance of class by teacher. Teacher makes an extra effort to improve teaching.	Learners are proficient in language of instruction. Learners have access to quiet, safe place to study. Learners come from a supportive home environment. Learners can afford textbooks and extra lessons. Parents show interest in their children's progress.	Management Principal takes strong leadership role, is very visible during school hours. Teachers and learners play an active role in school management Ecology Everyone in the school is committed to making it work. Parents play active role in School Governing Bodied and in supporting the school in general.
4	Excellent buildings. One or more well equipped science laboratory. Library or resource centre. Adequate curriculum materials other than textbooks. Good teaching and learning resources (e.g., computers, models). Attractive grounds. Good copying facilities.	Teacher is over-qualified for position and has an excellent knowledge of content matter. Teacher has an extraordinary commitment to teaching. Teacher shows willingness to change, improve and collaborate, and has a vision of innovation. Teacher shows local and national leadership in professional development activities.	Learners fluent in the language of instruction. Learners take responsibility for their own learning. Learners are willing to try new kinds of learning.	Management There is a visionary, but participatory, leadership at the school. Ecology There is a shared vision. The school plans for, supports and monitors change. Collaboration of all stakeholders is encouraged and practiced.

Table from Rogan & Grayson, 2003, p. 1188-1190.

Like in the Profile of Implementation, in this construct the dimensions also have four operational levels. In each case, an increase in the level indicates a greater capacity to innovate, for example, under the physical resources dimension, a school at level 2 has some apparatus for science available while a school at level 3 has sufficient science apparatus. However, in the Capacity to Support Innovation construct, unlike in the Profile of Implementation, the levels do represent a progression, and the ultimate goal for a school would be to achieve level four on all four factors.

For the present study only the Profile of Implementation and Capacity to Support Innovation were used because of its scope. In the Profile of Implementation three dimensions were looked at: these were the classroom interactions, science practical work, and science in society. The assessment could not be used because it includes written tests which the study did not intend to look at. The capacity to support innovation was narrowed down to mean the teachers' qualities or factors and the physical resources provided.

This theory provided a valid lens through which the study looked at the teachers' classroom practices and the extent to which the teachers are putting the intents of the new SJSSC into practice. It was therefore, considered a useful theoretical framework to be used to develop the questions for the questionnaire and classroom observation schedule, and in the analysis of data. It would be useful to apply the theory in the context of a curriculum reform particularly in a developing country such as Swaziland to test its validity. The theory has been applied in other situations (Rogan, 2004; Tawana, Rollnick & Green, 2006). The following chapter discusses the research methodology for the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the research methodology for the study. The research methodology is organized under the following subheadings: research design; population and sample description; instrumentation; validation of the questionnaire; the pilot study; and the main study.

3.1 Research Design

The study used the mixed-methods survey research design (Creswell, 2005; Creswell & Plano Clark, 2007) to determine teachers' knowledge of, attitudes towards and practices in the implementation of the new Swaziland Junior Secondary Science Curriculum. The relationship between the teachers' knowledge, their attitudes, and classroom practices was also determined. A mixed-methods survey research design is a procedure where both quantitative and qualitative data are simultaneously or concurrently collected through a survey questionnaire, and analyzed to get better insight into a research problem than each type on its own (Creswell, 2005). It involves interpretation and converging of quantitative and qualitative data in a single study. Mixing the methods allowed the researcher to "bring together the differing strengths and non-overlapping weaknesses of quantitative methods (large sample size, trends, generalization) with those of qualitative methods (small N, details, in-depth)" (Creswell & Plano Clark, 2007, p. 62).

3.2 Population and Sample Description

The population of this study consisted of all secondary teachers who are currently teaching Form One science using the new Swaziland Junior Secondary Science Curriculum in the Manzini region of the country. By the time of data collection the teachers had taught the curriculum for about a year and were expected to be familiar with the demands of the curriculum. The Manzini region was selected because it has the largest number of secondary schools in the country. This region has a total of 55 secondary schools and the schools are variously located (in urban, peri-urban, and rural settings) and resourced (well-resourced and poorly-resourced). Peri-urban schools were regarded as those schools that are outside town, but not in totally rural settings. Of the 55 schools, 8 are located in urban, 13 in peri-urban and 34 in rural settings.

The following method was used for selecting the schools that participated in the study. Three lists consisting of urban, peri-urban, and rural schools in the Manzini region were compiled. Within the lists, the schools were grouped into well- and poorly- resourced based on the knowledge of the researcher as an education officer. For the pilot study, three schools, one from each list were purposively selected ensuring representation of location and availability of resources. In the three schools all teachers teaching science in form-1 using the new curriculum were taken as the sample for the study. The three schools yielded ten teachers in total, seven males and 3 females. For the main study, 20 schools: 6 urban, 6 peri-urban, and 8 rural were also purposively selected from the remaining schools in the lists. Almost equal numbers of schools from the different locations were selected and the representation of variously resourced schools was also ensured. Having an almost equal number of variously resourced schools from different locations would allow the comparison of results.

In the 20 schools, there were 45 Form-1 science teachers in total who were using the new curriculum materials. On average, there were two teachers per school with some schools having only one teacher while others had three. The survey questionnaire was distributed to all 45 teachers. Thirty seven (82 %) teachers completed and returned the questionnaire. These were 17 females and 20 males. The majority of them hold the Secondary Teachers' Diploma (STD) while some have the Bachelor of Science (BSc) with the Post Graduate Certificate in Education (PGCE).

3.3 Instrumentation

The research instruments used in the study were: a teacher survey questionnaire, which was the major research instrument, an interview schedule, and classroom observation schedule that were used for purposes of triangulating and validating the data. The questionnaire was used to collect data that was used to assess the teachers' knowledge, attitudes, and practices in implementing the new curriculum. The interview and classroom observation schedules were meant for a few selected teachers from those who completed the questionnaire.

3.3.1 Teacher Survey Questionnaire

Procedure for the development of questionnaire items

Elements of the Rogan & Grayson (2003) theory of curriculum implementation were used to construct questions about teacher qualifications, teacher participation in professional development, school physical resources, and curriculum materials for the preliminary sections of the questionnaire (Appendix E). Other items, for example, gender and teaching experience were also included based on the reviewed literature. The new curriculum materials meaning the JC science teaching syllabus, teacher's book, and learner's book were used to develop the knowledge items. Science syllabi for other countries were used to get distracters for the items on knowledge of the curriculum. To develop items for measuring the teachers' attitudes, a number of attitude instruments were reviewed. Some items were developed based on the reviewed literature and others were adapted from Aldous (2004).

To obtain information about teachers' classroom practices, an open-ended question asking teachers to describe the best lesson they, themselves, had taught in implementing the new curriculum was developed. This question had guidelines which incorporated the elements of the Rogan & Grayson (2003) theory of curriculum implementation to help teachers focus in their descriptions and give relevant information. The elements of the profile of implementation that were used are the classroom interactions (as teacher- and learner-activities that took place during the lesson); science practical work (as nature of best lesson and lesson objectives); and science in society (as introduction of lesson) to determine how teachers included societal issues in science teaching. This method of using a questionnaire to determine teachers' classroom practices has been used in other studies (Onwu & Stoffels, 2005). This constituted the first draft of the questionnaire, which was validated as described in section 3.4. The validation process resulted in the second draft of the instrument, which was used for the pilot study (Ref. 3.5). The pilot study gave rise to the final version of the questionnaire which was used for the main study.

The structure and scoring of main study questionnaire

The final version of the survey questionnaire had 67 items in total. It consisted of four sections: A, B, C, and D. The structure and scoring of items in these sections are described below.

Demographic information

Section A of the questionnaire had four items that yielded biographical profiles of the individual teachers and these were on gender, qualifications, and teaching experience. Research has indicated that biographical issues and the classroom context have an influence on teachers' practices in the classroom and curriculum implementation (Aldous, 2004; Gwimbi & Monk, 2002, 2003; Onwu & Stoffels, 2005; Scholtz et al., 2004).

Information about the schools

Section B of the questionnaire consisted of six items about the schools' profile. The items included location of the school, a checklist on the state of availability and adequacy of resources (school library, science laboratory and science equipment) and the number of learners in the Form One science class. Class size has been known to affect what happens in the classroom (Finn, Pannozzo & Achilles, 2003).

New curriculum materials and teacher involvement

Section C (a) of the questionnaire had fifteen items intended to find out the availability and frequency of use of new curriculum materials (JC Science Teaching Syllabus, Form One Science In Everyday Life Teacher's Book 1, and Science In Everyday Life Learner's Book 1). It also sought information on the extent to which the teachers were involved or consulted in the development of the curriculum as well as their preparation for its implementation. In addition, there were items to elicit information on whether and how often the teachers used other teaching and learning materials other than new curriculum materials. They had to give reasons for using or not using the additional materials. Lastly, this part of the questionnaire required respondents to indicate their readiness to teach the new curriculum in their classrooms.

The collected data from sections A, B, and C (a) of the survey questionnaire were directly entered into the computer and the Statistical Package for the Social Science (SPSS) was used to obtain frequencies and percentages.

Teacher knowledge

Section C (c) of the questionnaire elicited data to determine what teachers know about the new curriculum in terms of its aims, teaching methods, and assessment procedures. This section consisted of an assortment of twenty-eight correct and incorrect statements about the new curriculum. A three-point scale was attached to each item: 'No' (1); 'Yes' (2); and 'Don't Know' (3) for the teachers to indicate whether the statements were correct or not about the new curriculum. The following table shows the items that measured the different aspects of the curriculum.

Table 3.1: Allocation of knowledge items

	Number of items allocated
Aims	1, 2, 3, 4, 5, 6, 8, 10, 11, 12, 15, 22, 24, 27
Teaching methods	7, 9, 14, 16, 18, 19, 21, 23, 25, 26
Assessment procedures	13, 17, 20, 28

There were only four items testing for teachers' knowledge of assessment procedures because at the time of data collection, there were no assessment guidelines accompanying the new curriculum, which would inform teachers about context-based assessment. These few items were based on the kind of assessment items provided in the Learner's Book.

The knowledge items were analyzed first to determine the number of respondents who selected each response for the different items. Then the percentage of respondents who got each item correct was calculated. Each item was scored either 1 or 0. One point was allocated for an item where the respondent correctly indicated it as correct or incorrect. For example, the item, 'the curriculum aims to help learners develop the use of scientific concepts and skills to address social issues' is true about the curriculum. Then if a teacher said this statement is correct, that is, selected 'yes' option, he/she was scored one point. In a case where the respondent wrongly indicated the item as correct or incorrect, or chose the 'Don't Know' option, the item was scored a zero. For example, a teacher who selected a 'no' option for the above-mentioned correct statement was scored a zero. Where there was no response, the item was scored 0. Appendix H shows the key for scoring the knowledge items. These yielded raw scores. Then the percentage of respondents who got each item correct was calculated from these raw scores.

The overall knowledge score for each teacher (Appendix J) were calculated in order to determine the relationship between the teachers' knowledge and factors such as gender and school location. The obtained individual teachers' overall scores for the knowledge section were then entered into the computer and analysed using descriptive statistics to obtain frequency distribution tables and measures of central tendency. The median was used to divide the scores into categories. A chi-square test was performed to determine the relationship, if any, between the knowledge scores, gender and school location. The chi-square test was used because the sample was not randomly selected.

Teachers' Attitudes

Section C (b) of the questionnaire was on teachers' attitudes towards the new curriculum. It had eighteen items, positive and negative statements about the curriculum. For each attitude component there was a positive and a negative statement to counter those teachers who could have been guessing by cancelling them out if they agreed or disagreed with both versions of the attitude component. The items sought information on: whether teachers feel teaching is enjoyable and interesting with the new Swaziland Junior Secondary Science Curriculum; whether the change from the old curriculum, SWISP, to the new curriculum was necessary; whether the new curriculum is different from SWISP; whether the new approach enhances concept development; whether the new curriculum promoted teacher creativity; whether it was easy to get the local materials needed to teach the new curriculum; and whether the new curriculum is demanding and tiring to teach. All items in this part of the questionnaire were statements with a four - point Likert scale attached to each item. The Likert scale scored 1 to 4 across the responses 'strongly disagree' (1), 'disagree' (2), 'agree' (3), and 'strongly agree' (4). It gave the respondents a wide choice to choose what best suited their views about the curriculum. They had to tick the corresponding number, making it easier for them to write their responses, thus increasing reliability.

Some scholars (McMillan & Schumacher, 2001, 2006) recommend that the neutral or undecided category be included in the Likert scale. They argue that if the neutral choice is not included and that is the way the respondent actually feels, then the respondent is forced either to make a choice that is incorrect or not to respond at all. Other researchers prefer the four point Likert scale because respondents opt for the easy way out by selecting the neutral category. It also helps to avoid responses clustering around the middle and therefore, not enabling statistical analysis of data (as is sometimes the case when the five point Likert scale, with neutral category included, is used) (Czaja, 2005; Weems & Onwuegbuzie, 2001). The researcher settled for the four-point Likert-scale because with the new curriculum we need to have an idea of what attitudes the teachers are developing towards it. That is, whether positive or negative.

In scoring the attitudinal items, responses were dichotomized by fusing them into agree and disagree. Both positive and negative statements about the curriculum were considered. The teachers expressed a positive attitude towards the new curriculum by agreeing with the positive statements and disagreeing with the negative ones. They were seen to be negative when they agreed with the negative statements and disagreed with the positive ones (King, Beazley, Warren, Hankins, Robertson, & Radford, 1988; Ward et al., 2002). The teachers' responses to attitudinal items are shown as Appendix K.

Teachers' classroom practices

Finally, section D of the survey questionnaire required respondents to describe the best lesson they themselves have taught in implementing the new curriculum. They were asked to describe the lesson under given sub-headings: lesson topic; reasons for considering the particular lesson the best; length of the lesson; nature of lesson; lesson objectives; equipment or materials used for the lesson; how the lesson was introduced; classroom organisation; learner activities; teacher activities; were objectives met; and how achievement of objectives was assessed. These subheadings were not in any way meant to limit their responses.

The respondents' descriptions of their best lessons were read several times trying to make sense of the data. A matrix of the lesson features or guidelines, which were in line with the theoretical framework, against the respondents' numbers was developed (Appendix L). For the nature of the lesson, organisation of the classroom, form of assessment, and nature of the lesson objectives qualitative data were quantified, that is, frequencies and percentages were obtained. For example, teachers had to state the nature of the lesson (whether practical, theory or mixture of the two). The total number of lessons that were reported as practical, theory or mixed was calculated to give an idea of how much science practical work was involved in teaching the new curriculum. Each sub-total was expressed as a percentage of the total number of lessons (37). The rest of the data were summarized to get the reasons teachers considered the particular lesson the best; the way teachers used societal issues or problems, if at all, during their lessons; and classroom interactions (learner activities and teacher activities) that took place during the lessons. The summarized data were scrutinized for the predominance of some elements to decide whether the lessons were learner-centred. A copy of the main study questionnaire is attached as Appendix E.

3.3.2 *Interview Schedule*

For purposes of triangulation, the researcher interviewed three teachers who had completed the survey questionnaire. The interviews were conducted to get in-depth and better insights into the teachers' understanding of, their attitudes towards the new curriculum and what was happening in the classroom from the teachers' own words and perspective (Creswell, 2005). That would help verify and extend the information obtained from the survey questionnaire.

The interview schedule was semi-structured. It began with questions about the teacher's qualifications, teaching experience, and involvement in professional development activities. These are some of the basic factors that relate more directly to the extent to which teachers would embrace innovation (Rogan & Grayson, 2003). The rest of the questions elicited information about the teachers' attitudes towards the new curriculum and classroom practices. These were: whether participants saw the new curriculum differently from the old one; what would make them want or not want to implement the new curriculum in their classrooms; how they conducted their lessons when teaching the new curriculum in their classrooms; the challenges they faced, if any, as they implement this new curriculum, and their overall feelings or comments about the curriculum. For the complete interview schedule see Appendix F. All interviewees would be asked the same basic questions in the same order so that interviewees answered the same questions, thus increasing the comparability of responses. That also allowed data to be complete for each participant on the topics addressed in the interview, and facilitated the organisation and analysis of the data (Cohen, Manion & Morrison, 2000). To further increase reliability, the researcher built rapport with each participant by talking to them about other general issues before the actual interview commenced.

Analysis of Data from Interviews

The interviews were tape-recorded and that enhanced the validity of the data by providing an accurate and relatively complete record. The tape-recorded interviews were transcribed into interview transcripts. The data were examined to get a sense of what was being said. The interview questions were used to organize and present the data from the interviews (McMillan & Schumacher, 2001).

3. 3.3 *Classroom Observation Schedule*

The interviewed teachers were also observed teaching the new curriculum in their classrooms by the researcher over a period of time to further validate the data from the survey questionnaire. The classroom observations allowed the researcher to obtain first-hand information from the classroom, thus providing the most direct evidence of what was happening in the classroom. They also enabled the researcher to see things that the teachers would not easily talk about in the questionnaire and during the interviews.

For the classroom observations, an observation schedule was prepared and used to collect observation notes. The classroom observation schedule included: the date of the observation; the setting; the observer; the role of the observer; and descriptive and reflective notes. In writing the descriptive notes, particular attention was paid to information about whether lesson objectives were made clear; how the teacher incorporated societal issues or problems in the lesson; the classroom and its organization; the use and nature of science practical work; the interactions that were taking place (teacher and learner activities); and the resources and their organisation. For the complete classroom observation schedule, see Appendix G. Before the first classroom observation in each school, the researcher observed the school buildings and its surroundings. She also asked the teacher to be observed a few questions about availability of learning materials such as computers and copying machines. This information was used to determine whether the schools had the capacity to support the new curriculum implementation as determined by the theoretical framework.

Analysis of Data from Classroom Observations

The observational data were analysed within Rogan & Grayson (2003) framework of curriculum implementation by organising the notes into the following themes: classroom interactions; science practical work; and science and society. The teachers were assigned into different levels of these dimensions as suggested by the theoretical framework (Ref. 2. 5) according to their observed practices. The teachers' practices were interpreted within this framework to say whether they (practices) were as intended by curriculum developers or not. Furthermore, the data was analysed against the aims of the curriculum to check which aims, if any, were attempted or achieved during the described and observed lessons. Lastly, the information about the schools and teachers was analysed within the Capacity to Support Innovation construct to determine whether the schools were in a position, according to the framework, to support the curriculum implementation. Finally, the teachers' practices were related to their knowledge to find out if teachers who are knowledgeable always exhibit the desired behaviours. For ethical reasons, the completed questionnaires, interview transcripts and observational notes are kept in a safe place and they will be destroyed 15 years after the study.

3.4 Validation of the Questionnaire

After construction, the questionnaire was given to a science curriculum designer who was part of the writing team that developed the new curriculum materials to test its content validity (Fraenkel & Wallen, 2006; Masondo, 2004). This colleague was given the draft questionnaire items and the JC science teaching syllabus, the SIEL Teacher's Book 1, and SIEL Learner's Book 1 to test the content validity by matching the items with the corresponding aims, recommended teaching methods, and assessment procedures for the new curriculum. She checked if the content of the questionnaire was appropriate for the research question, comprehensive, and logically addressed the intended variables, knowledge, attitudes, and classroom practices. This designer agreed with the researcher for over 80% of the items. The colleague was also asked to provide answers to the questionnaire items for the knowledge section as to verify the accuracy and objectivity of the scoring key. The items on which she did not select the same answer as the questionnaire developer were either modified or discarded.

The questionnaire was then given to another curriculum designer, an English language specialist, to check the language of the questionnaire items, by proof reading, and correcting the grammar; format of the items, and length of sentences. The validation of the items resulted in the removal of several unsuitable items, which had flaws, especially the ones where the science designer did not agree with the questionnaire developer in assigning them to the different aspects of the curriculum. The validation produced a 76 item questionnaire that was administered to teachers in the pilot study.

3.5 Pilot Study

The developed instrument, 76-item questionnaire was administered to ten teachers in a pilot study. Items 1 – 25 were about teachers' biographical information, schools profile, curriculum materials, and teacher involvement in the development of the curriculum. Items 26 – 45 were about teachers' knowledge of the curriculum while items 46 – 75 were on the teachers' attitudes towards it. The last item was an open-ended question that required responding teachers to describe the best lesson that they themselves had taught in implementing the new curriculum.

3.5.1 *Purpose of the Pilot Study*

The purpose of the trial was first to establish the time it would take teachers to complete the questionnaire. The teachers were firstly asked to time themselves as they completed the questionnaire and write the time down. The times varied from 20 to 45 minutes. The average time of 30 minutes was obtained and used as a guide for completing the main study questionnaire. Secondly, to find out whether the procedure used for the administration of the questionnaire would result in any serious problems or any problems would arise from the management of the results. Thirdly, it was to test the clarity of the questionnaire items to the teachers. The teachers were asked to indicate items that were not clear and comment on the format of the items. This helped to determine ambiguities or difficulties in wording. For example, the item that asked teachers whether they were involved in the development of the instructional materials was changed to whether teachers were part of the writing team that wrote the instructional materials for the new curriculum. In the former question, teachers who did not write the materials but only piloted them felt they were involved in the development of the curriculum materials, and therefore responded 'Yes'.

3.5.2 *Administration of the Pilot Study*

The questionnaire was distributed to all teachers who were teaching Form 1 science using the new curriculum in the selected schools. The questionnaires were left with the teachers to complete and were collected by the researcher on an agreed date. The decision to collect the questionnaires minimized chances of non-return. The survey questionnaires were identified by number codes rather than teachers' names and thus ensuring anonymity and non-traceability of responses in the research to external people (Czaja & Blair, 2005; Macmillan & Schumacher, 2001, 2006). Appendixes A, B, and C show the letters of permission to conduct the study from the Manzini Region Educational Office and school principals. Appendix D is a form of consent, which informed the teachers about the purpose of the study and asked them to sign it as declaration of their informed consent to participate in the research project.

3.5.3 Results of Pilot Study

Analysis of the pilot study results showed that some of the items testing for knowledge were too obvious to respondents such that all of them (respondents) selected the correct options. These were items 26, 27, 28, 29, 31, 33, 36 and 45 that measured the teachers' knowledge of the aims of the curriculum. They were accordingly modified by using science syllabi for other countries to get distracters that were closer to the correct option. Care was taken to assure that the distracters were incorrect but plausible. On the section on attitudes, there were some non-responses, for example, for items 53, 56 and 65. These items carried two words, which might have meant different things to the teachers and therefore making them not able to respond. For example, item 53 was 'teaching the new curriculum is more tiring/ demanding, and 65 – 'teaching the new curriculum is more enjoyable/ interesting for me'. Each item was split into two different items like 'I enjoy teaching science with the new curriculum, and science teaching is more interesting to me with the new curriculum'.

For item 38, testing the teachers' knowledge of the teaching methods, many respondents (7 out of 10) selected the wrong option. The item was regarded as commonly misunderstood and it was re-worded to make it clearer and understandable. Other items such as items 26, 30, 35 and 40, measuring aims of the curriculum, were identified to be too lengthy and were accordingly improved by breaking an aim into more than one item. Besides, there were items that required an increase in the number of categories or responses. For example, on the item that asked about the state of the school libraries, it was noted that some teachers from the same school selected different options for whether their schools were well resourced or poorly resourced. Consequently, the item was changed to include more options like: well resourced, under-resourced, or poorly resourced.

Classroom practice

The section on classroom practice, which required the respondents to describe their best lesson in teaching the new curriculum, did not yield any meaningful results since many respondents did not respond to it and those who did just wrote scanty descriptions in a few lines. These results necessitated changes in the nature, clarity and format of items, and consequently, guidelines or sub-questions were added under which respondents were to describe their best lessons. These included questions about the way the lesson was introduced, the nature of the lesson, teacher and learner activities, and assessment, among other things (Appendix E).

3.5.4 Reliability of the questionnaire

The Reliability of the Questionnaire used for the pilot study

The reliability which is the consistency of the scores from one set of items to another (Frankael & Wallen, 2006) was calculated for the knowledge items and attitudes items.

Reliability for Knowledge Items

The items on knowledge were dichotomous, meaning there was either correct or wrong response. For these items, the split-half procedure was used to determine the internal consistency reliability of the instrument. The items were divided into two halves: odd-numbered and even-numbered items. The respondents were scored for each group of items as described in section 3.3.1 for the main study questionnaire. In this way, the raw score for each respondent was obtained. The percentage scores were then calculated from the raw scores for both sets of items. The scores obtained by each respondent on the odd-numbered items were correlated with their scores on the even-numbered items using the Pearson product-moment coefficient. The correlation between the two sets of scores was found to be 0.603. The reliability for the scores on the total test was calculated using the Spearman-Brown prophecy formula as follows:

$$\text{Reliability of scores on total test} = \frac{2 * \text{reliability for } 1/2 \text{ test}}{1 + \text{reliability for } ½ \text{ test}}$$

$$= \frac{2 * 0.603}{1 + 0.603}$$

$$= 0.75$$

The reliability for the total test scores was found to be 0.75. Considering the acceptable reliability value (at least 0.70 and preferably higher) for research purposes (Fraenkel & Wallen, 2006), 0.75 is within the acceptable range. However, it should be noted that the questionnaire underwent further review incorporating the pilot study results.

Reliability for the Attitudes Items

Attitudinal items were polytomous, a range of responses would be acceptable, meaning the items are not scored right versus wrong. The Cronbach alpha or alpha coefficient (Frankael & Wallen, 2006) was calculated to determine the reliability of the instrument. Cronbach alpha reflects how well the different items complement each other in their measurement of different aspects of the same variable (Thorndike, 2005). It typically varies between 0 and 1, and the acceptable value is 0.7 and above. The Cronbach alpha for the questionnaire used in the pilot study was obtained to be 0.513. This value is obviously below 0.7 and therefore, it falls below the acceptable range. However, this value changed and increased after the item review and modification that resulted from the pilot study data analysis.

Reliability of the main study Questionnaire

The reliability of the final version of the questionnaire used for the main study was also determined. For both the knowledge and attitudinal items, the reliability was calculated as described for the pilot study questionnaire. For the section on attitudes the internal consistency reliability, Cronbach alpha was 0.706. This value is within the acceptable range for research purposes.

For the knowledge items the Pearson product-moment correlation coefficient between the odd-numbered items scores and the even-numbered scores was obtained through SPSS to be 0.513 (Appendix I). The reliability for the scores on the total test was calculated using the Spearman-Brown prophecy formula as follows:

$$\text{Reliability of scores on total test} = \frac{2 * \text{reliability for} 1/2 \text{ test}}{1 + \text{reliability for } ½ \text{ test}}$$

$$= \frac{2 * 0.513}{1 + 0.513}$$

$$= 0.68$$

$$= 0.7$$

This value for the reliability is just on the lower end of the acceptable range. However, conducting both interviews and classroom observations to triangulate the questionnaire helped validate the data.

3.6 The Main Study

3.6.1 Administration of the Main Study

The questionnaire for the main study was administered as described in section 3.5.2 for the pilot study. The next chapter presents the results of the study from the analyses of both quantitative and qualitative data.

CHAPTER FOUR

THE RESULTS OF THE STUDY

4.0 Introduction

This chapter presents the results of the study. The quantitative and qualitative procedures outlined in section 3.3 were used for data analysis. Based on the research questions, the results of the study are as follows:

- Sample Characteristics;
- Teachers' knowledge of the new Swaziland Junior Secondary Science Curriculum;
- Teachers' attitudes towards the new Swaziland Junior Secondary Science Curriculum;
- Teachers' classroom practices;

The results from interviews and classroom observations are also presented. The results from the analyses of both the quantitative and qualitative data are compared to determine the similarities and differences, if any.

4.1 Sample Characteristics

4.1.1 Demographic Information on Respondents

A total of 37 teachers completed and returned the survey questionnaire. The teachers' demographic information is given in Table 4.1.

Table 4.1: Demographic profile of the participating teachers

Characteristics	**Response option**	**Teachers**	
		Number	**(%)**
Gender	Female Male	17 20	46 54
Highest academic qualifications	STD BSc BSc + PGCE BEd Other qualifications	16 1 8 5 7	43 3 22 13 19
Teaching experience	Less than a year 1 – 5 years 6 – 10 years 11 – 15 years 16 – 20 years more than 20 years	0 9 5 12 5 6	0 24 14 32 14 16
Number of years teaching Form 1 science	Less than a year 1 – 5 years 6 – 10 years 11 – 15 years 16 – 20 years more than 20 years non-response	2 11 13 5 2 3 1	5 30 35 14 5 8 3

Table 4.1 shows that the sample was 54 % male. The majority (about 80%) of the respondents have an academic background in science and thus are formally qualified to teach science at the junior secondary level. Teachers in Swaziland are considered qualified to teach when they possess a teaching qualification as well as the academic qualification such as the Bachelor of Science. There were 19 % of the teachers who held other qualifications, which included: Bachelor of Science in engineering; Master of Science in mathematics; Bachelor of Science in agriculture and Diploma in Agricultural education. Overall, only two teachers did not have a teaching qualification. The other qualifications are science related, therefore, one could safely assume that there was no teacher who did not have a science knowledge background in the sample used for this study. From Table 4.1 there was no teacher in the sample who had less than one-year teaching experience. More than 50 % have over 11 years teaching experience with 16 % of them having more than 20 years. Based on the teachers' experience, only two teachers had taught Form 1 science for less than a year. They would be the only teachers, if at all, who might not have used the old SWISP materials in teaching Form 1 science. The rest of the teachers had taught Form 1 science for more than a year, and therefore had used the SWISP materials. The 35 teachers might have been in a better position to view the new curriculum in relation to the old one.

4.1.2 Profile of the Schools

The schools used in this study included urban, peri-urban and rural schools. There were 12 respondent teachers from urban, 13 from peri-urban and 12 from rural schools. Interestingly, 28 teachers (76 %) reported that their schools had libraries and all the respondents (100%) reported that their schools had science laboratories. The following table shows the number of teachers who reported teaching in schools that have the various states of school libraries and science laboratories by school location.

Table 4.2: Teachers' reports of school resources by school location

Resource	**Response**	**Teachers**				
		Urban	**Peri-urban**	**Rural**	**Total**	**%**
School library	Poorly resourced Under resourced Adequately resourced	2 6 2	6 3 1	4 4 0	**12** **13** **3**	32 35 8
Science laboratory	Inadequately resourced Adequately resources	7 5	7 6	8 4	**22** **15**	59.5 40.5

Table 4.2 shows that most (about 67%) of the existing school libraries were poorly resourced or under resourced. Eight teachers (22%) from urban, 9 (24%) from peri-urban, and 8 (22%) from rural schools reported having poorly or under-resourced school libraries. Only 3 teachers (about 8%), two from different urban schools and one from a peri-urban school, reported having adequately resourced school libraries. No rural school library was reported adequately resourced. Furthermore, Table 4.2 shows that only 40% of the teachers reported having adequately resourced science laboratories. This finding is disappointing after learning that every school had at least one science laboratory because having the laboratories buildings without the scientific equipment and apparatus would not enable successful implementation of the new curriculum.

Whether the number of learners in the science classes was related to the school location was also investigated. The next table shows the results.

Table 4.3: Teacher: Pupil ratio by School Location

		Number of Learners					**Total number of teachers**
		Less than 40	40-50	50-60	60-70	more than 70	
Teachers:	urban	1	9	1	1	0	**12**
	peri-urban	2	8	1	0	2	**13**
	rural	1	6	2	1	2	**12**
Total		**4**	**23**	**4**	**2**	**4**	**37**

From Table 4.3 it is clear that the respondents had varying numbers of learners in their Form One science classes. The analysis revealed that more than half the respondents (23, 62%) reported having learners between 40 and 50. Considering the recommended ratio of one teacher to 40 learners for secondary schools in the country it appeared that many of the teachers had more learners in their classes than is recommended. For example, a total of 10 teachers: two from urban, three from peri-urban and five from rural schools had more than 50 learners in class and these were viewed as large classes. Although the problem of large class size seems to cut across all types of school location, it is more prominent in rural than urban settings. Large class size together with the problem of inadequate school resources was likely to make teaching the new curriculum difficult for the teachers. There would be overcrowding in the classrooms and not possible for learners to carry out hands-on activities which are promoted by the new curriculum.

4.1.3 Curriculum Materials

Availability of new Curriculum Materials

Table 4.4 displays the availability of the new curriculum materials.

Table 4.4: Teachers having new Curriculum Materials

Material	Number of teachers having personal copies	% of teachers having personal copies
JC science teaching syllabus	33	89
SIEL Teacher's Book 1	30	81
SIEL Learner's Book 1	36	97

Table 4.4 shows that the majority (89 %) of the teachers who participated in the study have personal copies of the JC science teaching syllabus, 81 % have personal copies of the Teacher's Book and almost all of them (97%) have personal copies of the Learner's Book 1 . Overall, a high percentage of the teachers have personal copies of the new curriculum materials and that might enhance the implementation of the curriculum if the teachers use them appropriately or as intended.

Teachers' Use of new curriculum Materials

The frequency at which the teachers use the new curriculum materials and other materials in teaching the new curriculum in their classrooms was investigated. Table 4.5 shows the results by school location.

Table 4.5: Frequency of teachers' use of curriculum materials by school location

Response option	**Never use**				**Rarely use**				**Often use**				**Very often use**			
School location	U	PU	R	**Total**	U	PU	R	**Total**	U	PU	R	**Total**	U	PU	R	**Total**
New curriculum materials – JC science syllabus	0	0	2	**2**	3	4	2	**9**	5	8	2	**15**	4	1	6	**11**
SIEL Teacher's Book 1	1	0	0	**1**	1	3	2	**6**	2	1	3	**6**	6	9	7	**22**
SIEL Learner's Book 1	0	0	0	**0**	0	0	1	**1**	4	3	1	**8**	8	10	10	**28**
Old SWISP materials	5	3	3	**11**	4	6	4	**14**	1	4	4	**9**	1	0	1	**2**
Any other additional materials	1	0	0	**1**	5	7	4	**16**	4	6	7	**17**	2	0	1	**3**

Key: U = Urban; PU = Peri – Urban; R = Rural

Table 4.5 shows that the new curriculum materials are frequently used by the teachers for teaching the new curriculum as: 71 % of the teachers use the JC science teaching syllabus often or very often; 76 % use the SIEL Teacher's Book 1 often or very often; and about 97 % of the surveyed teachers use the SIEL Learner's Book 1 often or very often. A comparison of Tables 4.4 and 4.5 reveals that there are always a lower number of teachers who reported not using the materials than those who reported not having personal copies of the materials. For example, 4 teachers reported not having personal copies of the syllabus, but only 2 teachers said they never used the syllabus; 7 teachers said they did not have personal copies of the Teacher's Book 1 but only 1 teacher reported having never used it; and only 1 teacher reported not having a personal copy of the Learner's Book 1, but all the 37 teachers reported to be using it. This analysis indicates that some teachers who did not have personal copies of the syllabus, Teacher's Book 1 and Learner's Book 1 had access to them. Thus, suggesting that copies of these materials were available in the schools for the teachers to use.

From Table 4.5, it is also clear that although, most teachers have the new curriculum materials and use them often in their teaching, many still reported to be using other additional materials as discussed in the next sub-section.

Additional Teaching and Learning Materials to those for SJSSC

Further analysis of Table 4.5 revealed that about 70 % of the surveyed teachers reported to be still using the old SWISP materials in teaching Form 1 science in addition to the new curriculum materials. While 38% rarely used the SWISP materials, 29% used them often and very often. This research finding is of interest in that there is mixing of old and new, perhaps because teachers are not familiar or not comfortable with the new curriculum. Whilst they were using the new materials, they mixed them with elements from the old curriculum. Furthermore, the table displays that besides using the old SWISP materials, 54% of the teachers reported to be using other additional materials. The teachers had different reasons for using or not using additional materials, as illustrated in Table 4.6.

Table 4.6: Teachers' reasons for using or not using additional materials to those for SJSSC

Response	Number of teachers	Percent (%)
The new materials do not have enough information for learners	16	43.2
The new materials do not give enough guidelines for practical work	7	18.9
The new materials have sufficient information and do not need supplement	8	21.6
Other reasons for using or not using additional materials	6	16.2
Total	**37**	**100.0**

Teachers' reasons for using additional materials to those of SJSSC

Table 4.6 shows that sixteen teachers (43%) were not very happy with the new SIEL materials because they reported to be using additional teaching and learning materials for the reason that they felt the new curriculum materials do not have enough information for learners. The information was probably insufficient not only for the learners, but also for the teachers as the new curriculum appears to present equal difficulty in terms of the recommended approach. Seven teachers (19%) used additional materials because they felt the new curriculum materials did not give enough guidelines for practical work for both the teacher and learners. They have to work out the practical procedures for themselves. Other teachers had different reasons for using additional materials. These included that: teachers felt they needed more than one source of information; they needed extra information to give to learners as notes; they needed worksheets or workbooks as a supplementary for learners to record their observations; and they also needed to get some ideas for improvisation. Actually, these could be the reasons for mixing the new with the old. One teacher used additional materials because he did not have the Teacher's Book hence the Learner's Book or the curriculum itself made little sense to him.

Teachers' reasons for not using additional materials to those of SJSSC

Further analysis of Table 4.6 showed that 8 teachers (22%) were happy with the new curriculum materials because they did not use additional materials due to the reason that they felt the new curriculum materials have enough information and do not need supplement. One respondent, who was not happy with the new curriculum materials, had a different reason though for not using these materials. He felt the new approach, contextualization of science teaching, lowered the standards of science making it inferior. This is how he puts it:

"The new curriculum has long and many stories intended to popularize the science. These stories, however, adulterate scientific knowledge" Respondent number 12.

4.1.4 Teacher Involvement in the Development of the New Curriculum

Only 3 (about 8%) out of the 37 surveyed teachers participated in the writing of the new curriculum materials; and 6 (16%) teachers were involved in piloting the materials. There were 26 teachers (70 %) who attended the one-day orientation workshop for the implementation of the new SJSSC and the remaining 11 out of 37 did not attend. This analysis shows that about 30 % of the teachers met the curriculum for the first time in their classrooms.

Those respondents who reported having attended the orientation workshop were then asked how ready they felt they were to teach the new curriculum in their classrooms. This was to determine if the teachers felt the one-day orientation workshop was enough to enable them to implement the new curriculum in their classrooms. Table 4.7 presents the results.

Table 4.7: Teachers' readiness to teach the new curriculum

Response	Frequency	Percent (%)
Not ready to teach curriculum	3	11.5
Ready to teach curriculum	20	77
Very ready to teach curriculum	3	11.5
Total	**26**	**100.0**

Table 4.7 above unexpectedly indicates that the majority of the teachers 23 (88 %) of the 26 teachers who attended the professional development workshop reported ready or very ready to teach the new curriculum while only 3 (12%) said were not ready to teach the curriculum. This result is very interesting because many of these teachers did not have any experience with the curriculum, except the one-day professional development workshop, before they had to implement it in their classrooms. However, they still reported being ready to teach it. The support and guidance, provided through the Teacher's Book and Learner's Book on how to conduct the lessons, could perhaps explain why the teachers felt ready to teach the curriculum despite their minimal involvement in its development. These books give detailed guidelines for the lessons, thus the teachers were not challenged to design and plan their own activities. Or it could mean that they are not fully aware of what the curriculum demands of them since during the orientation workshop they were given only an overview of the curriculum.

Another reason could be that the teachers were simply 'hedging their bets' and giving the false impression of their readiness in order not to give the researcher the impression of incompetence. Teachers often view the researcher suspiciously as an 'undeclared spy' also on an evaluative mission.

4.2 Teachers' knowledge of the new curriculum

The first research question was concerned about the teachers' knowledge of the aims, teaching methods and assessment procedures for the new SJSSC. The responding teachers were asked a number of questions in an attempt to evaluate their level of knowledge in relation to the aims, teaching methods and assessment procedures for the new curriculum. Section C (c) of the survey questionnaire had statements about the curriculum, which respondents had to indicate whether they were correct or incorrect. This section was scored as outlined in sub-section 3.3.1. It is fundamentally important that the teachers implementing the new curriculum know its aims as explicitly stated in the JC science teaching syllabus, the recommended teaching and assessment procedures because this knowledge will guide their teaching, that is, planning and carrying out of learning activities.

Knowledge of the curriculum in terms of the aims

Table 4.8, on the next page, shows the teachers' knowledge about the aims of the curriculum.

Table 4. 8: Teachers' knowledge of the new curriculum in terms of the aims

Statement	No	Yes	Don't know	% Correct
The curriculum requires learners to be innovative and create scientific objects (true)	4	29	3	78
The curriculum seeks to develop objectivity in observation and in reporting observations (false)	0	34	2	0
The curriculum intends to assist learners develop scientific skills (true)	2	34	0	92
The curriculum aims to develop safety considerations in the laboratory (false)	0	35	2	0
The curriculum aims to enable learners to communicate scientific information with growing proficiency (true)	2	28	6	76
The curriculum intends to develop an understanding and efficient use of scientific instruments and apparatus (false)	3	32	2	8
The curriculum seeks to help learners develop the use of scientific concepts and skills to address social issues (true)	1	31	5	84
The curriculum aims to encourage the interpretation of collected information, using mathematical relationships, where appropriate (false)	2	34	1	5
Learners are required to recognise and appreciate the importance of living in harmony with the environment (true)	1	36	0	97
The curriculum requires learners to know that scientific knowledge is objective, fixed and not changing (false)	17	14	5	46
The curriculum aims that learners answer questions correctly (false)	8	24	4	22
The curriculum aims to enable learners to know, interpret and apply scientific, technological and environmental knowledge in wider contexts (false)	0	37	0	0
The curriculum seeks to make learners recognise the usefulness of science as a starting point for science-based careers (true)	2	34	1	92
The curriculum seeks to help learners develop the culture of using the scientific approach to carry out investigations (true)	0	35	2	95

As shown in Table 4.8, high percentages (76 - 97 %) of the teachers know the aims of the new curriculum. However, many and all the teachers in some cases could not identify the wrong statements about the explicitly stated aims of the curriculum. This might be an indication that the teachers were not very clear about the aims of the new curriculum.

Knowledge of teaching methods, the contextualization of science teaching

The following table displays the percentage of teachers who got the teaching methods' items correct.

Table 4.9: Teachers' knowledge of curriculum in terms of teaching methods

Statement	No	Yes	Don't know	% Correct
Community members should be used as resource-people when teaching this curriculum (true)	6	26	5	70
The curriculum requires the teacher to give learners procedures for practical work and projects (false)	19	17	0	51
Learning activities should begin with what learners already know from home, community and society (true)	2	34	1	92
Teaching/learning activities should be meaningful to learners in terms of local community norms and knowledge (true)	3	30	1	81
The curriculum demands that learners work in groups most of the time (false)	8	27	2	22
The teacher should give learners a lot of notes during lessons (false)	28	6	3	76
Learners should rely on the teacher most of the time during lessons (false)	24	8	4	65
The teacher is supposed to vary activities to include individual and group work (true)	1	35	0	95
The teacher acts as the main source of knowledge when teaching new curriculum (false)	20	7	10	54
The teacher is required to assist learners connect and apply their learning to home and community (true)	0	36	0	97

Inspection of Table 4.9 shows that many of the teachers (51 - 97%) know the teaching methods of the new curriculum. However, only about a quarter (22 %) know that the new curriculum does not require the use of groups most of the time. It is also interesting to note that half (51%) of the teachers thought that the new curriculum requires teachers to give learners procedures for practical work and projects. This is in a way consistent with the teachers' reports about the use of curriculum materials as some of them said they still used the old SWISP materials to get procedures for practical work.

Knowledge of assessment procedures in the new Curriculum

Table 4.10 shows the percentage of teachers who got each of the assessment items correct.

Table 4.10 Teachers' knowledge of curriculum in terms of assessment procedures

Statement	No	Yes	Don't know	% Correct
The curriculum requires mainly the use of oral questions and written tests for assessment (false)	15	14	8	41
In this curriculum, assessment questions should begin with contexts (true)	5	20	9	54
The curriculum demands the teacher to use a variety of assessment techniques, e.g., practical work, projects, written tests, oral questions (true)	1	34	2	92
The teacher should assess the cognitive aspect only (false)	21	5	10	57

Table 4.10 displays that 92% of the teachers know that a variety of assessment techniques should be used when teaching the new curriculum (perhaps from the orientation workshop or their training since almost all of them are qualified), but 41% still think oral questions and written tests should be the mainly used assessment procedures. Also, only 54% know that assessment items should begin with contexts, meaning that the questions should begin with a societal issue or problem, and not only require learners to know the scientific information, but also its application in everyday life.

4.2.4 Factors influencing knowledge of new SJSSC

The relationship between the teachers' knowledge scores and some factors (gender and school location) was examined. The overall knowledge scores (Appendix J) for the teachers were obtained as described in sub-section 3.3.1. The chi-square test was used to investigate the relationship between two of the variables. The chi-square test is a way of answering questions about association or relationship based on frequencies of observations in categories (McMillan & Schumacher, 2006). This non-parametric statistic was used because the sample was not randomly selected (Coolidge, 2000). The overall knowledge scores were dichotomized by splitting the data into two halves by the median (Coolidge, 2000). Those above the median became Group 1 (referred to as "High") and those below the median Group 2 (referred to as "Low"). The median knowledge score was obtained through SPSS to be 61. Tables 4.11 and 4.12 show the chi-square test results for the knowledge scores as they relate to school location and as they relate to gender, respectively.

Table 4.11 Chi - Square test results- knowledge scores and school location

School location	High knowledge	Low knowledge	Chi square (χ^2)	p
Urban	7 (36.8%)	5 27.8%)		
Peri urban	10(52.6%)	3 (16.7%)		
Rural	2 (10.5%)	10 (55.6%)		
χ^2 (2, N = 37)			9.416	.009

Table 4.11 shows that the probability of the observed chi-square (χ^2 = 9.416) is .009. That is, χ^2 (2, N = 37) = 9.416, p = .009. The probability for the obtained chi-square was less than the set significance level, $\propto$ = .05, (.009 < .05), the decision was to reject the null hypothesis at the 5% level of significance. The conclusion was that there was a significant relationship between the teachers' knowledge scores and school location.

Table 4.12 Chi-square test results- knowledge scores and gender

School location	High knowledge	Low knowledge	Chi square (χ^2)	p
Male	11 (57.9%)	9 (50.0%)		
Female	8 (42.1%)	9 (50.0%)		
χ^2 (1, N = 37)			.232	.630

Table 4.12 shows that the probability of the observed chi-square (χ^2 = .232) is .630. That is, χ^2 (1, N = 37) = .232, p = .630. The probability for the obtained chi-square was greater than the set significance level, $\propto$ = .05, (.630 > .05), the decision was to retain the null hypothesis at the 5% level of significance. The statistical conclusion was that there was no significant relationship between the teachers' knowledge scores and gender.

4.3 Teachers' Attitudes towards the new curriculum

The second research question was, 'what are the Form One science teachers' attitudes towards the new SJSSC?' The attitudinal data from the survey questionnaire were scored as described in sub-section 3.3.1. Table 4.13 shows the percentages of teachers who agreed with each of the statements about the new curriculum.

Table 4.13: Teachers' attitudes towards new curriculum

	Statement	**% Agreed**
1	It was necessary to change from SWISP to the new science curriculum	81
2	Teaching science is very interesting with the new curriculum	68
3	It is easy to find the local materials needed in the new curriculum	65
4	Learners get bored during science lessons	14
5	The new curriculum is **not** different from SWISP	16
6	Using the new curriculum makes it easier for learners to understand science	76
7	Teaching and learning has completely changed with the new curriculum from how it was done with the old system, SWISP.	86
8	Teaching the new curriculum is more tiring than SWISP	57
9	There was **no** need to change SWISP	19
10	There is **no** room for teacher creativity in the new curriculum	22
11	The local materials necessary for teaching the new curriculum are **not** available in my area	22
12	The new curriculum increases learners' interest and motivation in science learning	86
13	I enjoy teaching science with the new curriculum	70
14	Teaching is **not** fun for me with the new curriculum	30
15	Teaching the new curriculum is more demanding than SWISP	68
16	With the new curriculum, it is **not** easy for learners to follow science lessons	24
17	With the new curriculum's approach to science teaching is **not** interesting	32
18	The new curriculum allows me to be more creative than SWISP	51

Analysis of Table 4.13 reveals that 51 – 86 % of the responding teachers agreed with the positive statements about the new curriculum. Low percentages (14-32%) agreed with the negative statements. Overall, the teachers seem to be positive towards the curriculum.

4.4 Teachers' Classroom Practices

The third research question was about the teachers' classroom practices: 'how do the teachers go about contextualising the new curriculum in their classrooms?' Data to answer this question were obtained through section D of the survey questionnaire, which required the respondents to describe the best lesson that they had taught in implementing the new curriculum. In addition, during the teacher interviews the participants were asked how they conducted their lessons, and they were also observed teaching the new curriculum in their classrooms.

Reasons for Considering the Lesson the Best

The participating teachers stated that their lessons were between 40 – 80 minutes in length, which was equivalent to single or double periods. Interestingly, all the teachers, except two, described their choice of lesson of best practice in terms of how the learners responded to the lesson. Only those two teachers gave reasons which were about how well the teacher himself or herself presented the lesson. One of the two teachers felt the lesson was the best, because according to her, she presented it very well: she had clear focus; was audible enough; and gave clear definitions. The other teacher said the lesson was his best because the 'context', meaning the storyline used as a starting point for the lesson, enabled him to clearly introduce a topic (atoms, elements and compounds) he thought it was otherwise difficult to handle. In this case, the storyline was about an old lady who made a living through making and selling necklaces and earrings using beads of different colours. The beads were used to represent atoms. Learners were to join beads of the same colour to make structures that were likened to elements. Later, they joined beads of different colours to make structures likened to molecules and they combined these to form clusters, which represented compounds. These structures were meant to help learners visualize atoms, elements, molecules, and compounds.

The rest of the reasons for the choice of best lesson, listed were as follows, from most to least:

- The learners fully participated, were interested and motivated during the lesson;
- The learners were attentive and cooperative during the lesson;
- The learners responded correctly to most of the questions asked by the teacher and those in the textbook;

- The learners seemed to understand the lesson very well, for example, they came up with accurate conclusions;
- The lesson began with contexts which were familiar to the learners;
- The context used at the beginning of the lesson was good, interesting and raised a lot of discussion and debate;
- The learners had something practical to do during the lesson;
- The noise level was minimal and constructive;
- The lesson was very informative and dealt with practical issues faced by learners, for example, teenage pregnancy or where babies come from;
- The learners were able to plan an experiment or investigation and carry it out on their own;
- The learners were able to apply relevant intellectual skills, for example, the required mathematical skills;
- The lesson objectives were straightforward and easy to understand;
- The equipment required for the lesson was enough for every learner to use;
- The lesson required learners to think or was challenging to learners;
- The lesson was a fieldtrip which learners enjoyed;
- The local material needed for the lesson was easily available and
- The learners did well in the test for that particular topic.

Based on these reasons, the teachers viewed a 'best lesson' in terms of the learners' disposition to learn and one in which opportunities for meaningful learning were created. In a best lesson, the learners are highly motivated and actively involved. They participate, cooperate, respond correctly to most of the questions asked by the teacher or from the book; do activity-based work, and given opportunity to think critically. Moreover, the lesson as is suggested should make learners see the point of what they are learning, meaning it must be relevant, that is, based on learners' everyday life experiences and practical or social issues.

Science practical work

The responding teachers were asked to describe the nature of their best lesson as practical, theory, or mixture of the two. A large proportion of the teachers (22, 59 %) reported that their best lessons were a mixture of practical and theory; 19 % were practical; and again 19 % theory. However, it was interesting to note that, 32 % of the 78 % lessons reported as practical or mixture of practical and theory had all their lesson objectives being cognitive particularly at the knowledge and comprehension levels. Overall, only 17 (46 %) lessons had some objectives in the psychomotor domain.

Surprisingly, not a single lesson of those described as best lesson had objectives in the affective domain. This should be a cause for concern as some of the aims of the new SJSSC promote the development of skills in this domain. For example, one of the purposes of the curriculum is that learners should 'recognise and appreciate the importance of living in harmony with the environment by demonstrating the use of resources in a sustainable manner both individually and in the community' (MOE, 2005b, p. 2). Having many of the lesson objectives in the knowledge and comprehension levels and very few in the psychomotor domain is also worrying as the teaching syllabus emphasizes application of scientific information as well as the development of investigative skills (MOE, 2005b). Such as we have just found, although the unit objectives to be achieved and scientific process skills to be developed in a unit are spelt out in the Teacher's Book, the teachers seem not to pay much attention to them during the lessons.

Science and society

Another sub-question required the respondents to relate how they introduced their best lessons so as to determine whether a context (e.g., a specific issue or problem) was used as a starting point for the development of scientific ideas. Twelve teachers (32 %) reported having begun the lesson by directly going to the Learner's Book and reading the storyline or studying the picture at the beginning of the lesson. Fifteen teachers (41 %) began by reviewing the previous lesson, discussing homework or asking some questions related to the lesson, and then reading the storyline in the Learner's Book. The rest of the teachers, 10 (27 %), began by defining the terms that learners were bound to meet during the lesson, explaining and demonstrating for learners what to do and how to do it. For the 73 % of the teachers who followed the Learner's Book and read the provided storyline or context at the beginning of the unit or lesson, it could be concluded that they based their lessons on specific issues faced by society.

Classroom Organisation

The responding teachers were also asked to describe the manner in which the class was organized during the best lesson. From their reports, it is clear that classroom organisation was dominated by group work that is, having learners working in groups of between 5 - 11 learners. There was one exceptional lesson where the learners were divided into two groups of 23 learners, for example. This was a lesson that required the use of microscopes and there were only two available for use. Some teachers started with a whole class discussion, led by the teacher then followed by learners working in small groups. Others began with learners working in small groups followed by whole class discussion. Only a small proportion, 4 teachers (11 %), had learners working individually at first and then followed by whole class discussion, perhaps because their lessons were theory. The learners wrote answers to questions from the textbook individually and the responses were discussed as a class. The prevalence of group work seem to be consistent with the questionnaire results as 78% thought the new curriculum demands that learners work in groups most of the time.

Classroom interactions

The classroom interactions were determined by further asking the teachers to describe the teacher and learner activities that took place during the best lesson. Analysis of the teachers' descriptions revealed that during the lessons, learners were involved in the following activities:

- listening to teacher or learner reading the storyline from the book;
- listening to teacher giving instructions on how to carry out activities;
- writing answers to questions in the Learner's Book;
- copying notes;
- observing demonstration by teacher;
- discussing with teacher or fellow learners and
- doing some experiments.

On the other hand, the teacher activities included:

- reading the storyline;
- explaining how learners were supposed to do the activities;

- moving around groups monitoring and checking or marking learners' responses to questions;
- discussing answers to questions from the Learner's Book with learners;
- writing notes on the chalkboard for learners to copy;
- conducting demonstrations for learners and
- helping learners carry out investigations.

The teachers' written reports show that the lessons had elements of both the traditional approach and the new context-based approach to science teaching. However, the activities appear to be predominantly teacher-centred than learner-centred.

Assessment of Best Lesson

Finally, the respondents were asked whether the lesson objectives were achieved by the end of the lesson and how they assessed that. Almost all the teachers (97%) felt that the lesson objectives were achieved. The respondents reported to have assessed the achievement of lesson objectives mainly through oral questions or written exercises. A total of 29 teachers (78 %) had the assessment as oral questions or written exercises. Only 8 respondents (22 %) reported having assessed them through either practical or a mixture of practical and oral questions. Similarly, in the questionnaire more than half the teachers (59%) thought the new curriculum requires the use of written tests and oral questioning to be used as the main forms of assessment.

4.5 Results from Interviews

Three teachers with the highest knowledge scores in the different school locations were selected for the interviews and classroom observations. These teachers were considered to be knowledgeable of the new curriculum. During the interviews, the teachers were asked the question, 'what would make you want or not want to implement the new curriculum in your classroom?' All the three interviewed teachers indicated that they would want to implement the curriculum in their classrooms. They attributed their willingness to do so for the following reasons, beginning with the most likely to the least in that order:

- the new curriculum involves learners;
- it motivates learners to learn;
- learners learn to do things on their own and find the necessary information for themselves;

- it makes it easy for learners to understand scientific concepts;
- it has a lot of investigations and practical work;
- it promotes lots of discussions, which enable the teacher to identify misconceptions among learners; and
- the Learner's Book and Teacher's Book guide the teacher on how to conduct their lessons.

Based on these reasons, the teachers viewed the curriculum as one that stimulates learners' interest in science lessons, encourages active participation of learners while they take responsibility for their own learning, and enhances the development of scientific concepts. They appreciated the support and guidance provided through the Teacher's Book and Learner's Book.

Also, during the interviews the participants were asked how, in their own view, the new curriculum was different from the old one? The three interviewed teachers saw the new curriculum as being different from the old one. The differentiating features were given as follows (with the number of teachers who stated each reason given in brackets):

- The new curriculum involves learners more than the previous curriculum and demands them to do most of the work on their own while the teacher is minimally involved (3);
- The teacher does not have to tell the learners everything but he/she is there as a guide (3);
- The activities require learners to think critically (3);
- Topics are introduced with something familiar to the learners, the context, as an entry point before the learners learn the scientific concept under study (2);
- The new curriculum requires the use of learners' prior knowledge (2) and
- The new curriculum makes it easier for learners to understand science when science is based on their everyday life experiences (1).

Considering these differences, the new curriculum was described as one that uses familiar issues and learners' prior knowledge as starting points for the teaching of scientific ideas; use teaching methods, which encourage active involvement of the learners and critical thinking. The curriculum encourages teachers not to be transmitters of knowledge and learners to take responsibility for their own learning.

Although the interviewed teachers saw the new curriculum being different from SWISP in many ways, Teacher A expressed the view that the new curriculum was not completely different. She viewed the two curricula as similar in terms of the content covered, but different as far as the teaching approaches were concerned. She explained:

> *"… to me they (SJSSC and SWISP) are the same, but the difference is the approach. Just a different approach because the scientific concepts that were supposed to be done, from the previous SWISP are the same. Here the students are supposed to do eh ... some kind of eh ... practical and then from the practical or context point of view they then learn the concept that they are supposed to know from what they have done practically or from the context they are given"* (Teacher A).

The interviewed teachers pointed out that even though they liked this new curriculum, they were experiencing challenges in implementing it in their classrooms as illustrated below.

Challenges to the Teacher

All three interviewed participants felt implementing the new curriculum was challenging for the teacher and the learner. The following are what the participants viewed as challenges to the teacher in implementing the new curriculum:

- All three interviewed teachers said they did not have enough science equipment and learning materials to teach the new curriculum. Even those who had some equipment felt learning resources were not adequate for each learner to use. As an illustration, one interviewee puts it as follows:

> *"Teaching materials are not enough, there is need for well-equipped science laboratories …we are supposed to be having very big labs with enough equipment. But as of now we don't have enough materials and because of that it becomes difficult to teach, eh … according to this new curriculum. For instance, in the class that we are from, it would be wise to give three lenses to each group. But I was giving one yet you find that there are eight children or more in each group. As they were working, they would wait for one, you know because each and every one of them is supposed to look at the magnification done by the magnifying lens"* (Teacher A).

Teachers B and C also pointed out that at times it was difficult to obtain the suggested local materials they are supposed to use for the lessons or to improvise for the lessons. Linked to the problem of inadequate materials was the challenge of large numbers of learners in class, which resulted in big groups of learners sharing a few resources.

- The interviewed teachers felt the large number of learners in class was not manageable and thus hindered the successful use of the new approach or implementation of the curriculum. They voiced out that the new approach could be best used with small numbers of learners in the class. For example, one teacher had this to say:

  "… We have got big numbers as big as 70 or more and then it becomes difficult to teach this new curriculum. The new curriculum can be successful if the numbers may be 30 or less. From 40, 50 upwards, it becomes difficult to eh… for this curriculum to be successful" (Teacher A).

- Two of the interviewed teachers (A and B) found the curriculum demanding and tiring to implement. For example, in terms of lesson preparation they have to be knowledgeable and be ready for the unexpected.

- Two of the teachers felt that the syllabus is overloaded and they therefore do not have enough time to adequately prepare their lessons. According to them, this usually leads to some lessons, which are supposed to be practical, being taught as theory lessons. Besides, they have many periods (about 7 or 8 periods of 40 minutes per day) to teach in a day, had a lot of marking to do because of class size and the science departments were usually under-staffed due to the high teacher turnover rate in the sciences, attributing it to the low salaries paid to teachers in the country. In the participants own words:

  "We are being overloaded, especially if you are teaching forms 1, 2, and 3 like myself …. Another thing is that we have few science teachers, because they do not remain in the teaching profession, but leave for greener pastures. And as a result, the few teachers that are there in schools being overloaded" (Teacher A).

  "Ya! …. I have a number of periods because I have other classes. I have to do some marking after class. The time is usually not enough for preparing for each and every lesson that I have on that particular day. Also, at times we do not have time to collect the required local materials. Sometimes I do

> *not get all the materials that I need for the pupils and then it ends up being a theory instead of the pupils seeing the things and handling them and doing something in that particular activity"* (Teacher B).

- The teachers felt the new approach to science teaching and learning was time-consuming. For example, a representative voice had this to say:

> *"Lessons take a lot of time because when we are discussing the pupils come with a lot of questions, together with their suggestions, and I have to attend to all of them. As a result, I do not finish what I had prepared for that period and have to carry it on to the next one"* (Teacher B).

- One teacher felt she had to make sure that the learners were not carried away by the context, but learned the intended scientific concepts. In her words:

> *"If as a teacher you are not careful, the students may have a tendency of concentrating on the context and not learning the scientific concepts. The teacher needs to be careful that the students do get the scientific concepts. The students sometimes want to concentrate on the context and tell you more about what they have read from the context and what they have seen. Yet now as a science teacher you want them to get the scientific concepts"* (Teacher A).

The interviews results revealed that the teachers implementing the new curriculum are faced with a number of challenges including; large class size; inadequate school resources and science equipment; minimal learner participation in practical activities; and overload. Some of these challenges (large classes, and under-resourced science classes), if not all, constitute an impediment in the reform agenda. In developing countries, such as Swaziland, curriculum innovations are hindered by overcrowding in classrooms and inadequate resources.

Challenges for the Learner

The three interviewed teachers felt that the new curriculum also presented challenges to the learner. They felt it challenged the learners to think and answer thought provoking questions; to do most of the work on their own; and to learn to communicate with others. For example, one participant had the following to say:

> *"Learners have to learn to communicate with others. 'some learners are eh shy naturally they fail to communicate with others yet they do group work in class and then in this group work they have to communicate, they are*

> *supposed to talk with each other, discuss their experiences, say what they see in their practicals. Some are introverts. They fail to communicate. I think this is a challenge to them, to some of them"* (Teacher A).

This still being a newly introduced curriculum, it is no wonder that the learners have the highlighted challenges because they are used to the old method, chalk and talk, where the teacher did most of the talking and wrote everything for them as notes on the chalkboard. They need time to cope with the new demands.

Teachers' overall comments

In addition, when asked about their overall feelings and comments about the curriculum, all three teachers felt that in spite of the challenges, the new curriculum was generally good. The following were their direct words:

> *"Well as far as I can see it, I think it is a good approach except that if a teacher just leaves everything to the learners to do, the learners may not learn anything. The teacher must see to it that the concepts or the science in what is being done is learnt"* (Teacher A).

> "*I think this one is good compared to the one we have been doing, the SWISP. Although sometimes it is taxing on the teacher. Otherwise it's a good one"* (Teacher B).

> "*It is a good curriculum and has a lot of advantages against the old one. It is contextualised. It is student-centred."* (Teacher C).

The teachers' responses indicated that overall and despite the challenges implementing the curriculum presents, they saw the curriculum as a good one and having clear advantages over the old one. These results reinforce the neutral attitudes results because although they find the curriculum good, the challenges make them have some mixed feelings about it.

Other comments

Consistent with the fact that in the questionnaire many teachers said they still used the SWISP materials, one of the interviewed teachers felt the two approaches needed to be used together to complement each other. According to her, using only the new approach would result in some science concepts being lost. This is how she puts it:

> *'If we can concentrate on this approach [context-based approach], sometimes the science can get lost. I think the best thing to do is to just at times mix the two approaches. At times there is need for additional notes, sometimes some additional notes are written on the board for pupils to copy though not a lot'* Teacher A.

Given the one day orientation workshop that the teachers had, this teacher's feeling of wanting to mix the new and old approaches is probably due to the difficulties she goes through in implementing the new curriculum.

Moreover, during the interviews, the three teachers interviewed were asked how they conducted their lessons when teaching the new curriculum. All three teachers pointed out that they followed the Learner's Book as is, with the help of the Teacher's Book. As described in chapter one, in practice this means that the teachers start by reading the storyline at the beginning of the unit or lesson; give learners time to work on the "Over to You" questions individually; discuss their responses as whole class; and then learners work on the practical activities, which are usually done in small groups. As an illustration, some of the teachers put it this way:

> "*Okay, most of the time I just follow the sequence of the textbook. Then usually in the textbook there would be some readings for the pupils. They answer some questions; I give them time to do that. Sometimes they discuss in groups and then after that we discuss. I usually start with the pupils doing some activity either individually or in groups then we discuss and then they may correct their work and sometimes I collect their work and check on their responses"* Teacher B.

> *"I normally use the book the … what do you call it? The science book, the new one. Ya! that book in fact the way it is laid out … it gives you all the steps as a teacher, it gives you all the steps as to how to go about with the topic, when to give the learners work to do that is the "Over to You" sections [questions provided in the Learner's Book meant for the learner]. You do not think it out yourself as a teacher but you are guided by the book with the help of the teacher's guide. So what I normally do I use those two,*

the book and the teacher's guide to guide me. … So I always follow that"
Teacher C.

4.6 Results from Classroom Observations

The data from the classroom observations for the three selected teachers were analyzed using Rogan & Grayson's (2003) framework of curriculum implementation. Only three dimensions of the profile of implementation: classroom interactions; science practical work; and science in society were used. The fourth dimension of the framework, assessment, requires data on written tests, which was beyond the scope of this study. The profile of implementation for each teacher and the profiles of the capacity of their schools to support the innovation are presented next.

Profile of Implementation: Teacher A

Teacher A was the most experienced of the three observed teachers with a total of 30 years teaching experience. She taught a class of 69 learners in an urban school. Table 4.14 shows the profile of implementation for Teacher A.

Table 4.14: Profile of Implementation: Teacher A

Level	Classroom Interactions	Science Practical Work	Science in Society
1	Teacher: Used the textbook effectively. Engaged learners with questions. Learners: Stayed attentive and engaged [writing answers to questions from the book individually] Responded to questions		
2	Teacher: Engaged learners with questions that encouraged in-depth thinking [from the book].	Teacher used demonstrations to promote a limited form of inquiry [she explained the practical procedure to the learners and then let them do the practical] Learners communicated results using tables	Teacher based lessons on specific issues or problems faced by the local society [she used the contexts provided in the Learner's Book]
3	Learners: Engaged in minds-on learning activities, e.g., explaining how dye had moved through a plant materials in a lesson about diffusion	Learners performed 'guided discovery' type practical work in small groups, with the teacher not telling them what to do but helping them when having problems [but one or two learners in a group engaged in 'hands-on' activities while the rest were spectators]	

From the above table, it could be observed that the teaching practices for Teacher A were at different levels of the three dimensions of the profile of implementation. The involvement and participation of learners was high as it was evidenced by her classroom interactions being at level three of Rogan & Grayson (2003) operational levels. She gave learners enough time to work on the questions from their books. These questions required learners to think critically. Although she allowed them to discuss in small groups, they had to write down answers individually in their notebooks. She went around the groups marking their work as they were answering the questions.

For the science practical work, she was at level two and was the only observed teacher who allowed learners to perform guided discovery type of practical work in small groups of 4 to 11. That is, the teacher allowed the learners to work on their own with her guidance to do practical work. However, due to shortage of equipment, not all the learners in the groups engaged in hands-on activities. While one or two learners did the activities, the rest watched and waited to record observations and answer the questions. This was partly due to an oversight on the part of the teacher, not encouraging all learners to participate, and mainly because the learners were many in the groups. For example, in one observed lesson, all groups got one convex lens and one concave lens to work with. An interesting observation in this class was that the teacher did not bother to balance the groups in terms of number and gender. Nor did she assign roles for the group members. While one group had as few as four learners, another had eleven learners and the rest had seven or eight. Although the learners were of different numbers in the groups they always received the same number of the materials or apparatus, making those who were few to work better than those who were many.

The teacher based the teaching of scientific concepts on specific societal issues, thus placing her at level two of the science and society dimension. For example, when she was to teach about the different types of lenses (convex and concave) she began by reading the storyline which made reference to magnifying glasses and examples of where such glasses are used in everyday life, for example in spectacles. The weak part of this lesson was that the teacher did not conduct class discussions which could have opened opportunities for learners to develop communication skills, respond to questions, and initiate questions in the context of everyday life.

Profile of Implementation: Teacher B

Teacher B had 13 years teaching experience and taught a class of 71 learners in a rural school. The following table shows the profile of implementation for Teacher B.

Table 4.15: Profile of Implementation: Teacher B

Level	Classroom Interactions	Science Practical Work	Science in Society
1	Teacher: Used the textbook effectively. Engaged learners with questions. Learners: Stayed attentive and engaged [writing answers to questions from the book individually, participating in teacher-led discussions and copying notes] Responded to and initiated questions [especially during discussions e.g. during lesson on personal hygiene]	Teacher used classroom demonstrations to help develop concepts	Learners asked questions about science in the context of everyday life.
2	Teacher: Engaged learners with questions that encouraged in-depth thinking [from their book]. Learners: On own initiative offered a contribution to the lesson e.g. during discussions they contributed without being called upon by the teacher		Teacher based lessons on specific issues or problems faced by the local society [he used the contexts about common disease such as high blood pressure provided in the Learner's Book]
3	Teacher: Probes learners' prior knowledge e.g. he asked learners what they knew about healthy habits and wanted them to give reasons for what they raised.		

Table 4.15 indicates that the classroom practices for Teacher B were at level three for classroom interactions, level two for science and society, and level one for science practical work. This teacher did not have small group discussions, but conducted rich class discussions where learners participated freely. During the discussion sessions there was a lot of talking and sharing of ideas. He probed learners' prior knowledge. Learners asked questions about science in the context of everyday life as they discussed the storyline. At times there were some arguments and the learners offered contributions to the lessons on their own initiatives.

During discussions, the teacher allowed those who used scientific facts to support their arguments to elaborate. For instance, in one observed lesson there was an argument about washing or not washing hands after using the toilet. The teacher allowed one boy to explain to the class about germs being very small organisms that could not be seen with the naked eye and how these would cause diseases. A weak part of this teacher's lessons was that he did not always encourage all learners to speak during the class discussions. Only the vocal ones participated as he identified only those who raised their hands. As a result, some learners did not participate in the discussions but just waited for the teacher to summarize the points at the end of the discussion, and call out the correct answers from the Teacher's Book and so wrote them down. The teacher was emphatic on learners writing down the correct answers.

Another weak aspect of the lesson was not allowing learners to do 'hands-on' activities. This teacher either conducted classroom observations with minimal involvement of the learners or presented the lesson as theory in the lessons observed over a week period. This approach limited students' understanding and creativity, thus weakening the approaches that are promoted by the new SJSSC. The teacher was also observed to spend a lot of time giving notes, forced partly by the book rental system that the school was using. This system is described in detail in the next section.

Profile of Implementation: Teacher C

Teacher C was the least experienced of the three teachers with five years teaching experience. He taught in a peri-urban school and had a class of 50 learners. His profile of implementation is shown in the next table.

Table 4.16: Profile of Implementation: Teacher C

Level	Classroom Interactions	Science Practical Work	Science in Society
1	Teacher: Used the textbook effectively. Engaged learners with questions. Learners: Stayed attentive and engaged [writing answers to questions from the book, individually] Responded to questions and initiated some [occasionally]		Learners asked about science in the context of everyday life e.g. about the work of veterinary officers using microscopes to look at animal blood.
2	Teacher: Engaged learners with questions that encouraged in-depth thinking [from their book]. Learners: On own initiative offered a contribution to the lesson [sometimes, they raised hands without being begged by the teacher]	Teacher used demonstrations to promote a limited form of inquiry Learners participated in closed practical work in small groups [closed in the sense that teacher always demonstrated before learners did practical themselves. Also one or two learners in a group engaged in hands-on activities while the rest were spectators]	Teacher based lessons on specific issues or problems faced by the local society [he used the contexts about how assistant veterinary officers find out whether a slaughtered cow has disease provided in the Learner's Book]
3	Learners: Engaged in minds-on learning activities e.g. the 'over to you' questions from the book		

Inspection of the above table reveals that the classroom practices for Teacher C were at level two with some elements of level three for the classroom interactions dimension. He effectively used the textbook as he followed the sequence of activities provided. Although he made learners do the practical activities from their book most of which are designed in such a way to encourage learner discovery of information, he first demonstrated for them how to do the practical. This in a way turned the activities into closed practical work.

The number of available equipment was always not enough for all the learners in the lessons observed. For example, in one of his observed lessons each group was given one microscope to use. Since only four working microscopes were available, he was forced to form four groups. The teacher first demonstrated what learners had to do. For his demonstrations, learners had to come to the front desk and stand around. Some learners stood behind others without seeing what was happening. Other learners would answer the questions asked about the practical based on the teacher's demonstration without carrying out the practical themselves. For instance, when using the microscope some learners made drawings from the teacher's demonstration which was left at the front desk for their reference. There were no assigned roles in the groups. Consequently, in the groups one or two learners would actually do the hands-on activities while the others watched and waited to record the observations. Learners had to record observations and write answers to questions individually. The implications for the implementation of the SJSSC will be discussed in the next chapter.

Achievement of the aims of the SJSSC

One more important question to be answered is whether the aims of the new curriculum were attempted and achieved and if so, how effectively during the observed lessons. The educational aims of this curriculum are shown in the first column of Table 4.14. These aims were checked against the teachers' practices, including the objectives of the lessons and teaching methods used during the lessons to determine if they were attempted and achieved or not.

Table 4.17: Aims of the curriculum attempted during observed lessons

Aims of new SJSSC	Teacher A		Teacher B		Teacher C	
	Attempted	Achieved	Attempted	Achieved	Attempted	Achieved
1. Use the scientific concepts to address social issues	Yes	No	Yes	No	Yes	No
2. Develop the culture of using the scientific approach to carry out investigations and show innovation in creation of scientific objects	No	No	No	No	No	No
3. Develop scientific skills, confidently apply them to solve problems and communicate scientific information with growing proficiency	Yes	No	No	No	Yes	No
4. Recognise the usefulness of science as a starting point for science-based careers	Yes	Yes	No	No	Yes	Yes
5. Recognise and appreciate the importance of living in harmony with the environment by demonstrating the use of resources in a sustainable manner	No	No	No	No	No	No
6. Understand, interpret and apply basic science concepts and principles	Yes	Yes	Yes	No	Yes	Yes

Analysis of the above table shows that only aims 4 and 6 were achieved by Teacher A and Teacher C during the observed lessons. Aims 2 and 5 were not attempted in all the observed lessons. This result reinforces what came up from the questionnaire data that the teachers were not paying much attention to the affective domain objectives. Creativity was also not encouraged among the learners, at least during the few lessons observed. Therefore, one can conclude that the teachers' classroom practices did not fully match or were not in total synch with the broad intentions of the curriculum developers.

The Schools' Capacity to Support Innovation.

The data from classroom observations and school facilities survey were also analyzed to determine the capacity of the schools to support the innovation, the implementation of the new curriculum. The profile of the capacity to support innovation for the three schools is shown in Tables 4.18, 4.19, and 4.20. Only two sub-constructs: physical resources and teacher factors out of the four highlighted by Rogan & Grayson (2003) were used because the others: learner factors and the school ecology and management were beyond the scope of this project.

Table 4.18: Profile of the capacity to support innovation: school of Teacher A

Level	Physical facilities	Teacher factors
1	Toilets available.	
2	Adequate basic buildings in good condition. Suitable furniture adequate and in good condition. Textbooks for all. Some apparatus for science.	Teacher had the minimum qualification for position. Teacher participated in professional development activities [she attended the orientation workshop] Teacher had a good relationship with learners.
3	Good buildings, with enough classrooms and a science room. Electricity in all rooms. Running water. Well kept grounds	
4	Library [but poorly resourced]. Good copying facilities [situated in principal's office]	

Teacher A possessed the Secondary Teachers' Diploma (STD), which is the minimum qualification to teach at the junior secondary level. She always came to class in a jovial mood. The classroom atmosphere was relaxed. She taught in an urban school, which was observed to be at level two of the physical resources sub-construct of the Capacity to Support Innovation construct of Rogan & Grayson (2003)'s framework. Although there were elements of levels three and four, the school library was poorly resourced and could not be of much benefit to the teacher and learners. The copying machine available in the school was in the principal's office and not freely accessible to the teachers.

Furthermore, although the school had enough classrooms and a science laboratory, the size of the class, 69 learners, necessitated an alternative room to be used. The school hostel chapel was used for this class because the learners could neither fit in any normal classroom nor in the science laboratory. These learners carried out all their lessons in that chapel and had never used the science laboratory. The teacher informally complained of this place being far from the staff room and science laboratory making it difficult to carry the equipment and materials needed for class. When she had to ask learners to assist her, a lot of time was wasted as she had to call them from class. Otherwise the room was in good condition, had electricity, and a chalkboard.

The classroom organisation was such that the learners sat in desks arranged in rows with every learner having a chair to sit on. Most learners had small individual desks to write on while a few shared bigger desks in pairs. The room was big enough to allow space for teacher movement in-between rows. In this classroom small group discussions dominated. Science equipment and apparatus needed for the observed lessons were available, but not enough to enable every learner to carry out hands-on activities.

Table 4.19: Profile of the capacity to support innovation: school for Teacher B

Level	Physical resources	Teacher factors
1	Basics buildings-classrooms and one office, but in poor condition. Toilets available.	
2	Textbooks for all. Some apparatus for science. Electricity in at least one room.	Teacher participated in professional development activities [attended orientation workshop]
3	A science room. Running water.	Teacher was qualified for position and had a sound understanding of subject matter.
4		

The physical resources sub-construct for this school was basically at level two with some elements of level three. There was only one science laboratory in the school shared by all the classes resulting in some science lessons taking place in the ordinary classroom. An old chalk board was available for the teacher to write on in both the classroom and laboratory. All learners had the Learner's Book 1 because the school used the book rental system. In this system, the books are owned by the school and learners pay some fee to use them for the year. While the system is good in ensuring that all learners have books, it forces teachers to resort to some traditional teaching styles not purported by the new SJSSC. For example, the teacher was forced to give learners a lot of notes because they (learners) do not carry on with the books yet would write their external examination after three years.

The classroom organization was such that learners sat in rows of desks and chairs put close together in the classroom or in groups around tables facing each other in the laboratory. In the classroom, the learners were overcrowded and could not allow teacher movement in-between desks. There were six working tables in the science laboratory and these were not enough for all learners to write freely. The 71 learners shared the six tables and were squashed. Consequently, some had to write holding their notebooks by the other hand or putting them on their laps. The teacher's use of classroom demonstrations and content presentation instead of allowing learners to do hands-on activities could be attributed to the insufficient science apparatus, large number of learners, and not always conducting classes in the science laboratory. This teacher held the Bachelor of Science degree with the Post Graduate Certificate in Education and demonstrated to have adequate knowledge of subject matter.

Table 4.20: Profile of the capacity to support innovation: school for Teacher C

Level	Physical resources	Teacher factors
1	Toilets available.	
2	Adequate basic building in good condition. Textbooks for all. Some apparatus for science.	Teacher participated in professional development activities [attended orientation workshop]
3	Running water. Electricity in all rooms	Teacher was qualified for position and had a sound understanding of subject matter.
4	Library [poorly resourced]	

Teacher C held the Bachelor of Science degree with the Post Graduate Certificate in Education and taught in a peri-urban school. His school's physical resources were at level two and had elements of levels three and four. However, the available school library was poorly resourced. The science apparatus were insufficient. For example, in one of Teacher C's lessons, more than ten learners in a group shared one microscope. As a result, only a few learners were actually engaged at a time while the others remained spectators. In fact, some learners ended up not getting the chance to use the microscope. All the learners had the Learner's Book 1 because in this school, learners paid a book fee which enabled every learner to be issued with all textbooks at the beginning of the year.

All lessons took place in the science laboratory. The school had three science laboratories in all used by different classes at different times. The classroom organization was such that the learners always sat around the tables facing one another. For activities, they just worked in those tables as groups of 6-12 learners. Similar to Teacher B's situations, the learners could not write freely. The groups were almost permanent as only a few learners would change positions. One group was girls only, another one boys only, while the three were mixed. Interestingly, like in Teacher A’s case, the teacher did not bother to balance the groups in terms of gender and number. It is encouraged that groups of learners in class should be heterogeneous in terms of factors like gender, and ability to improve learner achievement.

In conclusion, it appeared that all the schools were at low levels of the profile of Capacity to Support Innovation. In light of Rogan & Grayson (2003) argument that for a school to be able to support an innovation, it should be at level four of the profile, one could conclude that all the three schools did not have enough capacity to support the implementation of the new curriculum. This finding was consistent with what the responding teachers stated in the survey questionnaire and during interviews. In the questionnaire only three teachers (about 8%) out of the 37 reported having adequately resourced school libraries and 15 (40%) of them said they had enough science equipment to teach the new curriculum.

Some conclusions could be made about the observed teachers. They were all qualified to teach science at the grade level; they all lacked skills to manage meaningful group work; all had relatively big classes, at least 50 learners; and their teaching practices were at low levels of the profile of implementation suggested by Rogan & Grayson (2003). Moreover, all their schools were at low levels of the profile of the capacity to support innovation, meaning that the schools did not have sufficient physical resources and adequately prepared teachers to support the implementation of the new curriculum.

A comparison of the data on teachers’ classroom practices from the survey questionnaire, interviews, and classroom observations revealed that there were commonalities. Consistent with the questionnaire and interview results, classroom observations showed that a majority of the teachers had the new curriculum materials; used the contexts given in the Learner’s Book as starting points for the development of scientific ideas; experienced some challenges as they implement the new curriculum; some of them had large classes; and most of their schools had inadequate physical resources.

4.7. Relationship between teachers' knowledge and classroom practices

The relationship between the teachers' knowledge and classroom practices was investigated by considering the classroom practices for the three selected teachers who were all knowledgeable about the curriculum. The overall scores for the teachers' knowledge of the aims, teaching methods and assessment procedures were 71 % for Teacher A, 75 % for Teacher B, and 71 % for Teacher C. The findings on the classroom practices for these teachers (section 4.6) showed that for all of them the classroom practices did not fully reflect the intentions of the curriculum developers. This meant that the teachers' knowledge of the curriculum was not always transferred into their classroom practices. There could be many reasons for the teachers not changing their classroom practices in line with the requirements and demands of the new curriculum. One factor, which appeared to have influenced the teachers' practices, was the schools' physical resources as discussed in section 4.6 above. The results of the study are discussed in the next chapter.

CHAPTER FIVE

DISCUSSION OF RESULTS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the discussion of the overall results of the study, the conclusions drawn and some recommendations made.

5.1 Discussion of Results

Overall, the results on teacher knowledge show that the surveyed teachers have good basic knowledge of the new curriculum (Ref. 4.2). The teachers' good knowledge of the curriculum may be attributed to their reported familiarity with the new curriculum materials. Most (more than 70 %) of the teachers reported having and using the new curriculum materials (Ref. 4.1.3). This reasoning is in keeping with the arguments of many scholars (Powell & Anderson, 2002; Schneider, Krajcik & Blumenfeld, 2005) who have stressed the importance of providing teachers with curriculum materials designed to reflect the intentions of the reform as the materials can assist them (teachers) in enactment of reform-based instruction. However, Powell & Anderson (2002) point out those curriculum materials alone cannot do everything. Other factors influence change in classroom practices. In light of this, the teachers' classroom practices may not be in synch with the intentions of curriculum developers even though the majority of the teachers are familiar with the curriculum materials.

The results further revealed that many of the teachers hold positive attitudes towards the new curriculum even though they feel it is challenging to teach (Ref. 4.3). With such positive attitudes, the teachers would be expected to teach the curriculum as intended (Zacharia, 2003). However, this was not the case as the teachers' classroom practices as observed did not reflect the intentions of the curriculum developers. There was not much change in the teachers' classroom practices from the traditional methods they have all along been using. Collectively looking at the teachers' self-reports about classroom practices (Ref. 4.4) in light of Rogan & Grayson's (2003) profile of implementation, the lessons seemed to be at low levels of the classroom interactions, science practical work, and science and society dimensions, meaning they were more teacher-centred. The described teacher and learner activities basically fell at level one of the classroom interactions dimension. There were however, elements of level two as the learners were engaged with questions from the Learner's Book which encouraged in-depth thinking.

For the science practical work dimension, some lessons could not fall even at level one of this dimension because they were theory; few fell at level one where the teachers conducted classroom demonstrations to help develop concepts; others had elements of level two where the teachers used demonstrations to promote a limited form of inquiry, but not all learners engaged in hands-on activities due to insufficient numbers of apparatus or equipment for the large class sizes. This finding is worrying as the teaching syllabus emphasizes application of scientific information as well as the development of investigative skills (MOE, 2005b). It is also inconsistent with the knowledge results as 95 % of the surveyed teachers knew learners should carry out scientific investigations. The classroom observations also revealed such inconsistencies between the teachers' knowledge and their classroom practices (Ref. 4.6). For the science and society dimension, the lessons fell at level two for those teachers who used the textbook and began by reading the context at the beginning of the unit or lesson. These teachers based their lessons on specific issues or problems faced by society.

What could be deduced from the results was that although the teachers used new curriculum materials, they used them in more traditional ways and coloured them with traditional ideas. For example, the mixing of new and old ways of teaching was evident from the teacher's written reports about the use of teaching materials (Ref. 4.1.3). About 70% of the surveyed teachers reported to be still using the old SWISP materials in addition to the new curriculum materials to get procedures for practical work and more information to give to learners as notes. Moreover, from the teachers' descriptions of the teacher- and learner-activities for the best lesson (Ref. 4.4), it was clear that the lessons had elements of both the new and old approaches. This practice can be explained by the argument that teachers as they reach out to embrace a new instruction, reach out with their old professional selves, including all the ideas and practices comprised therein (Cohen, 1990).

The teachers' classroom practices were not as intended despite that they were qualified to teach science at that school level. The reasons for the observed non-adherence to the requirements and demands of the new curriculum were neither known nor clear. However, the teachers indicated that there was lack of school physical resources and the number of learners in class was large for some of them (Ref. 4. 1. 2). For example, only 8 % of the teachers reported having adequately resourced school libraries and 40% reported having sufficient science equipment. The three interviewed teachers also voiced out these two problems and they were also evident during the classroom observations as all the three schools for the selected teachers fell at low levels of Rogan & Grayson construct of the Capacity to Support Innovation (Ref. 4.6). In other words, according to the Rogan & Grayson model, the majority of the schools studied did not have enough capacity to support the implementation of the new curriculum. The lack of school physical resources and large class size might be some of the reasons why the teachers resorted to lecturing and demonstrations (Onwu & Stoffels, 2005).

The findings on school resources should mean something to the government and the ministry of education officials in Swaziland. While it was a good and positive step that all the surveyed schools had at least a science laboratory and some had school libraries, it was not sufficient for the schools just to have libraries and science laboratories which were not adequately resourced. For a school to be able to successfully support the implementation of a new science curriculum, it must have excellent buildings, well-equipped science laboratories and library, good teaching and learning resources such as computers, and good copying facilities (Rogan & Grayson, 2003). In the absence of adequately resourced libraries, the teachers can not send learners out to search for information themselves. As a result, the teachers would be forced to resort to lecturing and presenting all the information for the learners as notes. Such practices weaken the approaches promoted by the new SJSSC. In addition, it was necessary that the science laboratories be well-equipped to allow for individual or at least small group practical work and scientific investigations.

There is need for the ministry of education and schools to improve the conditions in the schools, for example, ensuring that all schools have adequately resourced school libraries and access to the internet; increase the number of science laboratories in the schools to allow all science classes to be conducted in the laboratories; and then make sure all schools have sufficient science equipment to support the implementation of the curriculum. Since this could be a long term project, in the interim it is essential to find ways that will help teachers handle the curriculum under the present classroom environments. Professional development workshops can help to bring the teachers together so that they share ideas about the implementation. As some scholars assert that a high level of curriculum implementation can be expected if teachers have an opportunity to share ideas and problems with each other and receive support from supervisors and administrators (Glatthorn, Boschee & Whitehead, 2006).

Another factor that appeared to aggravate the problem of not properly implementing the new curriculum in the classrooms was the teachers' lack of skills to organise meaningful group work along cooperative lines. While the teachers' reports and classroom observations revealed that small groups prevailed during the lessons (Ref. 4.4 & 4.6), there was no evidence from both reported and observed lessons that these groups were used effectively. It appears that the groups were not well managed: there were no assigned roles for group members; and the learners did not work cooperatively. There were no cases in the form-1 classrooms observed where the learners worked together in small groups to accomplish shared goals, maximizing their own and each other's productivity and achievement. Although seating in groups, they worked individually on their own most of the time to accomplish goals unrelated to and/or independent of the goals of the others. Moreover, the teachers did not ensure that in the groups all learners got a chance of handling the apparatus by organizing the groups in set criteria. This is a cause for concern because research literature shows that small-group discussions in science teaching produce improvement in students' learning and improve students' ability to construct more complex arguments (Bennett & Lubben, 2006; Bennett, Lubben, Hogarth, & Campbell, 2004). Rogan (2004) warned that seating learners in groups does not necessarily result in achievement of outcomes. He observed that after doing group work learners could know nothing more than what they knew before. There is need therefore to in-service the teachers on organizing and managing group work as recommended in the curriculum. Knowing how and when to structure students' learning goals cooperatively, competitively, or individualistically is an essential instructional skill all teachers need (Johnson & Johnson, 1991).

Furthermore, what also seems to have limited teacher performance regarding the new curriculum was the short, 'one-size fits all' professional development workshop that the teachers had. They had a one-day orientation workshop in preparation for implementing the new curriculum, which was not likely to give them the necessary knowledge and skills, and change their beliefs about science and science teaching and learning to be aligned with the demands of the reform (Bennett & Lubben, 2006; Davis, 2003; Jeanpierre et al., 2005; Powell & Anderson, 2002). Although 88 % of the surveyed teachers reported being ready or very ready to teach the curriculum (Ref 4.1.4) the findings on their classroom practices did not bear this out. This observation can be partly explained by Cohen's (1990) argument that when teachers have included some new elements into their old ways of teaching in the process of implementing new instructions, they might not even see the need for improvement in certain areas nor want guidance about how well they are teaching because they lack full knowledge and understanding about the demands of the curriculum.

While in Swaziland only a few teachers were involved in the development and piloting of the new curriculum materials, and the teachers were only given an overview of the new curriculum through a one-day orientation workshop, research shows that those cases (Bennett & Lubben, 2006; Hofstein & Kesner, 2006; Parchmann et al., 2006) where the implementation of context-based science curricula was reported to be successful, their introduction and implementation were accompanied not only by teachers' involvement in their planning and development, but also by intensive and comprehensive professional development during their implementation.

Albeit tentatively, the results of the present study have shown that the teachers' classroom practices did not reflect the intentions of curriculum developers despite many having good basic knowledge and many holding positive attitudes towards it. That is, the teachers' knowledge of the curriculum was not necessarily transferred into their classroom practices. There appear to be some other factors that influence teacher change of classroom practices such as availability of instructional resources, teachers' organizational knowledge and skills of group work, 'one-size fits all' kind of professional development workshops, and large class size. We therefore, agree with Rogan & Grayson that "poor resources and conditions can limit the performance of even the best of teachers" (Rogan & Grayson, 2003, p. 1186). For too long science teachers' complaints that their classroom contexts limit, shape and direct their pedagogic choices have gone unheeded (Gwimbi & Monk, 2003).

5.2 Conclusions

The study sought to gain greater insight into how science teachers in the Manzini region of Swaziland were implementing the new Swaziland Junior Secondary Science Curriculum in their classrooms. It considered the teachers' knowledge of the aims, teaching methods, and assessment procedures of the new curriculum, their attitudes towards it as well as classroom practices. An attempt was made to investigate the interactions between the variables. The results from a survey questionnaire, interviews, and classroom observations revealed that:

- A majority (above 70%) of the teachers have and use the new curriculum materials;
- Overall, the teachers have good knowledge of the new curriculum;
- Many teachers hold positive attitudes towards the new curriculum;
- The teachers' knowledge of the curriculum was not necessarily transposed into their classroom practices;
- Teachers' classroom practices do not reflect the intentions of curriculum developers
- Availability of instructional resources played a key role in how well teachers implemented the new curriculum in the classroom;
- Teachers' lack of organizational knowledge and skills of group work, impacts negatively on classroom practice and
- Large class size constrains teacher change of classroom practices.

5.3 Limitations and delimitations of the Study

Limitations

One limitation of the study is the reliance on teachers' own descriptions (self-reports) of their best lessons to determine their classroom instructional practices, that is, teachers' self-report of adherence to curriculum requirements. A bias could result from teachers reporting a high level of service delivery than actually practiced. But the guidelines provided try to steer them (teachers) in the path of objectivity in reporting what they thought was their best lesson. This should give an indication of how they viewed the implementation of the new curriculum. Also, since the information used in the study was collected from teachers only, the study does not provide the learner's perspective of the implementation of the new curriculum. This was not intended, since the learners have just been exposed to the new curriculum. This was an exploratory study.

Delimitations

The findings of the study should be interpreted with caution, since although there was high return rate of the questionnaires; the sample was small and purposively selected. It should provide a basis for a more targeted study in the role of learning materials availability and curriculum reform. The non-random selection of the sample restricts the generalization of the findings to the whole population of secondary school science teachers in the Manzini region. Also, the fact that the research was done in only one of the four regions of Swaziland, limits the generalizations of results to all teachers in the country.

5.4 Recommendations

On the basis of the teachers' responses, the analyses of the collected data and the conclusions drawn from this study, the researcher recommends that:

- The Ministry of Education should revisit the issue of resources in the schools. First, ensure that all schools have libraries and physical facilities. Second, libraries and science laboratories be well equipped if they are to be of any use to the teachers and learners that is, to enable the successful implementation of the new SJSSC.
- The In-Service Education Department should organise professional development workshops for the teachers specifically in familiarizing teachers with classroom organisation structures.
- There should be an on-going support system for the teachers implementing the curriculum to help them cope with the curriculum‘s demands under the present circumstances. Feedback workshops can be organised where teachers would have a chance to share their experiences on teaching the new curriculum.

5.5 Possible Future Research

Research done with a larger sample including all the four regions of the country would give much better insights into the research problem. Also, research that includes both teachers and learners and more classroom observations would provide a balanced view of the problem when both perspectives are considered.

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APPENDICES

Appendix A: Letter of requesting permission from the regional education office

P. O. Box 66
Kwaluseni
Swaziland
15 September 2006

The Manzini Regional Education Officer
Manzini
Swaziland

Dear Sir

Re: Permission to Conduct a Research Project in Manzini Secondary Schools.

I am a Science Curriculum Designer stationed at The National Curriculum Centre and currently enrolled for a Masters degree in Curriculum and Instructional Design and Development with the University of Pretoria in South Africa. As part of the programme, I am required to carry out research.

I am requesting permission to conduct research in secondary schools in the Manzini region. The study is on the new Swaziland Junior Secondary Science Curriculum, recently introduced in all secondary schools in the country. The aim is to gain some insight into the implementation of this new curriculum in the classroom in some selected schools with the view to make recommendations, if any, on how to help teachers to effectively implement the new curriculum

The study is carried out under the Supervision of Professor G. O. M. Onwu at the University of Pretoria (Department of Science and Technology Education).

Thanking you in advance for your cooperation in this regard.

Yours faithfully

____

Eunice K. Mthethwa

Appendix B: Letter granting permission from the regional education office

MINISTRY OF EDUCATION

SIYINQABA

Kingdom of Swaziland

Telegrams: IMFUNDVO
Facsimile: (268) 505-6067
Telephone: (268) 5052248/9

P.O.Box 190
Manzini
Swaziland

REGIONAL EDUCATION OFFICE
MANZINI

26th September 2006

Eunice K. Mthethwa
P. O. Box 66
Kwaluseni

RE: PERMISSION TO CONDUCT RESEARCH PROJECT IN MANZINI SECONDARY SCHOOLS

Permission is granted to Eunice K. Mthethwa to conduct a research project in the Manzini Secondary Schools. In the findings of your research we hope it would assist Manzini region to correct or improve education where we fall short as a region. In that regard we kindly request you to provide a copy of your final report to the R.E.O.

Kindly submit a copy of this letter to each headteacher where your study will be conducted..

Thanking you in advance for your cooperation.

Yours faithfully,

M.E. Nkambule
R. E O.

REGIONAL EDUCATION OFFICER
R.E.O
6 SEP 2006
P.O BOX 190
MANZINI
MANZINI SWAZILAND

Appendix C: Letter to school principals

P. O. Box 66
Kwaluseni
Swaziland
29 September 2006

The Head Teacher
Manzini
Swaziland

Dear Sir/Madam

Re: Permission to Conduct a Research Project in your School.

I am a Science Curriculum Designer stationed at The National Curriculum Centre and currently enrolled for a Masters degree in Curriculum and Instructional Design and Development with the University of Pretoria in South Africa. As part of the programme, I am required to carry out research.

I am requesting permission to conduct research in your school. The study is on the new Swaziland Junior Secondary Science Curriculum, recently introduced in all secondary schools in the country. The aim of the study is to gain some insight into the implementation of this new curriculum in the classroom with the view to make recommendations, if any, on how to help teachers to effectively implement the new curriculum.

The study is carried out under the Supervision of Professor G. O. M. Onwu at the University of Pretoria (Department of Science and Technology Education).

Thanking you in advance for your cooperation in this regard.

Yours faithfully

____

Eunice K. Mthethwa

Appendix D: Letter of consent

Title of the Research Project: Teacher Knowledge, Attitudes and Practices in the Implementation of the Swaziland Junior Secondary Science Curriculum.

29 September, 2006

Dear Teacher

You are kindly invited to participate in a research project aimed at gaining some insight into the implementation of the new Swaziland Junior Secondary Science Curriculum in the classroom with the view to make recommendations, if any, on how to help teachers to effectively implement the new curriculum. The study seeks information about teachers' biographical information, instructional practices and views about the new science curriculum.

Your participation in this study is voluntary and confidential. You will not be asked to reveal any information that will allow your identity to be established, unless you are willing to be contacted for individual follow up interviews and classroom observations. Should you declare yourself willing to participate in the study, confidentiality will be guaranteed and you may decide to withdraw at any stage should you wish not to continue with an interview or observation.

As a teacher involved with the new curriculum, your responses will be very useful in determining how the new curriculum is being implemented in the country. The results of this study will help both teachers and the ministry of education officials to identify areas of curriculum implementation that will need some intervention. I hope you will be disposed to participate in this study which will be of tremendous help to junior secondary science teachers in this country.

If you are willing to participate in this research project, kindly sign this letter as a declaration of your consent, i.e. that you participate in this project willingly and that you understand that you may withdraw from the research project at any stage. Participation in this phase of the project does not oblige you to participate in the follow up interviews and observations, however, should you decide to participate in the interviews and observations your participation is still voluntary and you may withdraw at any time.

Teacher's signature ……………………………..: Date: …………………………..

Researcher's signature …………………………..: Date: …………………………..

Yours sincerely

Eunice K. Mthethwa

Appendix E: Survey questionnaire

University of Pretoria

TEACHER QUESTIONNAIRE

Instructions

1. The questionnaire is addressed to teachers who are currently teaching the new Swaziland Junior Secondary Science Curriculum in Form-one

2. Completing the questionnaire should take you approximately 30 minutes.

3. The questionnaire consists of four sections. To make it as easy as possible to respond, most of the questions (sections A – C) require you just to tick the appropriate number.

4. Section D requires you to write in your own words. Please answer the questions in detail.

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

SECTION A: BIOGRAPHICAL INFORMATION

Please answer each question by ticking the appropriate number.

1.

Gender:	
Male	1
Female	2

2.

Highest Academic Qualification (s)	
O' Level	1
Secondary Teachers' Diploma (STD)	2
Bachelor of Science	3
Bachelor of Science + PGCE	4
Bachelor of Education (BEd)	5
Masters in Education (MEd)	6
Other (please specify)	7

3.

Teaching experience:	
Less than a year	1
1 - 5 years	2
6 - 10 years	3
11 – 15 years	4
16 – 20 years	5
More than 20 years	6

4.

Number of years teaching Form 1 - science:	
Less than a year	1
1 - 5 years	2
6 - 10 years	3
11 – 15 years	4
16 – 20 years	5
More than 20 years	6

SECTION B: THE SCHOOL

Answer each question by ticking the appropriate number.

1.

Your school location:	
Urban	1
Peri- Urban	2
Rural	3

2.

Number of students in your Form-1 class:	
Less than 40 students	1
40 – 50 students	2
50 – 60 students	3
60 – 70 students	4
More than 70 students	5

3.

Does your school have a library?	
No	1
Yes	2

4.

If your answer to (3) is yes, would you say the library is	
Poorly resourced	1
Under-resourced	2
Adequately resourced	3

5.

Does your school have a science laboratory?	
No	1
Yes	2

6.

Do you have enough science equipment and materials for teaching and learning in your Form-1 science class?	
No	1
Yes	2

SECTION C: THE NEW CURRICULUM

Please answer the following questions by ticking the appropriate number.

(a) TEACHING MATERIALS AND PROFESSIONAL DEVELOPMENT

1.

Do you have a personal copy of the **Junior Certificate science syllabus**?	
No	1
Yes	2

2.

If you have the syllabus, how often do you use it for preparing your lessons?	
Never	1
Rarely	2
Often	3
Very often	4

3.

Do you have a personal copy of the Form- 1 **Teacher's Science Book**?	
No	1
Yes	2

4.

If you have the Teacher's Science Book, how often do you use it for preparing your lessons?	
Never	1
Rarely	2
Often	3
Very often	4

5.

Do you have a personal copy of the Form-1 **Learner's Science Book**?	
No	1
Yes	2

6.

If you have the Learner's Science Book, how often do you use it for preparing your lessons?	
Never	1
Rarely	2
Often	3
Very often	4

7.

How often do you use the Swaziland Integrated Science Programme (**SWISP**) Pupil's Workbook and Teacher's Guide?	
Never	1
Rarely	2
Often	3
Very often	4

8.

How often do you use **other materials** besides the new curriculum materials and SWISP materials?	
Never	1
Rarely	2
Often	3
Very often	4

9.

Choose **one** and tick the reason that mostly makes you use or not use additional materials to the new curriculum materials.	
The new curriculum materials do not have enough information for learners	1
The new materials do not give enough guidelines for practical work	2
The new materials have sufficient information and do not need supplement	3
Other (please specify)	4

10.

Were you part of the writing team that **wrote** the new curriculum materials?	
No	1
Yes	2

11.

If your answer to (10) is 'Yes', how ready are you to teach this curriculum?	
Not ready	1
Ready	2
Very ready	3

12.

Were you one of the teachers who **piloted** the new curriculum materials?	
No	1
Yes	2

13.

If your answer to (12) is 'Yes', how ready are you to teach the new curriculum?	
Not ready	1
Ready	2
Very ready	3

14.

Did you attend the **orientation workshop** in preparation to teach the new curriculum?	
No	1
Yes	2

15.

If your answer to (14) is 'Yes' how ready are you to teach the curriculum?	
Not ready	1
Ready	2
Very ready	3

(b) ATTITUDES TOWARDS THE NEW CURRICULUM

Show the extent to which you agree or disagree with the following statements by ticking the appropriate number.

Tick: 1. Strongly Disagree (SD)

2. Disagree (D)

3. Agree (A)

4. Strongly Agree (SA)

		SD	**D**	**A**	**SA**
1	It was necessary to change from SWISP to the new science curriculum	1	2	3	4
2	Teaching science is very interesting with the new curriculum	1	2	3	4
3	It is easy to find the local materials needed in the new curriculum	1	2	3	4
4	Learners get bored during science lessons	1	2	3	4
5	The new curriculum is **not** different from SWISP	1	2	3	4
6	Using the new curriculum makes it easier for learners to understand science	1	2	3	4
7	Teaching and learning has completely changed with the new curriculum from how it was done with the old system, SWISP.	1	2	3	4
8	Teaching the new curriculum is more tiring than SWISP	1	2	3	4
9	There was **no** need to change SWISP	1	2	3	4
10	There is **no** room for teacher creativity in the new curriculum	1	2	3	4
11	The local materials necessary for teaching the new curriculum are **not** available in my area	1	2	3	4
12	The new curriculum increases learners' interest and motivation in science learning	1	2	3	4
13	I enjoy teaching science with the new curriculum	1	2	3	4
14	Teaching is **not** fun for me with the new curriculum	1	2	3	4
15	Teaching the new curriculum is more demanding than SWISP	1	2	3	4
16	With the new curriculum, it is **not** easy for learners to follow science lessons	1	2	3	4
17	With the new curriculum's approach science teaching is **not** interesting	1	2	3	4
18	The new curriculum allows me to be more creative than SWISP	1	2	3	4

(c) KNOWLEDGE OF THE NEW CURRICULUM

Please read the following statements carefully. Show whether you think the statements are correct or not about the new curriculum by ticking the appropriate number as follows:

1. No, incorrect
2. Yes, correct
3. Don't know.

		NO	YES	DON'T KNOW
1	The curriculum requires learners to be innovative and create scientific objects	1	2	3
2	The curriculum seeks to develop objectivity in observation and in reporting observations	1	2	3
3	The curriculum intends to assist learners develop scientific skills	1	2	3
4	The curriculum aims to develop safety considerations in the laboratory	1	2	3
5	The curriculum aims to enable learners to communicate scientific information with growing proficiency	1	2	3
6	The curriculum intends to develop an understanding and efficient use of scientific instruments and apparatus	1	2	3
7	Community members should be used as resource-people when teaching this curriculum	1	2	3
8	The curriculum seeks to help learners develop the use of scientific concepts and skills to address social issues	1	2	3
9	The teacher is required to assist learners connect and apply their learning to home and community	1	2	3
10	The curriculum aims to encourage the interpretation of collected information, using mathematical relationships, where appropriate	1	2	3
11	Learners are required to recognise and appreciate the importance of living in harmony with the environment	1	2	3
12	The curriculum requires learners to know that scientific knowledge is objective, fixed and not changing	1	2	3
13	The teacher should assess the cognitive aspect only	1	2	3
14	The teacher acts as the main source of knowledge when teaching the new curriculum	1	2	3
15	The curriculum promotes that learners answer questions correctly	1	2	3
16	Learning activities should begin with what learners already know from home, community and society	1	2	3
17	The curriculum requires mainly the use of oral questions and written tests for	1	2	3

	assessment			
18	Teaching/learning activities should be meaningful to learners in terms of local community norms and knowledge	1	2	3
19	The curriculum demands that learners work in groups most of the time	1	2	3
20	In this curriculum, assessment questions should begin with contexts	1	2	3
21	The teacher should give learners a lot of notes during lessons	1	2	3
22	The curriculum aims to enable learners to know, interpret and apply scientific, technological and environmental knowledge in wider contexts	1	2	3
23	Learners should rely on the teacher most of the time during lessons	1	2	3
24	The curriculum seeks to make learners recognise the usefulness of science as a starting point for science-based careers	1	2	3
25	The teacher is supposed to vary activities to include individual and group work	1	2	3
26	The curriculum requires the teacher to give learners procedures for practical work and projects	*1*	2	3
27	The curriculum seeks to help learners develop the culture of using the scientific approach to carry out investigations	1	2	3
28	The curriculum demands the teacher to use a variety of assessment techniques e.g. practical work, projects, written tests, oral questions	1	2	3

SECTION D: CLASSROOM PRACTICE

Please describe the **best** lesson that you, **yourself**, have taught in teaching the new curriculum by answering the following questions. Write your answers in the spaces provided and feel free to elaborate.

Lesson Topic: ____

What makes you consider this particular lesson your best lesson?

____
____
____
____
____
____
____
____
____
____
____
____

How long was the lesson period? ____

Was the lesson theory, practical or mixture of the two?

____

What were the lesson objectives?

____
____
____
____

What materials/ equipment did you use for the lesson?

____
____
____

How did you introduce or begin your lesson?

How did you organise your classroom, i.e. did learners work individually, in small groups or as whole class?

Learner activities: what exactly were the learners doing during the lesson? For example, listening to teacher; observing demonstration; copying notes; reading; writing answers to exercises; copying questions for homework; or carrying out investigations. Please estimate the time the learners took for each activity that they did.

What was the teacher doing during the lesson?

____

____

____

Were the objectives of the lesson achieved? _________________________________

How did you find out?

____

____

____

____

I wish to know the results of the study, my address is:

THANK YOU VERY MUCH FOR HELPING WITH MY RESEARCH PROJECT.

Appendix F: Interview Schedule

Date:

School:

Interviewer:

Interviewee:

SECTION A

1. Your name is ……………………………….
2. For how long have you been teaching science?
3. Do you have a teaching qualification, E.g. Secondary Teachers' Diploma (STD), Post Graduate Certificate in Education (PGCE), Bachelor of Education (BEd), Master in Education (MEd)?
4. What are your majors?
5. Did you attend the orientation workshop in preparation of implementing the new curriculum?

SECTION B

1. In your own view, how is the new curriculum different from the old one?
2. What is it about the new curriculum that makes you want or not want to implement it in your classroom?
3. What do you do and how do you go about teaching the new curriculum in your classroom?
4. What are the kind of challenges, if any, that you encounter when teaching the new curriculum, in terms of yourself, the learners and materials?
5. What are your overall feelings or comments about the new curriculum?

Appendix G: Observation Schedule

Date:

School:

Class:

Teacher:

Observer:

Role of observer:

Length of observation:

Lesson Topic:

Were the objectives of the lesson made clear to learners?

____

____

Narration: nature of lesson, class organisation, pupils activities, teacher-pupil interactions, inclusion of societal issues and how achievement of objectives was assessed -------------------

----

Were the goals of the lesson achieved?

Reflections:--

Appendix H: Scoring guide for Knowledge items

Item no.	item	NO	YES	DON'T KNOW
1	The curriculum requires learners to be innovative and create scientific objects	0	1	0
2	The curriculum seeks to develop objectivity in observation and in reporting observations	1	0	0
3	The curriculum intends to assist learners develop scientific skills	0	1	0
4	The curriculum aims to develop safety considerations in the laboratory	1	0	0
5	The curriculum aims to enable learners to communicate scientific information with growing proficiency	0	1	0
6	The curriculum intends to develop an understanding and efficient use of scientific instruments and apparatus	1	0	0
7	Community members should be used as resource-people when teaching this curriculum	0	1	0
8	The curriculum seeks to help learners develop the use of scientific concepts and skills to address social issues	0	1	0
9	The teacher is required to assist learners connect and apply their learning to home and community	0	1	0
10	The curriculum encourages the interpretation of collected information, using mathematical relationships, where appropriate	1	0	0
11	Learners are required to recognise and appreciate the importance of living in harmony with the environment	0	1	0
12	The curriculum requires learners to know that scientific knowledge is objective, fixed and not changing	1	0	0
13	The curriculum requires learners to demonstrate the use of resources in a sustainable manner both individually and in the community	0	1	0
14	Scientific knowledge is created by the teacher together with the learners	0	1	0
15	The curriculum promotes that learners answer questions correctly	1	0	0
16	Learning activities should begin with what learners already know from home, community and society	0	1	0
17	The curriculum requires mainly the use of oral questions and written tests for assessment	1	0	0
18	Teaching/learning activities should be meaningful to learners in terms of local community norms and knowledge	0	1	0
19	The curriculum demands that learners work in groups most of the time	1	0	0
20	In this curriculum, assessment questions should begin with contexts	0	1	0
21	The teacher acquires knowledge of local norms by talking to community members, and by reading pertinent documents.	0	1	0
22	The curriculum aims to enable learners to know, interpret and apply scientific, technological and environmental knowledge in wider contexts	1	0	0
23	The curriculum requires the teacher to plan jointly with learners to design community-based learning activities	0	1	0
24	The curriculum seeks to make learners recognise the usefulness of science as a starting point for science-based careers	0	1	0
25	The teacher is supposed to vary activities to include individual and group work	0	1	0
26	The curriculum requires the teacher to give learners procedures for practical work and projects	*1*	0	0
27	The curriculum seeks to help learners develop the culture of using the scientific approach to carry out investigations	0	1	0
28	The curriculum demands the teacher to use a variety of assessment techniques e.g. practical work, projects, written tests, oral questions	0	1	0

Appendix I: Learners' Scores on even - and odd - numbered items of the questionnaire – knowledge section

Respondent's number	Odd– numbered items	Even– numbered items
01	64	64
02	64	57
03	57	64
04	64	71
05	71	64
06	71	57
07	71	71
08	64	64
09	79	71
10	57	43
11	57	57
12	50	57
13	64	64
14	71	64
15	57	50
16	64	57
17	71	57
18	50	50
19	64	71
20	64	57
21	71	64
22	64	57
23	50	50
24	43	43
25	57	50
26	43	57
27	64	64
28	57	64
29	57	71
30	71	57
31	50	43
32	64	64
33	57	50
34	71	57
35	64	50
36	79	64
37	57	71

r = 0.513
Overall Reliability determined using the Spearman-Brown prophecy formula = 0.7

Appendix J: Teachers' Overall knowledge scores

Teacher Number	Overall knowledge score (%)
01	64
02	61
03	61
04	68
05	68
06	64
07	71
08	64
09	75
10	50
11	57
12	54
13	64
14	68
15	54
16	61
17	64
18	50
19	68
20	61
21	64
22	61
23	50
24	43
25	50
26	61
27	54
28	61
29	64
30	64
31	46
32	64
33	54
34	64
35	57
36	71
37	64

Mean = 60.5 %
Median = 61 %
Mode = 64 %

Appendix K: Teachers' responses to attitude items

		Number Agreed	% Agreed
1	It was necessary to change from SWISP to the new science curriculum	30	81
2	Teaching science is very interesting with the new curriculum	25	68
3	It is easy to find the local materials needed in the new curriculum	24	65
4	Learners get bored during science lessons	5	14
5	The new curriculum is **not** different from SWISP	6	16
6	Using the new curriculum makes it easier for learners to understand science	28	76
7	Teaching and learning has completely changed with the new curriculum from how it was done with the old system, SWISP.	32	86
8	Teaching the new curriculum is more tiring than SWISP	21	57
9	There was **no** need to change SWISP	7	19
10	There is **no** room for teacher creativity in the new curriculum	8	22
11	The local materials necessary for teaching the new curriculum are **not** available in my area	8	22
12	The new curriculum increases learners' interest and motivation in science learning	32	86
13	I enjoy teaching science with the new curriculum	26	70
14	Teaching is **not** fun for me with the new curriculum	11	30
15	Teaching the new curriculum is more demanding than SWISP	25	68
16	With the new curriculum, it is **not** easy for learners to follow science lessons	9	24
17	With the new curriculum's approach science teaching is **not** interesting	12	32
18	The new curriculum allows me to be more creative than SWISP	19	51

APPENDIX L: Matrix for best lesson descriptions

T. No.	Lesson topic	Why best lesson	Length of less (min)	Nature of lesson	Nature of lesson objectives	Materials used	Introduction of lesson	Organisation of classroom
1	Finding vol. of irregular object	Students attentive Ls had something to do, listen to & see. T voice audible Clear focus & definitions, presentation No hazards for learners Noise constructive & minimal Lesson related to Ls daily life activities Ls made accurate conclusions	80	Mixture of two	Knowledge Practical	Various equipment	Demonstration by teacher	First in small groups then as whole class discussion
2	Teenage pregnanc y	Positive feedback from Ls Topic familiar & close to Ls everyday experience	4 periods	theory	knowledge	Learner's book	Recapping on previous lesson Reading context in learner's book	Small groups
3	Too tiny to see	Participation of Ls in group discussions Lesson easily understood by Ls Activity familiar to Ls	80 min	Mixture of two	knowledge	Different materials	Reading context from learner's book	Class discussion then small group activity
4	Put them together and see what you get	It made use of simply activity/practical to unveil a huge concept	80	practica l	knowledge	Different materials	Review of previous lesson	Small groups
5	Water wastage	Ls able to plan experiment and use it	50	Mixture of two	knowledge	Different materials	Reviewed previous	Small groups

		efficiently Ls able to apply required mathematical skills					lesson	
6	Ecology	Ls enjoyed going out More feedback from Ls than expected Cooperation from Ls Lot of interest from Ls	100	Practical (fieldwork)	Practical in nature	Different materials	Reading and discussion of context from learner's book	Small groups
7	Heat it and cool it	Ls demonstrated understanding of lesson Ls more interested	50	Mixture of two	knowledge	Various materials	Teacher explained & demonstrated what Ls were expected to do	First as class then small groups
8	Reproduction in plants	Cooperation by learners Increased interest and motivation from learners	50	Practical	practical in nature	Various materials	Teacher drew a labeled diagram for a flower on the chalk board for learners to use in comparing with flowers-live specimen they had Discussed with learners how they were supposed to carry out the activity	Small groups
9	Road safety and measuring mass	Pupils very excited about field trip	80	Mixture of two	Knowledge & practical in nature	Various materials	Teacher made pupils aware of different hazardous situations in the road	Individually and small groups

							Teacher asked learners to take safety precautions as they walked to a near by clinic	
10	Why safety first	Had easy to achieve objectives Good context Activities interesting to pupils Activities were relevant to students' safety at home, school and road Enabled learners to use mathematical skills	60	Mixture of two	knowledge	Learner's book and teacher's book	Teacher explained the need for safety Teacher read the context in learner's book	Individually at first the discussed as whole class
11	Elements and compounds	Context helped teacher to easily explain elements and compounds	60	Mixture of two	Knowledge	Different materials	Read context from learner's book	Small group
12	Measuring volume	The required equipment was enough for every learners to use Pupils more interested Most pupils seem to understand lesson	80	Mixture of two	Practical in nature	Various materials	Defined volume Explained different units of volume Told class of my favourite drink giving volume it usually comes (300 ml fanta orange) Had discussion with learners of their favourite drinks	Small groups

13	Classifying substances	Pupils were able to understand the lesson	80	practical	Practical in nature	Various materials	Reminded pupils of previous lesson Discussed effects of acids like from car batter on clothes	Small groups
14	Where babies come from?	Feels the topic was very informative to students It helps teacher to address issues which many parents can not discuss with their children	80	Theory	Knowledge	Learner's book and chart	Asking learners questions	Small groups
15	Measuring volume of liquids and solids	Pupils were able to do what was expected	70	Mixture of two	Practical in nature	Various materials	Grouped pupils Instructed learners to pour water in measuring cylinder Told pupils to accurately record volume of water	Small groups
16	Heat it and cool it	Pupils were able too take reading as required	70	Mixture of the two	Knowledge	Various materials	Read the story in learner's book	Small groups
17	Microscopic organisms	Learners were able to use microscope on their own Learners also answered questions in book correctly	70	Mixture of two	Both knowledge and practical	Different materials	Reading story in textbook	Small groups

18	Measure ment of volume of liquids and solids	All learners participated in lesson Learners were able to measure volumes correctly	80	Mixture of two	Practical	Different materials	Explained what they were supposed to do in lesson and how to do it	Small groups
19	Matter exists in three states	It was easy for learners to grasp the concepts Introductory story was the best fit to introduce the topic	55	Mixture of two	knowledge	Different materials	Read story in learner's book Discusses the story and questions that are part of story	Small groups
20	What we eat (more about indicator s)	Lesson required local and easy available materials (different kinds of food) Students were able to understand and follow instructions Students recorded the results correctly	60	Mixture of two	Knowledge and practical	Different materials	Teacher asked pupils what an indicator is and how it is important to our lives	Small groups
21	Characte ristics of living things	Most pupils were involved Pupils were eager to answer questions Story motivated pupils since was about something they knew Pupils were moved from the known to the unknown through the story	80	Mixture of two	Knowledge	Charts + pictures of animals	Teacher posed a question a whether pupils had ever wondered what made them different from a stone Pupils were asked to discuss the differences between them	Small groups

							and stones	
22	The microscope	Pupils listen attentively as teacher demonstrated the use of microscope Pupils showed interest to topic by posing questions	60	Mixture of two	Practical and knowledge	Various materials	Described what a microscope was as listed the different types (light and optical) Emphasized that it is a delicate and expensive instrument, therefore should be handled with care	Small groups
23	Classification of things (what is life)	Pupils were responding well during lesson They did very well in the test on this topic	15 * 40	Theory	Knowledge	Charts	Teacher used an example of a shop where there were many different items that had to be in order in the shelves	Individually then small groups then whole class
24	What we eat	All students participated Students motivated as they wanted to know how they were going to find out from the food stuffs they were asked to bring from home Fully participated during discussion	80	Mixture of two	Practical	Various materials	Teacher led discussion of the different types of food and they it comes from (plants or animals) Asked pupils about basic tastes and told them they would test different food	Small groups

							stuffs	
25	Safety on the road	Lesson taught precautions to avoid accidents on the road	70	Practical	Practical (demonstration of skills)	Road	Defined safety and stated the importance of road safety	Small groups
26	It's alive	Pupils more interested	80	-	Knowledge	-	read story in learner's book	Small groups
27	The male and female reproductive systems	Pupils more interested Very informative and practical for pupils	120	Mixture of two	Knowledge	Different materials	Reviewed characteristics of living things Discussed why young children can not reproduce	Whole class then small groups
28	Safety	Lesson began with familiar local events Required learners to think	60	Mixture of two	Knowledge	Different materials	Told learners that science lab was a special place to conduct experiments and the equipment/substances in there were dangerous Pupils had to cautious when in the lab	Small groups
29	Using a microscope	Learners very excited to use microscope Learners were able to use microscope	80	Mixture of two	Knowledge and practical	Different materials	Read story in learner's book Showed learners microscope and named parts	Two groups of 23 learners since had only two microscopes
30	Using a microscope	Students excited to see and use microscope	50	Practical	Practical	Various materials	Reviewed previous lesson	Small groups

31	Volume	Required learners to use prior knowledge Students enjoyed the lesson	45	Mixture of two	Knowledge and practical	Different materials	Posed question 'what is volume?' after some responses from pupils, and without telling pupils the correct answer they read the introductory story in learner's book	Small groups
32	Teenage pregnanc y	All pupils had something to contribute during lesson Pupils enjoyed lesson	80	Theory	Knowledge	Picture of pregnant woman	Used the picture and asked pupils what they saw Then asked whether it was good for them to be like that woman in the picture	Small groups
33	Classific ation of living things	Lesson was very practical Pupils interacted with their environment Encouraged pupils to analyse their work after making observations	100	Mostly practica l	Knowledge and practical	Various materials	Asked people to list different living things	Small groups
34	How do we grow	Lesson was thought provoking to learners Learners related well with topic	55	Mixture of two	Knowledge	Learner's book, teacher's book and chart	Asked learners a few questions related to growth	Small groups
35	Living things move	Lesson familiar to learners' experiences There was lot of	40	Theory	Knowledge	Different materials	Asked questions about	Individually

		arguing during discussion					classification, naming living and non-living things and how they differ	
36	Teenage pregnanc y	Learners participating during discussion Some kind of debate arose Lessons was about an everyday experience	50	Theory	knowledge	Learner's book	Read story from learner's book	Small groups then whole class
37	Teenage pregnanc y	Whole actively participated Real life issues openly discussed	80	Theory	Knowledge	Learner's book	Can not remember introduction	Small groups then whole class

Matrix for best lessons descriptions continue

Teacher No.	Learner activities	Teacher activities	Objectives achieved	Assessment
1	Listen to teacher Help teacher during demonstration Observed demonstration Reading Qns from board & textbook Carried out Investigation Wrote answers to Qns Copied summary & conclusion from board	Conducted demo Wrote notes & conclusion on board Moving around groups monitoring, marking responses to qns on board	Yes	Written exercise
2	Discussing (1/4 time); Reading (1/4 time); Writing answers to Qns (1/2 time)	Listening to group discussions Checking & marking written responses Correcting misconceptions	yes	Oral questioning
3	Reading Practical work Writing answers to exercises	Moving around groups checking group activity Assisting learners if necessary	Yes	Written exercise

4	Practical work Discussion throughout	Supervising practical Assisting Ls	Yes	Written questions
5	Practical Writing answers to questions	Observed learners doing experiment Help learners with required calculations	Yes	Written exercise
6	Observed organisms & remains of organisms Communicating in each group Recording observations individually Groups reported their findings to the class	At the field teacher was moving from group to group helping Ls and maintaining order On report back section in class, teacher wrote responses/name of organisms on board for Ls to copy	Yes	Oral and practical (Ls had to show live specimen of animals they collect during fieldwork)
7	Discussing with teacher (10 min) Observe demonstration by teacher as a class Record results from demonstration Plot graph using recordings (15 min) Observe another demonstration by teacher in small groups (10 min) Writing answering to questions (15 min)	Conducted demonstration for learners	Yes	Oral questions
8	Observed many flowers Drew diagrams of flowers Answered given questions	Moving from group to group helping learners on how to do the activity	Yes	Oral questions
9	Pupils listen to teacher giving procedure for practical (10 min) Practicing road safety precautions as they walked to clinic (10 min) Discussing with teacher road safety precautions and rules (10 min) At clinic, observe teacher as he demonstrates how to use beam balance (10 min) With the help of the teacher pupils measure mass in small groups (30 min) Walk back to school practicing road safety precautions (10 min)	Watch pupils if they observe road rules as they walk to clinic Lead discussion of safety rules with pupils Demonstrates how to use beam balance Helps pupils use beam balance	To a larger extent	Practical in nature – learners had to demonstrate the use and reading of beam balance and observe road rules.

10	Listen to teacher as she introduced lesson (10 min) Reading textbook and writing answers to questions in the book (25 min) Discussing exercise with teacher and correcting their own work (20 min) Listen to teacher as she summarized the lesson (5 min)	Introduced lesson Aided learners on doing the exercises Led discussion of exercise Summarized the lesson	Yes	Written exercise
11	Listen to learner who was reading the story from book (2 min) One in a group used beads to make a certain pattern The others were watching and making suggestions on what/how to make (15 min) Wrote down a description of what they had done (10 min) Listen to teacher as she/he explaining the relationship between atoms, elements, molecules and compounds using what learners have made using beads of different colours (20 min)	Read context to students Explained to learners what they were supposed to do Moved around making sure pupils were giving constructive ideas and there was no noise Concluded the lesson	Yes	Oral questions
12	Listen and responding to teacher’s questions (10 min) Measuring volume of water (60 min) Cleaning tables Copying notes from board (10 min)	Wrote groups’ measurement on board Explained how to read measuring cylinder	Yes	Practical in nature (demonstrate reading of measuring cylinder)
13	Classifying different substances using litmus paper	Moving around helping learners	Yes	Practical in nature (demonstrate by classifying different substances
14	Observing chart and making notes (30 min) Listening to teacher (20 min)	Observing if pupils were doing the right thing	Yes	Oral questions

	Copying questions for homework (5 min)	Marking pupils' previous notes, they had to make		
15	Carrying out investigation Copying notes	Writing notes on the board Explaining the experiment Showing pupils how to calculate density an its units	Yes	Oral questions
16	Gave each learner an activity to do in the experiment Record results in a table Read a thermometer	Moving around helping pupils Helped pupils set up the apparatus	Yes	Written exercise
17	Carry out investigation Prepare slides of leaf cells (30 min) Prepared slides for kidney cells Observed slides through microscope Answered questions on textbook	After reading the story, he explained to class that organisms are made of cells helped learners prepare slides move around groups ensuring the do and see the right thing focusing microscope for pupils who couldn't	Yes	Written exercise
18	Measuring volume of water Calculating volume of stone Copying notes	Helping learners in groups Writing notes on the board	Yes	Oral questions
19	Carrying out investigation Writing answers to questions	Checking proceedings in group work Checking learners answers	Yes	Written questions
20	Carried out investigations Recorded results	Moving around maintaining progress and order	Yes	Written questions
21	Reading Went outside class to observe small animals Writing answers to questions	Teacher going around checking what pupils were doing Helping learners with difficulties	Yes	Written exercise
22	Observing demonstration by teacher (25 min) Listening to teacher Write notes	Demonstration how to use a microscope Supervising pupils writing notes of functions of different parts of microscope	Yes	Practical and oral questions
23	Listening to teacher Responding to questions and giving examples Writing answers to questions	Explaining to pupils Asking pupils oral questions Wrote notes on chalk board showed some charts	Yes	Written test

	Copying notes			
24	Drew tables in their notebook to record results Tasted different foods Recorded results for each food stuff in the table (20 min) Tested food stuffs using litmus paper (20 min) Each group presented results to class Wrote conclusions from results	Led introductory discussion Moving around monitoring group activity Writing group results on the board Led discussion of results Made summary of lesson	Yes	Written exercise
25	Listen to teacher (10 min) Observed demonstration	Observed groups as they demonstrated road safety rules Gave guideline questions	Yes	Oral questions
26	Discussing in groups Listening to teacher Writing answers to questions copying notes	Moving around groups helping pupils	Yes	Written exercise
27	Listening to teacher and other pupils (20 min) Observing rabbits mating in agriculture department (10 min) Observing charts showing reproductive systems (20 min) Writing notes (15 min) Answering oral questions as conclusion Copying questions for homework	Leading discussion Observing rabbits with pupils Stating functions of different parts of reproductive system Writing notes	Yes	Oral questions
28	Listening to teacher (10 min) Watch demonstration by teacher (20 min) Reading book (20 min) Discussing with teacher as class	Leading discussion Demonstrating how to do practical Supervising group activity	Yes	Knowledge and practical
29	Listened to teacher reading story Answered oral questions during discussion of story Observed teacher demonstrating how to use microscope Used the microscope	Reading story Demonstrating Leading discussion Moving from group to group helping learners with the use of microscope	Yes	Practical

30	Listening to teacher and answering oral questions Carrying out investigations Writing answers to exercises	Helping pupils with the use of microscope Marking their work	Yes	Practical
31	Listened to teacher Did experiment Writing answers to questions (15 min)	Moving around group helping pupils	Yes	Oral questions
32	Wrote what they saw in picture Discussion with teacher	Visiting groups and helping them Making sure all participate in discussion	Yes	Oral questions
33	Responded to oral questions from teacher (10 min) Observing and collecting small animals from different environments (40 min) Recorded observation notes In class put animals in Petri dishes and observed structures (40 min) Answering questions in textbook	Observing pupils as they did their observations and collection of animals Checking their answers to questions summarized lesson	Yes	Written exercise
34	Answering oral questions (10 min) Discussing with teacher (30 min) Reading book (5 min) Writing answers to questions (10 min)	Playing a guiding role (facilitator) during lesson	Yes	Oral questions
35	Answering oral question, listening to teacher, discussing with teacher (8 min) Discussion Copying note writing Answers to questions (25 min) Listen to summary from teacher (10 min)	Leading discussion Writing notes on the board Marking learners' responses	Yes	Written exercise
36	Read story from book Discussing in groups Writing answers to questions Discussed as whole class	Supervising group discussion Led class discussion	Yes	Written exercise

37	Discussing in groups Discussing as a class Writing answers to questions	Leading discussion	Yes	-