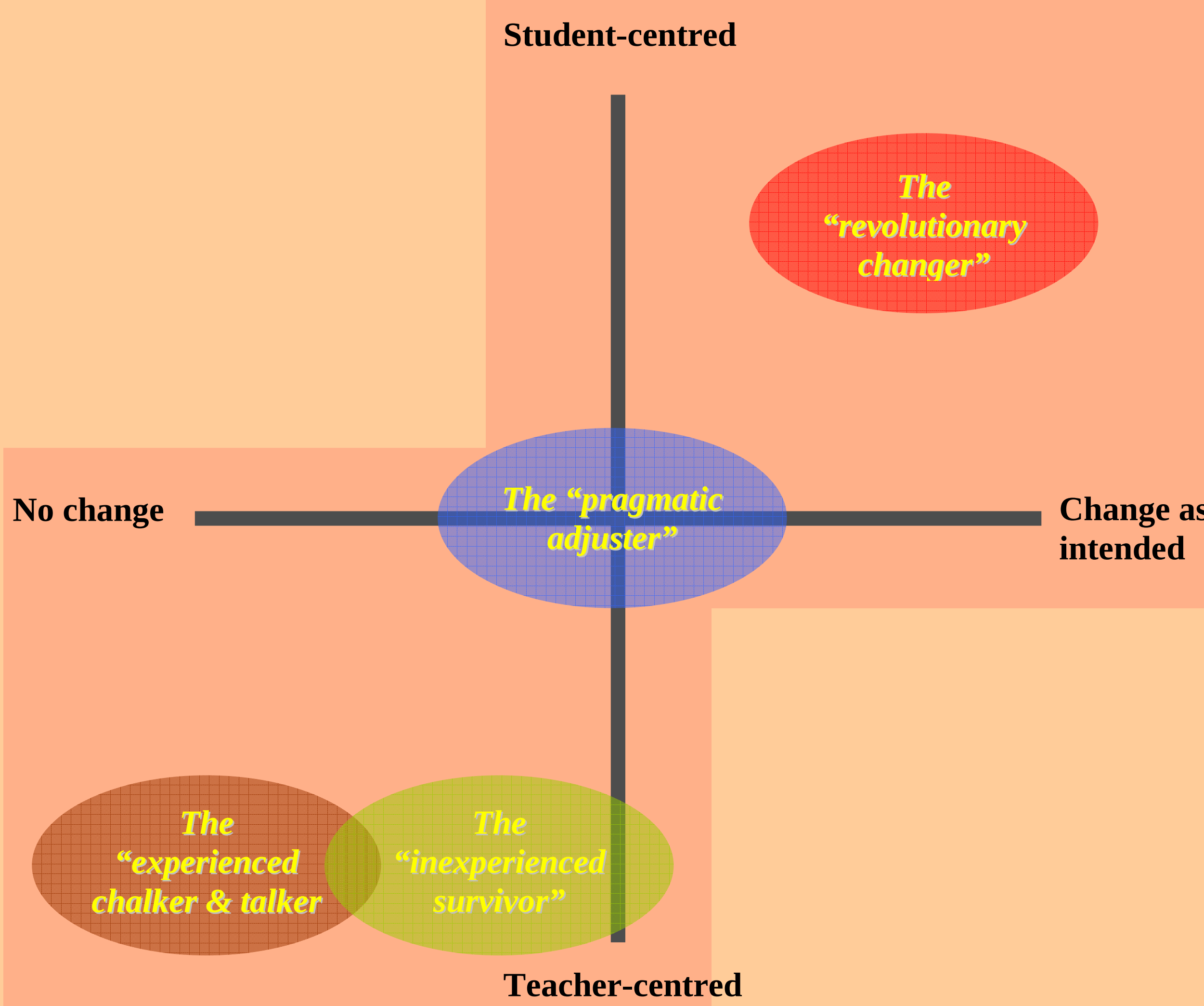
IMPROVING SCIENCE EDUCATION IN SWAZILAND : THE ROLE OF INSERVICE EDUCATION



Robert J. Stronkhorst

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PROEFSCHRIFT

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Robert Johan Stronkhorst

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te Den Haag

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Preface

My interest for this study originated from my involvement as an educator in development co-operation initiatives in Africa. This period has been tremendously enriching for myself and for those who accompanied me. At the same time we had the feeling that we were working for a good cause that ultimately resulted, albeit invisible and probably small, in some kind of improvement. Yet, there never really was an answer to the question: does it really make a difference? When I became involved in the education improvement project SMART in Swaziland, the opportunity arose to attempt to answer this question through research, which was the starting point for this study. At the end I think that this study has provided me with an answer, also to this question.

Stepping from the 'natural sciences' into the 'humanity sciences' research world required some adjustments, which I found illuminating and very worthwhile. I gradually discovered that these worlds are less far apart than I first thought. The central theme of my study has been the improvement of secondary education in Swaziland by advancing the teaching in the schools. Many people have been involved in the study and contributed - in some way or another - to its end-result, being this book. I want to convey my gratitude to all but will acknowledge some of them in particular.

First and foremost, I am deeply indebted to the teachers who were involved in this research and who allowed me to be part of the teaching and learning occurring in their classroom. The abundant data collection that has taken place was only possible through the support of these teachers, their students, their head of departments and their head teachers. I also want to thank all the teachers who came to the workshops, who I visited in their schools, who tried out materials in their lessons and helped me in improving the inservice courses and the teaching materials. I really miss the visits to your schools, our pleasant contacts and the many interesting educational experiences we shared. I hope that my study will ultimately benefit your work in some way.

I also want to thank the senior inspector for science of the Ministry of Education and the mentors of the regional INSET schools for their support.

The research and the writing of this book I could not have accomplished without the inspiring, encouraging and professional support of my two tutors. I want to thank Jan van den Akker and Ellen van de Berg for their support in guiding me through this process.
I also want to thank Tjeerd Plomp and Wilmad Kuiper for their professional advice on specific parts of my thesis.

Being a member of the SMART team the study was conducted under the umbrella of the SMART project supervised by the University of Swaziland and the Vrije Universiteit van Amsterdam. I want to thank the dean and staff of the Faculty of Education of UNISWA and the director and staff of the International Cooperation Centre (CDCS) for their support. In particular I want to thank Sabelo Manyatsi, Fortune Dlamini, Bongile Putsoa, Nel velthorst and Fer Coenders for providing me with valuable information and/or comments on specific chapters of this book.
A special thanks goes also to Mieke Kapteijn of the Instituut voor Didaktiek en Onderwijspraktijk (IDO) of the Vrije Universiteit for her professional validation of the biology curriculum materials and for the comments on specific chapters of this book.

I am also grateful to all who assisted in the data collection and analysis that provided the basis for this thesis. In particular I want to thank Sebo Boerma, Claudia Scheepers and Nienke van Wermeskerken for a job well done, your enthusiasm, the interesting discussions we had and your pleasant company.

Kevin McKenney, Sandra Schele and Paula Krupers-Achterberg thank you for your professional finishing touches in the language and lay-out of this book.

Last but not least I want to herald the never relenting support I have received from my family and friends. I appreciate your helping hands I received at times that I felt lost in my ocean of words. I want to thank my 'paranimfs´, my daughter Sylvia and my son Erik, for helping me in a very stimulating way through the last phase of this intellectual interlude. An, I owe so much to you and it is to you that I therefore dedicate this book.

Haaksbergen, August 2001

Aan An

Chapter 1
Introduction

The improvement of science education in a developing country through inservice education forms the central theme of the study described in this book. The study focuses on the design, development and effect of a biology inservice course that has been organised in the context of a development co-operation project in Swaziland. The main challenge was to design inservice courses that pursued improvements in teaching deemed attainable in the context of Swaziland. To this end, the designers have attempted to base their design on available knowledge of context and inservice theory. This chapter provides a general introduction to the study and its background. Section 1.1 presents background information on this study. Section 1.2 gives a brief description of the country in which the inservice course has been implemented. In section 1.3 the aim and research questions of the study are introduced. Section 1.4 provides an overview of subsequent chapters of this book.

1.1 Background of the study

1.1.1 Improving science education: the potential of inservice education

Science[1] education plays a decisive role in human resource development, which is indispensable to the sustained development of nations (Calloids, Göttelmann-Duret & Lewin, 1997). Many initiatives have been undertaken over the last 30 years to adapt the science education programs of the developing world to the needs of modern societies, often with disappointing results (Calloids et al., 1997; de Feiter, Vonk & van den Akker, 1995). Assistance from the industrialised world have often taken the form of simply transferring forms of science education that were seen as 'ideal' in the western world, without considering the feasibility, desirability and sustainability of these efforts in the local context (Guthrie, 1990; Ogunniyi, 1996; Walberg, 1991).

[1] In this book the term 'science' is used as an overall term to refer to the subjects biology, chemistry, physics and mathematics, unless indicated otherwise.

In recent years, inservice education has come to be considered an important means for improving the quality of science education in developing countries, even though little is known about the effectiveness of such courses in these contexts (Calloids et al., 1997; de Feiter et al., 1995; Farrel, 1993; Ware, 1992). A survey in two developing countries revealed as common criticism of science inservice courses, that they had little effect on teachers' actual practice. This was thought to be due to the fact that the realities of schools and students had not been taken into account (Calloids et al., 1997).
The picture that emerges, though fragmented, is not a very encouraging one at first sight. Yet, although many efforts to assist the developing world in their strides to improve science education have failed to meet their goals, lessons have been learned that can guide us in further initiatives. The efforts of the described inservice project, to improve science teaching, should be seen in this light.
Following Bolam (1982), inservice education is defined as follows in this book: those education and training activities engaged in by teachers, following their initial professional certification, intended to further develop their professional knowledge, skills and attitudes in order that they can educate pupils more effectively.
The inservice project and its inservice courses are introduced in the next section.

1.1.2 The SMART inservice project

This study focuses on an inservice course that has been developed and implemented in Swaziland by a project known under the acronym SMART *(Science & Mathematics Advice and Regional Training)*. The SMART project was part of a co-operative link between the University of Swaziland (UNISWA) and the Vrije Universiteit Amsterdam (VUA)[2]. The SMART project was the most recent in a series of inter-university co-operative initiatives to assist Swaziland with the problems it faced in its Science and Science Teacher Training Programmes (see chapter 2). This project was preceded by another inservice project called IMSTIP *(Inservice Mathematics and Science Improvement Program)*.
The SMART project was started in 1993 and provided inservice for science teachers until 1998, with the long-term goal of improving the quality of Science education in Swaziland High Schools (UNISWA & VUA, 1992). This was to be achieved through i) strengthening of local structures, ii) improving conditions in

[2] The Vrije Universiteit Amsterdam (VUA) was represented by the Centre for Development Cooperation Services (CDCS).

the schools and, iii) teacher guidance and support. The strengthening of local structures entailed capacity building in the provision of science inservice education. By the end of the project in 1998 a science education centre was established at UNISWA, staffed with four well-trained local inservice educators. Furthermore, a regional inservice network had to be set up, consisting of eight well-equipped regional INSET schools, staffed with four mentor-teachers each. Because the mentor-teachers were expected to shoulder extra tasks without extra compensation, the organisation of the regional inservice activities met with many problems, many of which have yet to be resolved. Improvement of conditions in schools has been realised by provision of science equipment to a number of schools and by setting up resource centres.

The focus of this study is on the third component of the SMART project, namely teacher guidance and support through development and implementation of ongoing inservice courses for science teachers throughout the country (see Figure 1.1).

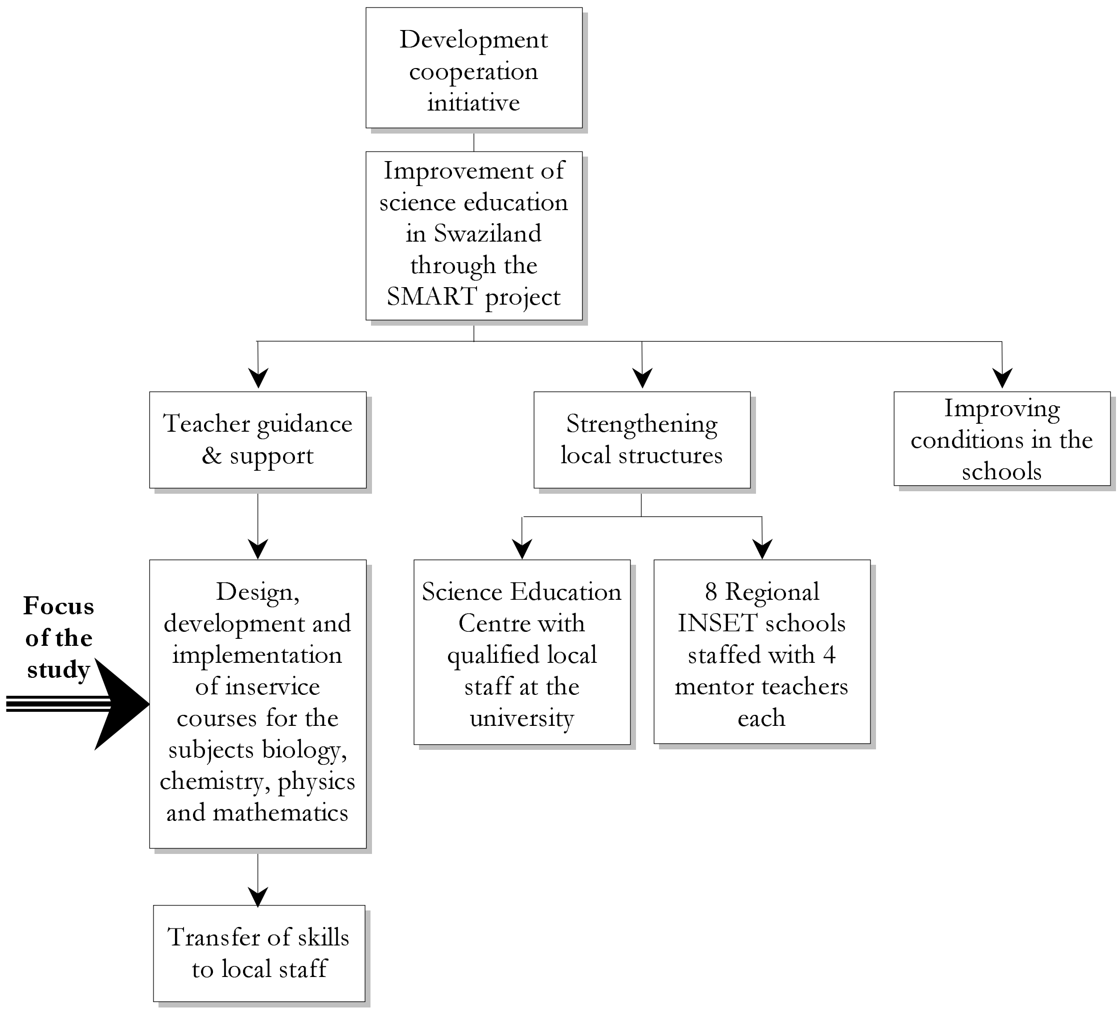

Figure 1.1: The SMART project and the focus of this study

These inservice courses were to be developed and implemented by a team of four teacher educators, specialised in respectively biology education, chemistry education, mathematics education, and physics education. The teacher educators filling these roles were initially four expatriates, who gradually have been replaced by trained local staff enabling transfer of knowledge and skills. The SMART project document (UNISWA & VUA, 1992), formed the initial basis for course development by the team members.

The goal for the inservice courses was formulated as follows in the project document (1992, p. 16):
To improve science teaching in Swaziland High Schools by strengthening the professional quality of the teaching force and by building confidence in a more effective way of teaching through a practically oriented and more student-centred teaching approach.

The inexperienced science teachers in senior secondary education formed the target group with which this goal had to be realised. At that time, the main limitations in the teaching of the sciences were apparently perceived to be in the way practical work was conducted and in the level of student involvement in lessons. In order to meet the goal stated above, the following activities were specified in the project document:

- organisation of one-day workshops at UNISWA, two times per year for each subject;
- organisation of one-day workshops at the 8 INSET schools, two times per year for each subject;
- development of teaching materials to support the implementation process in a practically oriented and more student-centred teaching approach.

In 1993 the SMART team started with the development and implementation of inservice courses for the different subjects, based on the above goal and the prescribed mode of operation. The courses, developed by individual SMART staff members, were initially based to a large extent on the approach of their predecessors in the IMSTIP project (see chapter 2). Persisting doubts amongst staff members around the feasibility of the goal and the effectiveness of the approach initiated a period of reflection in which the inservice approach was evaluated, information on successful inservice strategies was gathered, and needs of teachers were assessed. This eventually led to a different approach with the following goal (see chapter 3):

Promoting professional development of science teachers who are in the stage of 'becoming competent in the basic skills of instruction', focussing on the further improvement of these basic instructional skills.

The greater emphasis placed on improvement of basic instructional skills was thought to be more relevant and realistic in the educational context of Swaziland when compared to the initial goal of facilitating a more practically oriented and student-centered teaching approach. However, as will become clear in the following chapters, the promotion of more student-centred ways of teaching did not disappear from the inservice menu.

This study starts with a reconstruction of the processes that led to common design principles for SMART inservice courses in all subjects, geared to this new goal. Next, the focus will be on the design and development of one SMART inservice course for biology teachers, and the evaluation of its effect in the classroom.

The next section will clarify how this study has originated from the SMART project activities.

1.1.3 Origins of this study

Based on previous experiences with similar projects, VUA has increasingly realised the importance of formative evaluation for improving its interventions. In the SMART project document this surfaced as follows (1992, p. 21):

'Inservice staff will continuously monitor the project activities with a view of establishing whether or not they are on course in terms of meeting the intended goal'

However, even today, teacher educators usually have not received much training in developing an educational course, let alone in evaluating it. Furthermore, most teacher educators don't have the opportunity to spend much time for studying the contextual situation and the latest 'state of the art' theory. Therefore the team requested professional assistance in the development of courses that effectively address perceived limitations in teaching of the sciences in the high schools in Swaziland. VUA co-ordinated and supported the design and research initiatives in their projects, and was assisted in this by the University of Twente (UT)[3]. Support came in the form of concrete assistance in the design and evaluation efforts by specialists and research assistants.

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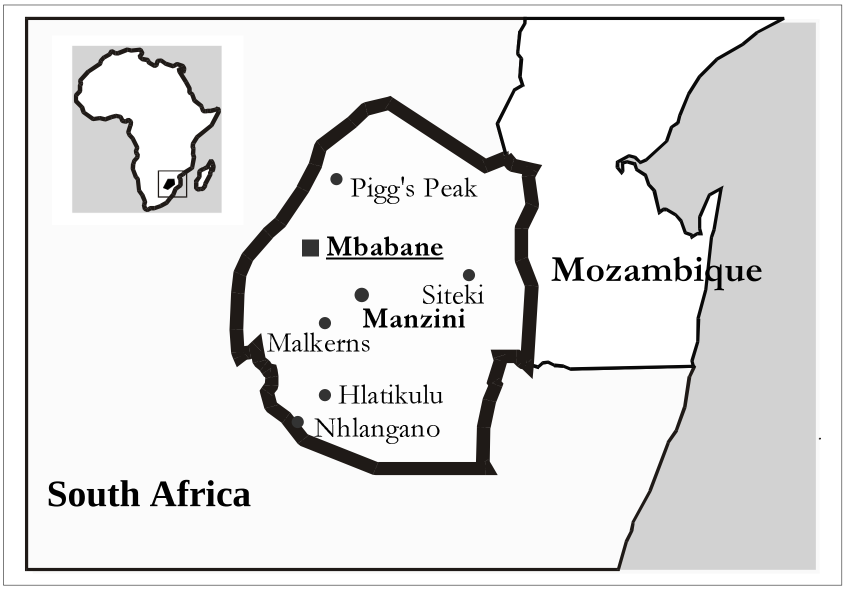
[3] The University of Twente (UT) was represented by the Department of Curriculum of the Faculty of Educational Science and Technology.

The author of this book has been an inservice educator for the subject biology in the SMART project in Swaziland, and as such has been involved in the activities and deliberations that led to the formulating of a list of 'design principles'. More specifically, he was responsible for the development of the inservice courses for biology teachers. He also participated, together with research assistants, in three evaluation studies related to the design and development of biology inservice courses (Boerma, 1994; Coenders, Dlamini & Stronkhorst, 1995; Scheepers, 1995; Stronkhorst 1995c & 1998b; van Wermeskerken, 1998).
Being the designer, organiser as well as investigator of the intervention might not be ideal from a research point of view. Yet, it gave the advantage of easy access to schools and teachers for data collection as well as having in-depth knowledge of issues and situations of the educational system of Swaziland. Moreover, more independent researchers have been involved in the data collection and analysis, so that too strong reliance on the perspective of the individual researcher could be prevented.
Inservice courses are developed in abundance all over the world. This however rarely goes hand in hand with systematic evaluation studies to improve the designed products, as has been done in the SMART project. It was therefore considered important to test the worth of the products in terms of changes in the classroom, and to reflect on the feasibility of the design and design process in the context of a developing country.
Practitioners and researchers alike have mentioned time and again that there is a need for this kind of contribution to knowledge growth. Stoll, de Feiter, Vonk and van den Akker (1996) observe, for the African setting, that little is known about the effectiveness of inservice programs in the developing world. Loucks-Horsley, Hewson, Love and Stiles (1998) note from a western perspective that although there is consensus about the general characteristics of professional development, there is much less known about how to put those principles into practice. They assert that this is largely due to the fact that professional developers are so busy designing and conducting professional development that they have not had the time or inclination to write about their work. This state of affairs has also been noted by Richey and Nelson (1996), who observe that the obstacles for doing developmental research are often created by the daily pressures within education and training environments, which hinder developers from the systematic construction and testing of solutions to their problems.
Evaluation of and reflection on the design of inservice courses has been put into practice in the SMART project. This study of one SMART inservice course provides a clear example.

1.2 Context of the study: Swaziland

Umbuso weSwatini, or the Kingdom of Swaziland, is one of the smallest countries in Africa and about half the size of The Netherlands. The country is surrounded by South Africa, except for the Northeast, where it borders the Republic of Mozambique (see Figure 1.2).



Note: The University of Swaziland is located in Kwaluseni, close to Manzini. The eight regional INSET schools are located in the city and towns indicated on the map. There are two INSET schools at Manzini

Figure 1.2 The Kingdom of Swaziland

After having been a British High Commission territory, Swaziland gained independence in 1968. Today it is ruled by King Mswati III. The country is divided into chiefdoms, which are ruled by chiefs who are the direct representatives of the King. The country has been divided into four regions for administrative purposes: Hhoho, Manzini, Lubombo and Shiselweni. Since all political power is vested in the monarchy, the system of government and decision-making is highly centralised (Chisholm, Marope, Dumba-Safuli & Makwati, 1998). The population of the country is estimated at slightly less than one million with an annual population growth of 2.9 percent (Central Intelligence Agency, 1999). Close to 50 percent of the population is under 15 years of age. Eighty percent of the Swazi live on homesteads in rural areas. The official languages are SiSwati and English with the latter being the official written language and the medium used in schools.

The nation's main economic foundation is agriculture with a large proportion of the population being engaged in subsistence farming. The economy of Swaziland is closely linked to that of South Africa, which is its most important trading partner. Economic growth has been slowing down after the apartheid era came to an end in South Africa.

Swaziland is going through a difficult time with a deteriorating economy, increasing unemployment through ever-increasing flows of school leavers and job seekers, increasing signs of social unrest and escalating crime, and the tragic impact of AIDS. The deteriorating socio-economic status prodded the advent of a National Development Strategy (NDS Steering Committee, 1998). It is only in a scenario symbolised by the local *dvoye* (secretary bird, symbolising efficiency, transparency and accountability) that the NDS is expected to actually assist Swaziland to get on the road to socio-economic progress.

These general features of Swaziland determine to a great extent the scope of operations for its educational system, its schools, its teacher education and training, and thus the SMART project too (see chapter 2).

1.3 Aim and research questions of the study

This study focuses on an inservice program for senior secondary biology teachers in Swaziland, as it has been implemented from 1994 through 1998 as part of the SMART project. This study kicked off in 1994, when the SMART project team changed its goal and formulated design principles for the development of its inservice courses for biology, chemistry, mathematics and physics accordingly (see section 1.1.2). The SMART team aimed at developing inservice courses for each subject that were realistic in the context of Swaziland, and effective in improving the teaching of science teachers (see section 1.1.2). This study aims at clarifying the process that led to the SMART design principles, at reconstructing the development of one inservice course for biology teachers that has been based on these principles, and at assessing and interpreting the effects of this course. To address this aim, the following activities have been carried out: i) a reconstruction of the process that led to the design principles for the SMART inservice courses, and a reconstruction of the development of an inservice course for biology teachers that has been implemented in 1997, ii) an evaluation of the short and long term effect of the '97 biology course, and iii) an interpretive exploration on (personal and school

related) factors that have played a role in participants' decisions to change or not to change their teaching behaviour as intended.
The guiding question for the *reconstruction studies* has been:

1. *How have the SMART design principles been established, and how have these been put into practice in the '97 biology inservice course?*

The main research question guiding the data collection of the *evaluation study* has been:

2. *What has been the effect of the '97 biology inservice course on the professional development of biology teachers in Swaziland?*

Building on Kirkpatrick (1959), Guskey (2000) proposes a model for the evaluation of professional development courses, distinguishing five levels of effect: i) participants' reactions, ii) participants' learning, iii) organisation support and change, iv) participants' use of new knowledge and skills, and v) student learning outcomes.
An important assumption for this model is that effect on a certain level can only be obtained, when effects occurred at preceding levels.
In the further specification of research question 2 that follows regarding 'effect', reference is made to the effect levels of the Guskey/Kirkpatrick model.
Guskey (2000) considers teachers' use of new knowledge and skills (G/K effect level 4) to be the most relevant outcome of inservice courses – that is, the primary factor influencing improvements in student learning. This is also the main level on which the effect of the '97 biology inservice course has been evaluated.
However, at the risk of appraising non-events at this level (Charters & Jones, 1973), it was considered important to check to what extent teachers had participated in a functional way (participation as intended by the course designer) in the course, and to what extent they were satisfied with the course.
Investigations related to participants' satisfaction with the course (G/K effect level 1) have been guided by the following research question:

2a. *How has the inservice course been perceived by the participating teachers?*

The following more specific research question has guided the research on G/K effect level 4:

2b. *What has been the effect of the inservice course on teaching behaviour of participating teachers?*

Calloids et al. (1997) note that evaluations of inservice training activities for science teachers in the developing world are usually contemporaneous with the inservice events. Evaluations are very rarely undertaken after six months or a year to establish whether any impact on practice has been sustained. In this study, short-term as well as long-term effects of the inservice training activities have been assessed. The following research question has guided these investigations:

2c. What has been the difference between short and long term effects of the course?

Attention has also been paid to G/K effect level 5, albeit it a lesser extent, through an inquiry into students' satisfaction with the change in teaching (if any) and the curriculum materials.

The inservice course is not the only factor influencing teaching behaviour. Many factors at the macro, meso and micro level can play a role here as well. An effort has been made to explore which factors influence the effect of the course at the micro level, particularly from the perspective of the teachers. The following research question has guided these *interpretive investigations*:

3. How can the effects of the inservice course be interpreted?

The SMART project staff has put a lot of effort into the design and development of inservice courses that would respond to the professional development needs of science teachers in Swaziland and would be more closely aligned with the realities of the schools and students. This study explores, for one subject and one course, what has been accomplished to this respect. Lessons that have been learned may contribute to better design of inservice courses in similar contextual situations in the future.

Precise and rich context descriptions of these 'lessons learned' are considered essential for generalisation purposes (Richey & Nelson, 1996; van den Akker, 1999; Yin, 1994). To enable teacher educators, program designers and researchers to determine the relevance of this study for their particular situation, a more detailed description of the contextual situation for the SMART inservice courses has been included in this book (chapter 2).

1.4 Overview of the following chapters

The studies that have been conducted in Swaziland in relation to the design, development and effect of a SMART inservice course are described in the following chapters. *Chapter 2* describes the contextual situation in which the inservice course has been implemented. *Chapter 3* presents the common design principles for the SMART inservice courses, as well as the studies and deliberations that formed the basis for these principles. *Chapter 4* focuses in on one particular biology inservice course, outlining and discussing the development of the course, and reporting on the participants and their perceptions of the value of the course. C*hapter 5* outlines the design of the study that evaluated and interpreted implementation in the classroom of nine participating teachers, followed by a presentation of the results in *Chapter 6 and 7*. Finally, the main outcomes of this study are summarised, discussed and put into perspective in *Chapter 8*.

Chapter 2
Context of the study

This chapter describes contextual aspects prevailing at the time that the SMART inservice courses were developed and implemented. In addition to a general overview of Swaziland's educational system, contextual aspects are considered that may have had an influence on the degree of success (or failure) of the inservice courses. Not all of the contextual information presented in this chapter was available when decisions were made about the design of the inservice interventions. Following an overview of the education system in section 2.1, further detail about the SMART project and its immediate context is provided in section 2.2. Subsequently section 2.3 describes the target of the SMART program: science education at senior secondary level in Swaziland. This chapter ends with a summary in section 2.4.

2.1 General overview of the formal education system of Swaziland

2.1.1 Educational policy

The SMART project has been a joint initiative of UNISWA, the inspectorate for science education of the Ministry of Education, and VUA. The project has not been part of a broader structural approach, endorsed by policy makers, to improve (science) education at senior secondary level in Swaziland.
In the period when SMART was operational, 1993 - 1998, educational policy in Swaziland remained tacitly understood and subject to many interpretations (Chisholm et al., 1998). In 1998, however, the Ministry of Education of Swaziland produced a draft policy document for education. This document was ultimately to be incorporated into Swaziland's Economic and Social Reform Agenda (Ministry of Education, 1998), as part of the National Development Strategy mentioned in chapter 1 (section 1.2). The Principal Secretary of the ministry opened the discussion on the document with the following remark: 'our educational system - based on the imbokodvo manifesto of 1968 - has been static

and has not adapted to the changing needs of society'. This acknowledgement of the weakness of the system by a politician might have been prompted by the many critical messages that were coming from the Swazi society about the high cost of education and the minimal social and economic returns thereof (cf. Chisholm, et al., 1998). Many efforts have been made in the past to improve the system (i.e. national educational reviews, educational committees and working groups, conferences on education of Swaziland, as well as a host of projects and interventions to remedy the problems). These initiatives are all expressions of individual, organisational and political will, concern and commitment to the development of education in Swaziland. In spite of all these efforts and the recommendations made, the people of Swaziland had to wait until 1998 when a draft for a comprehensive educational policy was produced by the policy makers.

2.1.2 Structure, efficiency and quality control

As in most developing countries, the educational system of Swaziland has expanded tremendously since the country gained independence in 1968. Limited resources mandated that compromises had to be made regarding quality of education. Quantitative and qualitative aspects of development of the educational system in Swaziland are briefly discussed below, and compared with other countries in the region.

Around the beginning of the twentieth century missionaries introduced western-styled education to Swaziland, with the colonial government later becoming involved. By the 1950s, more than half of the school-age Swazi children still did not attend school, and more than half of the teachers were untrained. At that time less than five hundred pupils were enrolled in secondary education (Dlamini, 1996). Since independence in 1968, a rapid expansion of the educational system has taken place. Table 2.1 illustrates this rapid expansion in the increase in number of pupils, teachers and schools for the period from 1976 until 1996, for both primary and secondary education.
This rapid growth has taken place more or less beyond the control of government with its efficiency often called into question. In the 1990s each community wanted its junior secondary school to be upgraded to a high school as soon as possible, creating enormous pressure on available staffing and resources.

Table 2.1: *Number of pupils, teachers and schools in primary and secondary education in 1976, 1986 and 1996 (Central statistics office, 1976, 1986 & 1996)*

		1976	1986	1996
Primary education	Schools	420	471	529
	Teachers	2 513	4 290	5975
	Pupils	92 721	142 206	202 439
Secondary education	Jun. sec. schools		53	49
	high schools[a]	67[b]	47	121
	Teachers	885	1 617	3035
	Pupils	17 396	30 489	54 873

Note: [a] high schools provide education at junior as well as senior level;
[b] total number of junior secondary schools and high schools

When SMART was operational, the system consisted of 7 years of primary education, followed by 3 years of junior secondary education and 2 years of senior secondary education. Plans existed already for many years to merge primary education and junior secondary education into 9 (or 10) years of basic education for all. The new educational policy (see section 2.1.1) is expected to address this issue.
There are three colleges offering vocational education with a minimum entry requirement of Junior Certificate. For those who manage to pass the O-level examination and obtain a General Certificate of Education (GCE), a fierce competition ensues for the limited places in higher education. Basically, three opportunities exist for this group in Swaziland: i) the University of Swaziland, ii) Swaziland College of Technology, and iii) Teacher Training Colleges.

When it comes to efficiency of the system - and the opportunities it offers, there is a lot of dissatisfaction in the Swazi society, as has been mentioned before. Approximately 55% of the pupils who entered primary education in 1984 did not make it to secondary education, whilst only about 10% of the 1984 cohort succeeded in passing the O-level examination (Stronkhorst, 1997). The rapid expansion of the school system has not led to equal opportunities for all. The considerable contribution that parents have to make towards the education of their children is often too much for many of the poor members of this society, resulting in overrepresentation of children of fairly well-to-do families in tertiary education (cf. NDS Steering Committee, 1998). The fierce competition for the limited places in higher education causes many GCE graduates to go looking for opportunities in vocational education. This downward mobility of GCE holders has the effect of minimising the opportunities for Junior Certificate holders. The result being that, even with further training, finding employment is a big problem at the moment in Swaziland.

All schools, colleges, and the University operate under the jurisdiction of the Ministry of Education. Inspectorates of the Ministry of Education are responsible for the maintenance, improvement and control of the quality of education in the schools. Inspectorates exist for each subject in secondary education. Ideally, an inspectorate exists of 1 senior inspector and 4 regional inspectors. These departments are not always fully staffed however, probably due to lack of resources. For science, only one regional inspector has assisted the senior inspector at the time of SMART. The inspectorates are advised by national panels, consisting of representatives from teacher associations, teacher training institutions, curriculum development centre, etc., on issues related to the subject and the teachers. The national science panel has often been frustrated by lack of decisions, actions and progress. This was true during the period when SMART was operational.

Despite its problems in maintaining the quality of the educational system, Swaziland is performing relatively well when compared with other 'less and least developed' countries in the region (Based on UNESCO's country education indicators, Appendix A). Swaziland has maintained a considerable investment in its educational system between 1985 and 1995 of approximately 20% of total government expenditures. This is on par with the considerably richer Botswana and South Africa. Other figures, such as the number of years of schooling for the younger generation, the pupil-teacher ratio in primary and secondary education, and the number of students enrolling in tertiary education are quite good compared to other countries in the region. However, there is a lot of debate going on at the moment in Swaziland whether the relatively large expenditure on tertiary education is fair to the majority of the people, who never get to this level and have only limited opportunities for further training and employment.
On the other hand, if we compare Swaziland with a 'more developed country' like The Netherlands, gaps (as far as wealth and investment in the educational system is concerned) seem to have become bigger rather than smaller over the years, as illustrated in Appendix A.

2.1.3 The schools

The target group of the SMART inservice program was the population of science teachers teaching in form 4 and 5 of the Swaziland high schools. The expansion of the high school system was progressing at a particularly fast pace at the time of SMART (see table 2.1). This rapid expansion has led, for the sciences, to bottlenecks in staffing, laboratory facilities and equipment provision for many schools. These conditions in the schools have had implications for the design of the SMART inservice program, as is discussed in chapters 3 and 4. More information on the schools and how they operate is provided below.

Although a considerable number of non-governmental high schools exist, almost all of their teachers are employed through the government. In 1991, only 31% of the high school teachers had more than 10 years of experience. The pupil/teacher ratio in high schools in 1991 was 18:1, which can be considered very low, whilst the average number of pupils per class was 35 (Ministry of Education, 1994). However, especially in the lower forms, class sizes are often considerably larger. This problem can be aggravated when there is a shortage of teachers, such as the persistent teacher shortage for the science subjects at senior secondary level (Dlamini, 1995; Stronkhorst, 1992).
Research on how the high schools in Swaziland operate remains scarce. The image that follows is based mainly on data collected in relation to this study, and other SMART related studies (Boerma, 1994; Preenen, 1997; Scheepers, 1995). Most schools have one head teacher and one deputy, who concentrate mainly on their administrative tasks. School policies related to teaching and learning are highly unusual. Departments are managed by head of departments who, possibly due to financial constraints, are often neither confirmed nor remunerated. On average, the (acting) heads of departments have received little or no training or support for managing and leading a department. The school culture with regard to teaching and learning is authoritative and formalistic in most schools. This, together with limitations in physical facilities and resources (e.g. water and electricity supply, furniture, textbooks, science equipment) and large classes, often leads to limited variations in teaching methodology. Classes are often interrupted or cancelled due to all kinds of extramural events, and, at the time of SMART, also because of teachers' strikes. Especially in rural areas, pupils spend a lot of time walking between home and school, and have little opportunity to study at home. English language competence (the prescribed medium in schools)

is a major hurdle for progressing through the system, especially when credit passes are required for entrance into tertiary education (Ministry of Education, 1994). Little or no attention is paid to improving study and reading skills.

2.2 The SMART project

2.2.1 Origins of the project

As introduced in chapter 1, the SMART project has been part of an inter-university co-operation program between the Vrije Universiteit of Amsterdam (VUA) and the University of Swaziland (UNISWA). The information below describes how the project evolved from the co-operation between the two universities, and the implications this had for the SMART project.
Starting in the 1970s, VUA has been active in supporting universities in southern Africa with the problems they faced in their science and science teacher training programs. The focus was initially on limitations in quantity and quality of candidates entering the science degree programs of the universities. Pre-entry science (bridging) courses have been designed and implemented to deal with this problem (for an overview see Cantrell, Kouwenhoven, Mokoena & Thijs, 1993). Later on, perceived limitations in the teacher training programs and the teaching of science in schools became the primary focus of support. Teacher training projects have been initiated to tackle these problems (for an overview see de Feiter et al., 1995; de Feiter, MacFarlane, Stoll & van den Akker, 1998).
These intervention programmes have also been carried out in Swaziland through joint initiatives of UNISWA and VUA[1]. In Swaziland, a bridging course known as SPEC (Science Pre-entry Course) was in place from 1978 until 1990. From 1985 until 1998, gradually more emphasis was put on science teacher education programmes. The main aim of the interventions was initially to expand the ranks of the teaching force. Reorganisations in the preservice training eventually replaced these interventions, and new initiatives shifted focus toward improving science education in the schools. However, shortage of science teachers remains a problem even now (see section 2.3).

[1] The information that follows is based on the SMART project document (University of Swaziland & Vrije Universiteit Amsterdam, 1992) and the twelfth and last progress report of SMART (University of Swaziland & Vrije Universiteit Amsterdam, 1998).

When the focus of the interventions started shifting toward teacher education, the institutional basis of the interventions eventually moved from the faculty of science to the faculty of education of UNISWA. The inservice interventions became the responsibility of a new Department of Inservice of this faculty. The first INSET initiative started in 1985 through the STIP (Science Teaching Improvement Program) project, funded by the European Community. In 1987 UNISWA, in co-operation with VUA, started the full-fledged inservice program IMSTIP (Inservice Mathematics & Science Teaching Improvement Program), as the successor of STIP. The activities of the project, which were aimed at improving the quality of science teaching in Swaziland's high schools, included: organising workshops, development of teacher and student material, school visits and setting up a science equipment loan scheme. A formal evaluation of the project (Williams & Brophy, 1989) contained positive remarks about its achievements and concluded that there was still a vital need for continuation of an IMSTIP-type inservice program. Plans for continuation of the co-operation between UNISWA and VUA were laid down in the SMART project document (UNISWA & VUA, 1992) and could be realised after further funding had been secured. This funding came from the Dutch government, the European Union, the University of Swaziland, the Ministry of Education of Swaziland[2] and VUA (Figure 2.1).

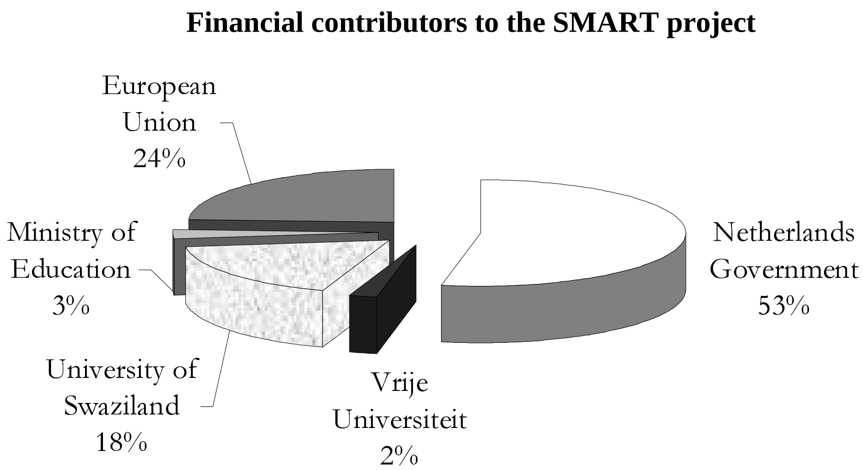


Figure 2.1: Percentile contributions of donors and institutions to the SMART project activities

[2] The relatively small contribution of the Ministry of Education, as main beneficiary, is notable. The ministry was supposed to contribute considerably in the regionalisation of the inservice. However it had not committed itself yet to this in the project document, in terms of a concrete budget. The success of SMART in setting up a regional system of inservice greatly depended on this contribution.

The goal of the SMART project, in relation to teacher guidance and support, has already been introduced in chapter 1 (section 1.1.2). Activities to be carried out in striving towards this goal, and how these were to be implemented, have been described in considerable detail in the project document (UNISWA & VUA, 1992), which was used as a starting point for deliberations on the design of the inservice program (see chapter 3). In these deliberations it was important to take into account the earlier initiatives that had taken place with the goal of improving science education in schools.

2.2.2 The science teacher education context of the SMART project

The main goal of the inservice courses of the SMART project was to improve science education in the high schools. Knowledge of, and close co-operation with the existing training programs for science teachers was clearly important for the project. Some more information on these programs is provided below, as well as on the links between SMART and these programs.

In Swaziland, separate teacher preparation programs exist for science teachers at junior and senior secondary level. The junior level teachers are trained at a Teacher Training College, whilst the senior level teachers (the target group of the SMART inservice courses) are trained at the University of Swaziland. At the time of SMART, two teacher preparation programs for senior secondary level science teachers existed at UNISWA. In practice however, only one of these programs delivered a significant number of science teachers to the system. These teachers would become potential participants of the SMART inservice courses. This program is briefly outlined below.
The science teacher training at the university consists of a four year Bachelor of Science (BSc) degree program offered by the Faculty of Science of the university, followed by a one year Post Graduate Certificate of Education (PGCE) program, offered by the Faculty of Education. The BSc program has as its main goal to train scientists, and is not so much geared to what is required for science teachers. However, BSc graduates often have no option for employment other than entering the teaching profession. These graduates can follow a one-year (or two years part-time) PGCE program. In this program students are offered three modes of education (see Box 2.1).

Box 2.1: Main elements of the PGCE program offered to BSc degree holders in Swaziland

Educational foundations courses
Offered by the Department of Education Foundations and Management. The department offers courses in educational sociology and psychology, guidance and counselling, history and philosophy of education, and education management and administration.

Methods courses
Offered by the Department of Curriculum and Teaching. The department is responsible for instruction in teaching methods, materials and curriculum design and development, and educational technology in all subjects.

Teaching practice
Candidates enrolled in the PGCE program are required to complete and pass 12 weeks of supervised teaching practice (spread over two separate periods).

It should be noted that the BSc program and the PGCE program are operating rather independently from each other, and are experienced by students as two quite distinct worlds. Furthermore, the teaching practice period is of rather short duration, in which logistical problems often reduce the guidance and supervision to incidental visits of preservice staff, mainly for assessment purposes. These kinds of shortcomings in teacher training of science teachers are not unique to Swaziland, nor are they limited to the developing world (Anderson & Mitchener, 1994; Calloids et al., 1997; Guyton & McIntyre, 1990; Nyagura, 1996).
Teacher educators of both preservice and inservice training programs in Swaziland have been aware of these problems and have made repeated recommendations to address inadequacies. (Lubben, 1988; Manyatsi,1987; Stronkhorst, 1992; Williams & Brophy, 1989). Furthermore, an interdepartmental committee made up of preservice and inservice educators was established to facilitate the further development and improvement of science teacher education programs at UNISWA.

SMART was not the only project that provided inservice education to teachers in Swaziland. The Inservice Co-ordination Committee (ICC) monitored and co-ordinated what was going on in this respect. At the time of SMART, inservice activities were also organised for junior secondary science teachers under the auspices of the science inspectorate. The Inservice Centre of the Ministry of

Education and the SMART project were also involved in this. These inservice activities were more of the 'one-shot/one day' type, and lacked basic design principles.

2.2.3 SMART as part of a development co-operation initiative

Projects like SPEC, IMSTIP and SMART have been carried out in several countries in Southern Africa, such as Lesotho, Botswana, Malawi, Mozambique, Namibia, South Africa, Zambia and Zimbabwe. These activities have been, and continue to be in some cases, part of development co-operation initiatives between a university in The Netherlands (mostly VUA, for these kind of projects) and local universities of less developed countries. The contribution of the Dutch partner university has mostly fallen under the Dutch development co-operation program and budget. In Swaziland, Botswana, and Lesotho this co-operation between a Dutch university and the local universities has gradually come to an end, whilst in Mozambique and South Africa the co-operative programs still continue. The fate of the co-operation with the other countries mentioned is not clear at this moment. This is partly due to localisation and institutionalisation of the projects (missions accomplished), but might also be related to choices the Dutch government makes based on its policy for development co-operation. The Dutch government recently adopted the following guiding principles as a basis for development co-operation:

- good governance: development aid can only be efficiently used if a country has good governance;
- sustainability: development aid should not only be geared to solving temporary problems, but also enable continuing development when the assistance ends;
- ownership: countries, organisations and/or persons receiving assistance should be in control of their own development as much as possible.

The Netherlands also wants to concentrate its structural and long term development co-operation more on assistance to the poorest countries, of which only a limited number have been selected based on the aforementioned principles.

The SPEC and IMSTIP projects were more geared to solving problems that Swaziland experienced in its science and science education programs. Whilst the SPEC project was set up to boost the number and quality of students entering the Faculty of Science, the IMSTIP project was aiming at improving the quality of science and mathematics education in the schools. SMART continued with the 'IMSTIP mission', but shifted the emphasis from strictly 'problem solving' to also addressing the elements of 'sustainability' and 'ownership'. As mentioned before, the focus of this study is not on the 'sustainability' and 'ownership' elements of the SMART project. The main donors have evaluated achievements of the project related to these elements, and it seems that on the short term some reasonable successes have been booked in this area (Lieshout & Nsibande, 1996). This study focuses on the 'problem solving' element of the project related to teacher guidance and support, which will remain the basis for program design for the localised institution and staff.

2.3 Science education at senior secondary level: the target of SMART

The goal of the SMART inservice courses was to improve science education in the high schools of Swaziland. This was to be done by improving teaching skills of the science teachers in such a way that would thereby lead to improved student learning. The improvement of teaching skills should lead to better implementation of the existing science curriculum in schools. It could be expected that improvement in the learning of students should ultimately lead to better examination results. In this section some more information will be provided on the science teachers, the science curriculum and science examination results of Swaziland.

2.3.1 The science teachers

This section focuses on two issues related to science teachers in Swaziland: i) their numbers, and ii) their teaching.

As mentioned in section 2.2.1, there was a shortage of science teachers at the time of SMART, which was caused by limited output of teachers by the local teacher training programs (see section 2.2.2), exacerbated by the fact that teachers did not stay for very long in the teaching profession. This chronic shortage of science teachers is not unique for Swaziland (Calloids et al., 1997).

Below follows some more information on supply and retention of science teachers in Swaziland, based on surveys conducted by Dlamini (1995) and Stronkhorst (1992).
In 1993, 641 science teachers were teaching at secondary school level in Swaziland. Due to a shortage of local qualified science teachers, 21% of the science teachers were expatriates, most of whom were quite experienced. This compares with 12% for the non-science teachers. 71% of the science teachers were male and the majority was in the age range 25-39. 24% of the science teachers were not properly qualified in 1993. Of those who were properly qualified, 29% were teaching subjects they were not qualified for. The shortage of local qualified science teachers increased during the period when SMART was operational. This followed a decision by UNISWA in 1991 to replace its compulsory (for degree programs) Concurrent Certificate in Education (CCE), by a one year Post Graduate Certificate in Education (PGCE) program (see also section 2.2.2), which was not compulsory. The result being that very few BSc graduates - the main source of science teachers in Swaziland - obtained a certificate in education between 1991 and 1998. In 1998 there were some indications that something was going to be done about this situation at higher policy level (NDS steering committee, 1998; Ministry of Education, 1998). It must however be mentioned that due to the inefficiency of the system (e.g. many small schools and many different syllabuses for science) the demand for science teachers could be somewhat inflated.
As mentioned before, a teaching career is not a first choice for most BSc graduates. Adding this fact to the often unattractive teaching conditions, it should come as no surprise that BSc graduates don't stay in the profession for long, if they choose for it at all (Lubben & Mdluli, 1988; Wheldon & Mathunjwa, 1986). This is reflected in the very low retention rate of local graduates: only 35% of the properly qualified teachers stay longer than 4 years (Dlamini, 1995).
Limited supply combined with low retention rates result in severe limitations in science department staffing. Many departments cannot muster even one teacher for each of the three science subjects with physics forming a particular problem. In practice, this state of affairs had the following consequences for science education in high schools at the time of SMART: i) a considerable number of under qualified teachers in the sciences and/or, ii) high teaching loads and/or, iii) large classes and/or, iv) less than the prescribed number of periods per subject. This situation put severe constraints on the delivery of good science education in the high schools of Swaziland. The SMART inservice will not be able to make a

contribution as far as supply is concerned, but might be able to contribute in motivating and assisting teachers to stay longer in the profession.

As far as the teaching of the sciences is concerned, the afore-mentioned 'Swaziland school culture' and limitations in physical facilities and resources (see 2.1.3) can contribute to limited variation in teaching methodologies, also for science teachers.

2.3.2 Science curriculum

This section provides information on two elements of the science curriculum: i) the syllabuses for the natural sciences, and ii) the textbooks for the natural sciences.

The National Curriculum Centre (NCC) of Swaziland is responsible for curriculum development and co-ordination at the primary and secondary levels. The main focus of the NCC thus far has been on the development of the primary education curriculum. The senior secondary education curriculum is based on the overseas Cambridge O-level syllabuses and examinations. Although ministerial directives related to choice and combinations of syllabuses exist, in practice schools have a lot of freedom in making their curriculum choices. For the natural sciences, schools used the following Cambridge syllabuses at the time of SMART: biology (5090), science (physics/chemistry 5124), combined science (5129), additional combined science (5130) and human and social biology (5096). Chemistry (5070) and physics (5054) were not offered in the majority of the high schools. Single science subjects, like biology, were originally meant for students interested in science careers. However, through revisions in the UK these have gradually developed into more broad 'science for all' kind of syllabuses (de Feiter et al., 1995). At UNISWA, the combination of biology (5090) and science (5124) is seen as sufficient training for pursuing a science career, and is therefore the most common combination offered in schools to the more science-inclined students. Since all students are supposed to do at least one science subject at senior secondary level, a 'soft option' (combined science) is offered nowadays to the majority of the students. However, the teaching of a subject like combined science often creates problems in schools because it is a rather crammed syllabus (a combination of subsets of the single science syllabuses), that mostly needs to

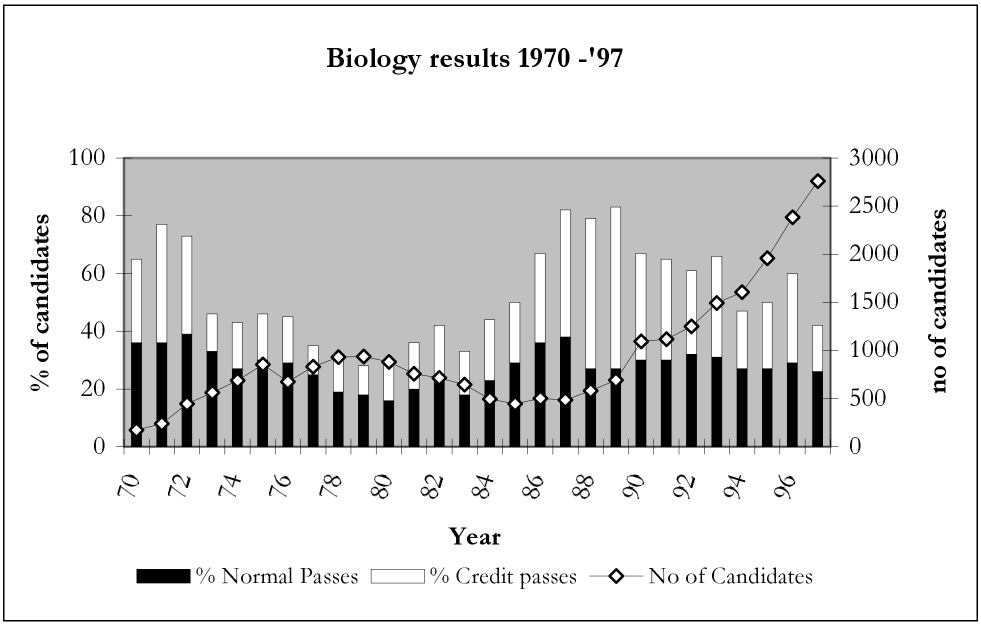
be taught by at least two different teachers, and which gives limited opportunities for further education.
The design of the '97 biology inservice course, that is focussed upon in chapters 4 to 6 of this book, had to be geared to the improvement of implementation of four syllabuses (biology, human and social biology, combined science, and additional combined science), which was a complicating factor.

For the natural sciences, students often have to buy expensive textbooks, mostly originating from the United Kingdom. In many schools this might have contributed to the fact that considerable numbers of students did not have a science textbook, as their parents could not afford to pay for these. For mathematics a much cheaper, regionally produced, textbook was available. This limitation of the textbook availability in schools had to be taken into account in the design of the inservice courses.

2.3.3 Science examination results

It could be expected that the success of the SMART inservice courses should ultimately lead to better learning of students, and thus to better examination results. Three questions are of interest here, and are further discussed below: i) is there need for improvement of examination results? ii) do examination results in Swaziland provide information on changes in standards of achievement? and, iii) can the examination results be used as an indication of the effects of the SMART inservice courses?

The JC science examinations are set and marked in Swaziland. The results have been quite good (close to 80% pass) and constant over many years, indicating norm-referenced examinations. These results provide little information on changes in standards of achievement, and not much can be said on whether improvement is needed based on these results.
The senior secondary examinations are set and moderated by the University of Cambridge Local Examinations Syndicate (UCLES), but marked in Swaziland. The examination results of Swaziland for the subject biology (5090) are presented in figure 2.2 below (subjects like mathematics and English show similar patterns).



Note 1: credit passes are the A, B and C Cambridge O-level scores (± > 55%) and normal passes are the D and E scores (±35-55%)
Note 2: total % of candidates that passed per year = % credit pass + % normal pass

Figure 2.2: Examination results for the subject biology (COSC syllabus 5090) over the period 1970 -'97

What can be noted immediately are the considerable changes that occurred in the results over the years, indicating a more criteria-referenced examination. However, it is strange that examination results of students of one country change so much, in an apparently unpredictable way over the years. To be able to do something about declining results it is important to know what causes the decline.

Declining quality of science education in the schools could be a cause of the declining examination results. And indeed, some relate the gap in examination results in the sciences between junior and senior secondary education in Swaziland to the limited enactment of the curriculum by senior secondary teachers, especially in relation to higher cognitive learning of students (Rollnick, Manyatsi, Lubben & Bradley, 1998). However, it is difficult to explain the fluctuations in results through this, especially if these also take place in non-science subjects. From this perspective it is interesting to note that in the 1980s, at the time of IMSTIP, examination results improved remarkably. But, when SMART started in the 1990s, a dramatic decline in examination results was witnessed, results dropping from an approximate 80% total pass rate in 1989 (of which ± 55% credit passes) to a 40% total pass rate in 1997 (of which ± 15%

credit passes). This might indicate that other factors played a more important role than the perceived limitations in the teaching of science teachers.

Figure 2.2 seems to indicate that the absolute number of students allowed to write the examinations has a strong influence on the examination results, with strong increases in numbers (±700 candidates in 1989 rising to ±2800 candidates in 1997) leading to dramatic falls in results. Research indicates that the fall in results is predominantly caused by the fact that more and more academically weak candidates are allowed into senior secondary education, unable to pass subjects like mathematics, biology and English (Stronkhorst, 1997c). This research also indicates that examination results differ considerably between schools. This is thought to be due to differences in admission, selection and streaming policies and practices of schools.
Of course more factors can play a role in such examinations, some of which are uncontrollable (e.g. results of other countries) for a country like Swaziland (Kahn, 1989). Some African scholars have also related poor performance of African students in the sciences to African culture and African worldview (Jegede, 1990; Ogunniyi, 1995). However, other African scholars (Dzama and Osborne, 1999) challenge this standpoint as follows:
"Poor performance in science in developing countries in Africa is not due to a conflict between science and African traditional values and beliefs but rather to the absence of supportive environments for serious science learning and absence of vocational incentives".

In short, it seems that declining science examination results in Swaziland in the 1990s are a sign of declining achievement in schools, which could not be stopped by the SMART inservice intervention through addressing perceived limitations in the teaching of the sciences. After other more fundamental issues are properly addressed, effects of inservice interventions like IMSTIP and SMART might become more visible in the results of these types of examinations.

2.4 Summary

Following independence, there has been an extraordinary expansion of formal education in developing countries, which has been accomplished with limited and often declining resources (Farrell, 1993). Swaziland has risen to this challenge, and performs quite well if we compare it with other countries in the region. However, in many developing countries this expansion has resulted in shortcomings in learning conditions in schools, shortcomings in the training of teachers, high dropout rates of students, low motivation of teachers, and relatively low educational achievements (Calloids et al., 1997; Farrell, 1993; Verspoor, 1989; Ware, 1992). Swaziland has been no exception to this, as has been illustrated in this chapter.

The SMART project, aimed at improving science education in the high schools of Swaziland mainly by facilitating better teaching of the sciences through setting up an inservice education system and through direct provision of resources to schools. The SMART project had limited means and influence to have a significant impact on the following obstacles to effective science education, as have been described in this chapter: i) absence of an overall policy to improve (science) education, ii) limitations in the science inspectorate, iii) shortcomings in the preservice training for science teachers, and iv) limitations in the management of the schools. This obviously put boundaries on what this project (and its preceding projects) could achieve in the area of high school education improvement at a national level.
Yet, even if conditions are not optimal at the various levels of an education system, inservice programs seem to have potential in less developed countries (de Feiter et al., 1995; Farrell, 1993; Macdonald & Rogan, 1990; Ware, 1992). A local initiative, like the SMART project more or less was, can ignite a broader change and become more and more effective in the long run when institutionalisation of the project (i.e. capacity building) has been adequately provided for. Some positive developments in this area have been described in this chapter.

The challenge for the SMART designers was to facilitate better teaching of the sciences that was feasible for the science teachers to implement in the realities of their schools.
As mentioned, not all of the information presented in this chapter on the realities of teaching in the schools was available when the SMART project staff started their deliberations on the design for the inservice courses. Nonetheless, as has been alluded to already and will be elaborated on in chapter 3, the impetus for the design of the SMART inservice courses has been to assist the many inexperienced science teachers. These teachers are assumed to have deficiencies in subject knowledge and teaching skills, and are teaching predominantly in a formalistic way in far from optimal conditions with hardly any support. These

assumptions were largely based on the SMART inservice educators' own impressions and experiences, which in hindsight appear quite accurate as illustrated in this chapter.

The following chapters illuminate the design and development of an inservice course aimed at facilitating better teaching of the sciences by promoting practices considered feasible for the science teachers in the realities of their schools. We also examine what the course achieved in this respect.

Chapter 3
Towards the *SMART* design principles: A reconstruction

This chapter describes the design principles of the SMART inservice programme, including how these have been established and improved. The chapter starts with an introduction in section 3.1, followed by a summary of the study that evaluated an early-SMART inservice course in section 3.2. Section 3.3 presents the knowledge base that was available to SMART staff at the time of deliberation on design. Subsequently, section 3.4 portrays a reconstruction of the processes and factors that eventually resulted in the initial SMART design principles. Section 3.5 provides a reconstruction of how these principles have been improved through formative evaluation studies and deliberations in SMART staff meetings. This chapter concludes with a summary in section 3.6.

3.1 Introduction

When SMART was launched in 1993, the project document (UNISWA & VUA, 1992) formed the main guideline for planning (see also sections 1.1.2 and 2.2.1). It prescribed in detail the number, duration and budget for the workshops to be organised each year, nationally and regionally. Furthermore, teaching materials had to be developed to support the implementation of a practically-oriented and learner-centred teaching approach. Since the evaluators of the preceding IMSTIP project had been quite upbeat about its achievements (Williams & Brophy, 1989), the SMART team initially continued more or less staying the course of their predecessors. However, as already touched upon in chapter 1, this experience somehow raised doubts amongst some staff members on the feasibility of the goal and the effectiveness of the approach. A study was initiated to find out more about: i) the effectiveness of an early-SMART inservice course, ii) what was known about teaching and learning in these contextual situations, and iii) the existing knowledge base on effective strategies and principles for inservice education.

In the light of the outcomes of this study the SMART team decided that it would be prudent to consult experts for advice on the future design of the SMART inservice courses. Following an extensive process of deliberations and consultations, the SMART team formulated its initial design principles for its inservice courses. Consensus on these design principles was reached in meetings held in the years 1993 and 1994. Based on these design principles, project staff started developing inservice courses for all science subjects.

In 1994 and 1995 two formative evaluation studies were conducted geared toward improving courses and related curriculum materials. The SMART team used the output of these formative evaluation studies to adjust its design principles in 1995. The main inputs and outputs of the deliberations of the SMART team on the design of its inservice courses are summarised in figure 3.1.

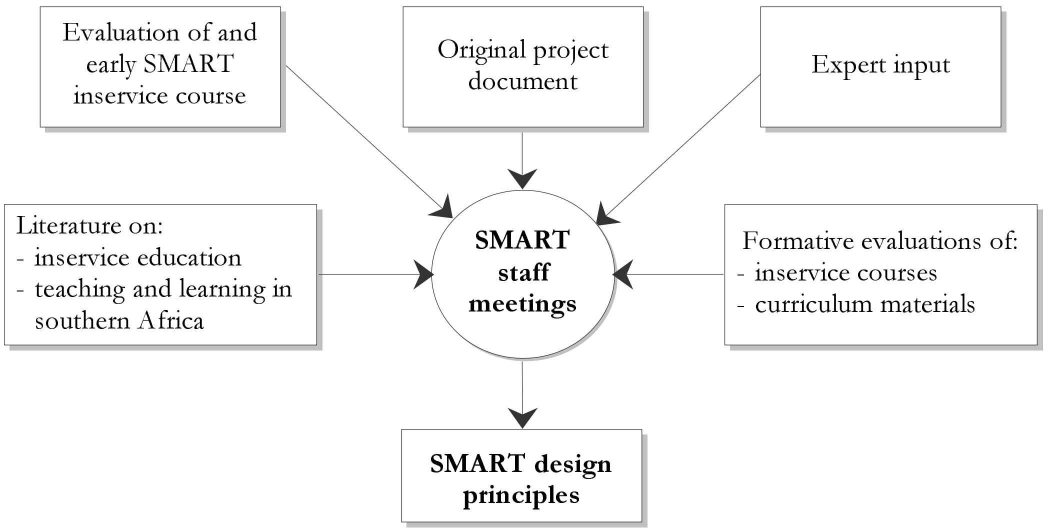


Figure 3.1: Factors and processes that played a role in the decision making on design principles by the SMART project team

Deliberations were limited to both local and expatriate staff members of the SMART project, and no particular strategy was adopted to guide this planning process. Moreover, not all SMART staff members were equally involved in these deliberations since some local counterparts were abroad for further studies and some of the expatriate staff was replaced.

The evaluation studies have mainly been initiatives of individual staff members, approved by the SMART project team. SMART staff was assisted in these studies by students working towards their Master's degree in educational design from the University of Twente. These studies can be characterised as 'learning by doing' for SMART staff, as far as design and evaluation skills are concerned. The (sometimes critical) reflections on these studies in this chapter are from the perspective of the author of this book, who participated in these studies as a SMART staff member.

The main purpose of this chapter is to present the SMART design principles that formed the basis for development of the '97 biology inservice course, which served as the primary example in this study. This chapter will also clarify how these principles were established in a 'real life' situation.

3.2 Evaluation of an early-SMART inservice course

In 1993, at the advent of the SMART project, no generally accepted design principles were available for the development of inservice courses in the subjects of interest. In the absence of common design principles, each inservice educator started designing inservice courses for his subject quite independently, using the following specifications in the project document as his compass:

- promotion of 'a practical and learner-centred teaching methodology';
- organisation of three national one-day workshops[1] per year during the holidays lasting from 9 a.m. until 3 p.m.;
- the writing of teaching materials.

In the IMSTIP project (predecessor to the SMART project) inservice courses had been designed and implemented along similar lines. Some of the IMSTIP staff had in fact been transferred to the SMART project. Together with newly appointed staff they initially continued organising the national workshops in a way similar to what had been done in the IMSTIP period. How this was carried out for the biology workshops is briefly described below.

The focus in each workshop was on one specific topic from the COSC biology syllabuses used in Swaziland (see chapter 2). The topic was chosen by the inservice educator based on suggestions made by teachers in previous workshops. The inservice educator then compiled a number of 'practical and learner-centred' student activities for this topic in a booklet, which was

[1] Another important pillar of the SMART project was to set up a regional system for inservice. The idea was that the SMART project would play a leading role in setting up this system, but that the science inspectorate of the ministry of education eventually would run it. However, the discussion on this had only just started in 1993.

distributed to the teachers participating in the workshop. These booklets provided only limited advice on how the activities should be used in class. In the workshop the emphasis was placed on teachers trying out and discussing the student activities. The expectation was that this approach would enable and stimulate teachers to integrate the learning activities in a 'practical and learner centred' way into their own lessons.
To encourage the teachers to start using the student activities soon after the workshop, a topic was chosen that teachers were expected to teach in the term following the workshop. This was indicated in a teaching scheme produced by the IMSTIP and SMART projects, recommended by the science inspectorate, which most teachers followed (Ministry of Education & UNISWA, 1995).

An evaluation study was initiated in 1993 to determine the worth of this type of biology inservice courses (Boerma, 1994; see also Stronkhorst, 1995c). The following research question guided this study:
How effective is the inservice approach used with the biology courses, particularly with regard to implementation of the teaching methodology that is promoted by the project?
To answer this question, the following data were collected:

- perceptions of participating teachers of two workshops (n_1 = 35; n_2 = 63) and their related curriculum materials, collected through questionnaires and interviews;
- perceptions of students (n = 63) on the lessons in which the teaching materials were used;
- behaviour of three teachers (of whom one had attended the workshop) and their students when a learning activity from the teaching materials was used in class. A lesson profile was used as a means to objectively registering the behaviour of said groups. This profile represented the intentions of the designer of the inservice course related to behaviour of teacher and students during the lessons, as compared to the extent to which these expectations were realised. This was carried out by use of lesson observations and teacher interviews.

On the level of perceptions of teachers (G/K effect level 1) the results of the study indicated that:

- most teachers highly appreciated the workshop;
- the trying out and discussion of student activities in the workshop was seen as very useful;

- the curriculum material was seen as very useful, and most of the teachers intended to use the student activities in class;
- the teachers saw time constraints (in the workshops) as the biggest problem.

On the level of perceptions of students (which could be interpreted as an element of G/K effect level 5) the results indicated that most students were of the opinion that they learned a lot during these lessons and that they enjoyed the lessons more than the ones they normally get.

At the teaching behaviour level (G/K effect level 4) the case studies of three teachers revealed that the one who visited the workshop used the material very much in line with the intentions of the designer. The second teacher hardly did anything the designer had intended, and the third one was somewhere in between these two extremes. Two of these teachers met with time constraint problems in preparation and in teaching when using the student activities.

Reflections of the author (former SMART biology inservice educator)

From these results it could be concluded that most teachers were satisfied with the workshops and curriculum materials and what they gained from these. Their students appeared to be quite enthusiastic (on average) with the lessons in which the student activities were used. The observations of lessons indicated considerable variation in implementation of the 'practical and learner centred' activities. It also should be noted that these activities seemed to be too complex for some teachers and often difficult to complete within normal lesson time.

On reflection, the results of this study are not really conclusive about the effect of the biology inservice courses on teaching methodology. Although teachers expressed their satisfaction with the workshops and materials, this can hardly be used as an indication for effect in terms of 'change in teaching methods' (see also Chapter 1, section 1.3). Furthermore, science teachers participating in the inservice tended to give socially desirable answers. This study did not investigate whether any change in teaching behaviour occurred on the short term (as intended), let alone in the long run. In the area of implementation the study only demonstrated that the three observed teachers used the student activities in a variety of ways. It should be noted that the teachers did not use the activities on their own initiative, but were asked to do so. The fact that students indicated that they enjoyed these lessons and gained from them (which were quite varied), also reveals little in terms of effects of the course on student learning outcomes.

Despite the fact that this evaluation provides scanty empirical evidence about the effect of the courses, a literature study that formed part of this study (Boerma, 1994) pointed out that the inservice courses could not be expected to be very effective because: i) these were not based on effective strategies and principles for inservice education, and ii) teachers were simply provided with some tools (student materials) for making their lessons more practical, whilst hardly any guidance was provided as to how these tools should be used. This message had an impact on the SMART team by initiating further debate.
The SMART team also benefited from this study in the following ways: i) insight was gained on effective strategies and principles for inservice (see section 3.3), and ii) lessons were learned on how to evaluate inservice courses. In this way this study established an important springboard for the future SMART inservice courses.

3.3 The knowledge base for SMART

In this section a description is given of the knowledge base, as it was available to the SMART team prior to starting their deliberations on the design principles. The knowledge base was mainly related to the following: i) the realities of teaching and learning in science classrooms of southern Africa in general and Swaziland in particular, which are outlined in 3.3.1, and ii) effective strategies and principles for inservice education, presented in 3.3.2.

3.3.1 The realities of teaching and learning in science classrooms

In 1993, when the SMART inservice educators started designing their courses, there was only limited information available on the teaching and learning in the Swazi science classrooms. However, local team members had been teaching the sciences in the high schools themselves, and the expatriate team members had gathered impressions through school visits and observations of lessons. These experiences suggested that the situation in Swaziland did not differ much from the situation described below for other African countries, an observation which in hindsight proved to be quite accurate, as reported upon in chapter 2.

Information about teaching and learning in African science classrooms remains limited. Nonetheless, most studies indicate a paucity of teaching skills. An over-dependence on the lecture method ('chalk and talk') and overemphasis on memorisation is particularly notable (Chapman, Snyder & Burchfield, 1993; Fuller, Snyder, Chapman & Hua, 1994; Macdonald & Rogan, 1990; Prophet & Rowell, 1994; Stuart, 1991; van den Berg, Lunetta & Finegold, 1994; van der Laan & Dimmendaal, 1994). Chapman et al. (1993) characterise classroom practice for many different subject areas in secondary education in Botswana as follows:
"Secondary education in Botswana is teacher-centred and teacher-dominated, emphasising lecture and class recitation and minimising individual student involvement and initiative. Teachers talk. Students listen, copy notes from the blackboard, and recite when called upon, usually in unison. Emphasis in learning is often on memorisation rather than problem solving, on recall rather than creativity. Discipline is important and strictly enforced"

MacDonald and Rogan (1990) also found, for 'black schools' in South Africa, that the more expository teaching style is strongly embedded in the culture. Also teacher factors (i.e. lack of confidence, motivation and/or ability) and practical obstacles (i.e. textbook availability, limitations in resources and facilities, limitations in communication, disjunction between school science and African life outside the classroom) are given as explanations for the over-dependence or adherence to the more expository teaching styles (Avalos, 1993; Cummings, 1990; Fuller & Snyder, 1990; Hurst & Rust, 1990; Nesbitt, 1990; Prophet, 1990).
This teacher-centred practice is often in sharp contrast with the intentions of the student-centred instruction favoured by curriculum designers (Prophet & Rowell, 1994). In situations such as those described above, a more 'student centred and practical work oriented teaching approach' might be difficult to pursue. London (1993) found that one of the most important reasons for failure of educational projects in developing countries is an insufficient regard for harmony between the project plan and social reality.

The information presented above stresses that any changes in the teaching approach pursued by an inservice programme need to take teachers' abilities and daily practice fully into account. Only with a full appreciation of these factors can realistic aims be set. Ogunniyi (1986) stresses the importance of taking the cultural background of nations into account for realistic designs of science education programmes. Walberg (1991) proposes that one focus on improving conventional teaching methods in these contextual situations. Based on their experience in an African setting, Rogan and MacDonald (1985) advise that one first address shortcomings in teachers' content knowledge and basic teaching skills before embarking on more innovative teaching methods.

3.3.2 Design principles for inservice education

Gaining knowledge of effective strategies and principles for inservice education is an important first step for the design of inservice courses:
…*"the general endorsement of inservice education means nothing without an accompanying understanding of the characteristics of effective as compared with ineffective inservice education efforts"* (Fullan, 1991, p. 315).

In 1993 the SMART team initiated a literature review (Boerma, 1994) that discerned seven principles for effective inservice education, which will be briefly presented below.

Principle 1: clearly defined inservice education
Any change to be pursued through inservice (in terms of professional knowledge, skills and attitudes of teachers) should be clearly defined (cf. Fullan, 1991; van den Akker, 1994), for both inservice educators as well as teachers (cf. Joyce & Showers, 1988). The need for and benefit of change should be evident to all stakeholders.

Principle 2: focused inservice education
Because teachers have a wide variety of professional development needs, it is important to differentiate among teachers and focus the inservice courses on specific groups. Studies on professional development phases of teachers give clear indications that teachers seem to be confronted with similar kinds of problems and professional concerns at particular phases of their professional development (Burden, 1980; Fessler & Christensen, 1992; Fuller, 1969; Huberman, 1993). Although differences can be found between authors concerning specifics, most of them distinguish three distinct professional development phases (see Figure 3.2).

I. Survival phase: the first year of teaching
- limited knowledge of instruction and of school setting
- lack of professional insight
- a desire to conform to preconceived images of teaching

II. Adjustment phase: the second through fifth year of teaching
- teachers enlarge their instructional repertoire
- increase their curriculum knowledge
- gain confidence in a personal style of teaching
- the building of competencies is a central theme of this phase

III. Mature phase: the sixth and subsequent years of teaching
- professional insight
- greater student-centred focus

Figure 3.2: Professional development phases of teachers

It should be emphasised that these phases cannot and should not be rigidly defined by and linked to years of experience. Nonetheless, it seems desirable for inservice initiatives to focus their support on specific career phases, taking into account their specific needs and concerns.

Principle 3: continuous inservice education

There is broad consensus that one-shot workshops (such as those SMART was organising in 1993) are ineffective and that inservice education needs to be a more long-term commitment organised on a continuing basis (Fullan, 1991; Jennings, 1993). Rogan and MacDonald (1985) note for South Africa that frequent mini-courses can be more effective than one long course.

Principle 4: addressing change concerns

After the intended change in teaching has been clearly defined for a specific group of teachers, an approach has to be adopted to effectively educate teachers in mastering and implementing this change. A way to do this that has proved to be relatively successful over the last two decades has been to address primarily teachers' concerns related to this change. It appears that teachers, when confronted with a change, potentially go through similar phases of concerns (Burden, 1990; Hall & Loucks, 1978; Hall & Rutherford, 1990):

1. awareness phase: informational and personal concerns dominate in relation to the change;

2. implementation phase: management concerns become more intense;
3. impact phase: teachers become more concerned of the consequences of the change, the collaboration that might be required for this, and the implementation of the change in their contextual situation.

This awareness of teachers' concerns allows for better guidance that can facilitate adoption of the change. This insight has become known as the Concerns Based Adoption Model (CBAM) (Hall & Loucks, 1978).
Skill acquisition models (Showers, Joyce & Bennett, 1987; Yeany & Padilla, 1986) try to address these 'change concerns' with the aim of facilitating the acquisition of an instructional skill. Inservice courses, based on such skill acquisition models, are composed of all or some of the following elements (Showers, Joyce & Bennett, 1987):

- presentation of theory or description of skills and strategies;
- demonstration of new skills and teaching strategies;
- practising of the new skills and teaching strategies;
- immediate feedback on practice experiences;
- guidance and support in the process of transfer to the real classroom situation (e.g. through curriculum materials, and/or coaching).

This model has demonstrated its validity through empirical evidence, showing its effectiveness on practice of teachers and on student achievement (Joyce & Showers, 1988), although long-term effects are less clear. Joyce and Showers (1980) indicate that when fine-tuning of teaching skills is the goal, instruction with demonstration can probably be sufficient. When more complex models of teaching are being introduced, however instruction, demonstration, practice with feedback and support are all considered crucial.

Principle 5: integration of clear and validated materials in inservice courses
Teachers implement a curriculum based on their own ability, their knowledge of students and their school environment. The SMART project aims at facilitating a more effective implementation of the existing curriculum by improving the teaching abilities of the already practising science teachers. Curriculum materials can play an essential role in this process by clarifying to teachers what a certain change or improvement implies, and how this could be implemented (Keursten, 1994; van den Akker, 1988; Voogt, 1993). The assumption is that teachers benefit from these materials, especially in the first steps towards implementation, because the materials enable them to explore and extend their 'zone of proximal

development' (van den Akker, 1994)[2]. Instructional materials should contain detailed procedural specifications related to the change or improvement to be pursued in the teaching (van den Akker, 1988). In order to assist teachers in improving the implementation of the curriculum, the integration of curriculum materials (i.e. exemplary materials) with inservice courses seems to be a promising approach (van den Akker, 1994). In this way, curriculum materials are used as a vehicle for change/improvement, and reduce implementation problems of teachers. These materials should clearly specify how teachers should teach a specific topic concentrating on specific instructional skills. It is essential that these examples be relevant, clear and feasible for the teacher (Doyle & Ponder, 1977-78; Fullan, 1991). It is also essential that these materials be validated by experts and through testing in the classroom (van den Akker, 1994).

Principle 6: improvement of the educational environment for teachers in schools

Inservice education that focuses on teachers as part of a team has more effect at classroom level as the inservice efforts focus not only on individual teachers, but also include their direct working environment (cf. Fullan, 1991; van Tulder et al., 1992). Advancement of co-operation, team development and promotion of active school-board and administrative support are seen as essential for real change to occur (Fullan, 1991; Huberman & Miles, 1984).

Principle 7: evaluation of courses

Formative evaluations of the inservice courses as well as the curriculum materials are essential to make appropriate adjustments for improvement (cf. Fullan, 1991; van den Akker, 1994).

The knowledge on context and inservice theory presented in this section was made available to the SMART team for their deliberations on design in 1993/94. This knowledge base has no doubt influenced the thinking of SMART staff members. The following section will reveal to what extent these principles have been incorporated in the design principles for the SMART inservice courses and, probably more important, the rationale behind adopting or not adopting a principle.

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2 Following Vygotsky (1978), van den Akker defines the 'zone of proximal development' as the distance between what individuals can accomplish alone and what they are capable of accomplishing with external support (materials and/or people), such as e.g. offered through exemplary curriculum materials.

3.4 Towards design principles for all SMART inservice courses

In the previous sections, results have been presented of studies that aimed at gaining insight in: i) the effectiveness of an 'early-SMART' inservice course, ii) what is known about the realities of teaching and learning in the schools, and iii) the knowledge base on effective strategies and principles for inservice education (mainly in western-based contexts). Gaining these insights was of course only the first step. SMART inservice educators had to weave these insights into a rationale for design of its inservice courses. With the results of the studies in hand, the SMART team started a process of deliberation and consultation that eventually resulted in design principles for future inservice courses. A brief summary of the deliberation and consultation process and its outcome will be given in 3.4.1 below. Following this, the initial design principles for the SMART inservice courses will be presented in 3.4.2. This will be followed by section 3.4.3 that reflects on the process and summarises the extent to which the available knowledge base has been taken into account in the SMART design principles.

3.4.1 Deliberations and consultations

An extensive process of discussions and consultations evolved in 1993 and 1994, following the studies described in sections 3.2 and 3.3 of this chapter. In most cases these discussions and consultations took place in SMART staff meetings, during which minutes were kept. At that stage the team existed of four expatriate inservice educators and two Swazi inservice educators, with one of the latter being the co-ordinator. Not surprisingly, SMART staff had a rather diverse view on science education and teacher education. Awareness of practices in schools and needs of teachers also varied. Some important aims in the first deliberations were to provide information, clarify views and create awareness. Several experts in the field of science education, inservice education, and curriculum design visited the project at this time and assisted the team in these deliberations. No persons outside the SMART staff and the invited consultants were involved in these discussions. A summary of the deliberations between SMART staff and consultants, including their main outcomes, follows. These deliberations focussed on the future goal and strategies for the SMART inservice courses.

The goal for the inservice courses

In these deliberations, the team members presented their view on 'ideal' classroom processes and on what the goal of the inservice courses should be. This was done in an attempt to clearly define the SMART inservice education (see principle 1 of section 3.3.2). The consultants noted a considerable degree of agreement among SMART staff members on these issues, which was summarised on paper (see Box 3.1).

Box 3.1: Summary of consensus in the SMART project team on issues related to the goal for the inservice courses, as reported by the consultants

The central **goal** of the SMART inservice program should be 'improvement of instructional processes in science education', which would lead to:

1. increased effectiveness in terms of student achievements (ergo higher passing rates on the exams);
2. a shift towards a more meaningful instructional approach that can be characterised by elements like:
   - more learning for understanding (less rote learning);
   - more varied and activity-based learning patterns (less passive note taking);
   - more relations to natural and social context and students' every-day life experiences;
   - more attention to 'practical', 'process' and 'problem solving' skills (e.g. observing, raising questions, formulating hypotheses, designing experiments, drawing conclusions), for example through demonstrations and student practical work;
   - more teaching-pupil and pupil-pupil interactions in questioning and discussion;
   - efficient use of textbooks;
   - systematic monitoring of students' progress through well balanced testing practices and homework.

It can be noted that team members agreed that improvement of instructional processes in the science classroom should be the central goal of SMART, and that many linked this to the pursuit of a shift towards a 'more meaningful instructional approach'. How this could lead to better specific student learning outcomes has not been translated in operational terms at this stage. Many of the elements that are mentioned as characteristics of this 'more meaningful instructional approach' (see Box 3.1) are in line with the goal for inservice as formulated in the original SMART project document (see chapter 1). Although there were doubts amongst team members concerning the attainability of the original SMART goal, most of them deemed a shift away from the apparently dominant 'chalk and talk' approach essential for improvement of instructional processes (and student learning) to occur.
The consultants noted that the elements mentioned by the SMART team as being characteristic of a 'more meaningful instructional approach', representing the situation aspired to in science classrooms all over the world. They emphasised that the degree to which these ideals can be realised in specific situations depends on many factors (time perspective, previous situation, subject- or theme- specific arguments, school conditions, student characteristics, external support, etc). The consultants advised the team to define criteria for an 'acceptable' or 'satisfactory' degree of realisation of these ideals in the context of Swaziland.

The inservice strategies

Team members presented their views on desired strategies for the SMART inservice courses. Here the consultants also noted a considerable degree of agreement among SMART staff members and summarised this as follows (see Box 3.2).

Box. 3.2: Summary of consensus on issues in the SMART project team related to inservice strategies for the inservice courses, as reported by the consultants

1. The major conclusion seems to be that the SMART project should shift from a predominantly 'missionary' approach to a more implementation-oriented strategy, that:
   - takes the concerns, working conditions, and 'zone of proximal development' of the teachers more seriously;
   - emphasises instructional changes that contribute the most to more effective pupil learning;
   - promotes a supportive infrastructure for schools and teachers.
2. Some more specific conclusions:
   - A shift should be made from the design of very broad teaching guides to the development of well-validated, exemplary materials that cover only a few lessons.
   - Those materials should be seen primarily as vehicles for learning of the teachers (in stead of textbook-replacing materials for regular use).
   - The strategy should strengthen the focus on implementation by:
     i. using knowledge about the concerns, conditions, and problems faced by teachers during the design of the materials, e.g. by anticipating known implementation problems with activity-based teaching through clear procedural specifications;
     ii. using a standard format for exemplary materials that makes them easy and attractive to read and utilise;
     iii. doing a systematic formative evaluation of successive draft materials (via expert appraisal, micro-evaluation, and field tests) in order to check the acceptability, feasibility, and effectiveness of the materials, and to generate suggestions for improving the materials;
     iv. focus on evaluation procedures and instruments that combine informativeness and efficiency;
     v. embed the exemplary materials in an inservice approach that includes the components of effective training (theory, demonstration, practice, feedback, coaching) and continuous support (staff and school development) to the extent possible.
   - The training and support of regional model schools and mentor teachers (see chapter 2) seems a very promising approach that deserves a lot of investment and systematic efforts.

As far as the strategy for its inservice courses is concerned, there appeared to be consensus amongst SMART staff on the following key issues:

1. The design of the inservice courses should be based on:
   - insight into the realities of teaching and learning in the Swazi high schools;
   - professional development concerns of teachers (related to principles 2 and 4 of section 3.3.2);
   - awareness of the 'zone of proximal development' of the teachers.
2. Promising strategies for the SMART inservice courses were considered to be:
   - continuous support (see principle 3 of section 3.3.2); an inservice approach which addresses concerns that teachers have in relation to the pursued improvement (the 'skill acquisition model' described under principle 4 in section 3.3.2 is suggested);
   - the integration of exemplary materials (see principle 5 of section 3.3.2) into the inservice approach;
   - development of a regional inservice system as a supportive infrastructure for schools and teachers (see principle 6 of section 3.3.2);
   - evaluation of the inservice courses on a regular basis, so that adjustments can be made if needed (see principle 7 of section 3.3.2).

It can be noted that important elements of the information available to SMART, as presented in section 3.3, come back in these key issues. However, it can also be noted that the realities of teaching and learning in the Swazi high schools have not been clarified as such. Also unclear was what exactly was meant by taking the 'zone of proximal development' of the teachers more seriously. The extent to which a 'practical and student-centred approach' and continuous support for teachers could be realistically pursued in the Swaziland context had been left open for further study and debate. The next sections will reveal to what extent these issues have been adequately addressed in the SMART design principles.

3.4.2 The initial design principles for the SMART inservice courses

Following the deliberations and consultations described in the previous section, the SMART team made some preliminary decisions regarding the development of teaching materials. However, a need was felt to agree on a more detailed design basis for all subjects from which these teaching materials were to be developed and for an inservice approach in which these materials would be integrated. The SMART team formulated and adopted its initial design principles for this purpose in meetings held in March 1994 (SMART Design Principles, 1994). In this document the following rationale is given for the inservice goal that has been formulated:

- the environmental uncertainty surrounding the teaching profession in Swaziland is rather high;
- the capacity of Swaziland to handle educational innovations is rather low;
- many science teachers in Swaziland have a limited repertoire of basic instructional skills and often use these in a limited way in a relatively non-conducive classroom situation;
- professional development activities should be properly matched to the stage of development of the target group teachers and to the realities of teaching and learning in the schools.

Based on this rationale the SMART team decided to limit the degree of innovation of the change in order to achieve at least a discrete but realistic change, and to focus on science teachers who are in the stage of "becoming competent in the basic skills of instruction" because this was considered the largest group of teachers by far. In practice, both survival and adjustment phase teachers, as defined in section 3.3 (see figure 3.2), were considered to belong to this target group. This resulted in the following goal for the SMART inservice courses, as formulated in the SMART design principles (1994, page 2, 3rd principle):
"Promoting professional development of science teachers who are in the stage of 'becoming competent in the basic skills of instruction', focussing on the further development/improvement of these basic instructional skills."

The intended outcome of SMART inservice courses was formulated as follows in the design principles (1994, page 2, 3rd principle):
"Professional development of the target group, showing in routine of handling of basic teaching skills, ultimately leading to better facilitation of the learning of their students."

It can be inferred that improvement of the basic teaching skills was assumed to lead to better learning of students. The 'basic skills' to be considered were defined rather broadly in these principles for design: design of a lesson, presenting and explaining theory, promoting textbook use and limit note giving, conducting practical work and demonstrations, questioning and group discussion, assigning exercises and homework.

Following the advice of the consultants the SMART team agreed to adopt the following elements of the skill acquisition model of Joyce and Showers (1988) as a basis for development of the SMART inservice courses:

- information on the theory of the particular basic teaching skill;
- demonstrations of the skill;
- practising of the skill by participants;
- follow-up and feedback on own practice.

It can be noted that 'guidance and support' in the process of transfer to the real classroom situation has not been explicitly incorporated as a training element in the courses. Apparently the team assumed, at this stage in the deliberations, that this support was not required for the improvement that was aimed for.
It was decided that in the one-day national workshops, to be organised by the team at UNISWA, the first three elements of this model were to be included in some form. It was also decided that from 1994 onwards the national workshops would be followed up with local workshops in 8 regions of Swaziland, for each of the 4 subjects. In these regional workshops, the follow-up and feedback elements of the model were to play a prominent role. In the period between the two workshops the teachers were expected to put the 'SMART ways of teaching' into practice in their lessons, using exemplary materials as support. In short, a kind of sandwich-structure was adopted for the SMART inservice courses containing the following three functional units: i) an initial national workshop, ii) an unsupervised 'try out' phase in schools, iii) a regional follow-up workshop (see Figure 3.3).

SMART inservice course units	**Training elements of course units**
Initial national workshop	▪ Theory ▪ Demonstration ▪ Practice
Try out in schools by teachers	▪ Practice (independent)
Follow-up regional workshop	▪ Follow-up ▪ Feedback

Figure 3.3: The structure and training elements of the SMART inservice courses

Based on prescriptions in the SMART project document and the available budget, the team decided to organise two of these 'three unit' inservice courses per year for each of the four science subjects. The national workshops were to last one day (6 hours, including tea and lunch) and the regional workshops half a

day (4 hours). No further design principles were formulated for the units and training elements of the SMART inservice courses. And, as mentioned earlier, for the 'try out' in schools no further support was envisaged at this stage. As far as the exemplary materials were concerned, the idea was that these would be integrated in all training elements of the inservice courses, though it was not specified how this would be done.
The initial SMART Design Principles (1994) guided the development of the SMART inservice courses in 1995 and 1996 and are summarised in Box 3.3.

Box 3.3: Summary of the initial design principles of 1994 for the development of SMART inservice courses and curriculum materials

The main **design principles** for development of SMART inservice courses:

- the initial workshops should contain the following training elements: theory, demonstration and practice;
- the 'try out' in schools should contain the following training element: practice;
- the follow-up workshops should contain the following training elements: follow-up and feedback.

The main **design principles** for development of SMART curriculum materials:

- teaching materials will consist of exemplary material and support material;
- main purpose of the exemplary material is exemplification of a basic teaching skill through detailed procedural specifications on essential and vulnerable elements;
- exemplary material to cover only 4 to 6 lessons for a certain topic and primarily to be seen as vehicles for learning of the teachers;
- in the exemplary material, emphasis will be put on promoting a pupil-centred approach and learning for understanding;
- lessons should have realistic equipment/material requirements and should not be too far removed from the daily practice of the average inexperienced teacher;
- the lessons should be based on, and geared to the existing curriculum and examinations;
- the material will promote the proper use of textbooks and not replace these;
- the exemplary materials will be validated by experts and tested in the classroom before further dissemination in inservice courses;
- explicit directions for content and format of the exemplary teaching materials and lessons are given;
- student material and other support material to be provided if necessary to enable teachers to organise lessons, similar to the exemplary lessons, for other parts of the topic; these materials could contain student activities introduced in the exemplary lessons or other supporting materials necessary for proper practising and implementation by teachers in the schools.

3.4.3 In conclusion

Section 3.4 provides a reconstruction and presentation of the following: i) persons involved in the design, ii) the deliberation, consultation and decision-making processes on design, and iii) the initial SMART design principles. Some concluding remarks are provided on these elements below, followed by a reflection on the design process and initial design principles in light of the accumulated knowledge base that has been presented in section 3.3.

Only SMART staff members and invited experts have been involved in decisions related to the design principles that were eventually adopted for the SMART inservice courses. Other main stakeholders (e.g. inspectorate, preservice teacher educators, school administrators, and teachers) in the initiative to improve science education in schools have not had a direct say in this. The decisions were made on a consensus basis in SMART staff meetings. Because local staff had to go for further training abroad, involvement in the deliberation and decision processes has been limited for some of them.
The SMART team had not adopted a specific planning strategy for their design deliberations. These deliberations mostly took place on the initiative of individual staff members.

The following factors have influenced the design process that eventually resulted in the initial SMART design principles: i) the project document, ii) the evaluation of an early-SMART inservice course, iii) available knowledge on context and inservice theory, and iv) consultations of experts.
The project document had already established fairly firmly that workshops and curriculum materials had to be the main elements of the inservice approach. The budget put further limitations on the extent to which these elements could be implemented.
The early-SMART inservice courses that have been evaluated were based on the inservice approach that had been adopted in the inservice project that preceded SMART. The outcomes of the evaluation study were not conclusive concerning the effect of the course, but the literature study attached to the evaluation report revealed serious shortcomings in the design of the courses. There is no doubt that this has influenced the thinking of at least some SMART staff members.

Most of the 'state of the art' design principles that had been reported upon in the literature study were also emphasised by the experts that were consulted in a later stage, which contributed considerably to reaching a consensus in the SMART team on major design issues.

The initial SMART design principles defined what was to be improved in the teaching of a specific group of teachers in a specific school context (substantive principles) as well as how this should be approached (procedural principles). Below, the substantive and procedural SMART design principles are compared with the principles that have been introduced in section 3.3, and which are categorised as substantive and procedural principles in Box 3.4.

Box 3.4: The extent to which effective principles from 'state of the art' literature on inservice education have been taken into account in the formulation of the initial SMART design principles of 1994

Substantive design principles:

1. *Clearly defined inservice education*
   The goal and intended outcomes for the inservice courses were defined at a general level. However, the key term 'basic teaching skill' was defined rather broadly and is open to interpretations of considerable difference. Important stakeholders were not involved in the design process.
2. *Focused inservice education*
   The target group (and the stage of development of the target group teachers) for the inservice courses was defined. It was clear that the workshop-based SMART inservice approach could not be tailored to the individual needs of teachers. Nevertheless, because a lot of teachers in Swaziland were inexperienced, SMART decided to devote its attention primarily to this group of teachers. The program design could then be geared specifically to the problems and concerns of these teachers. However, at the same time the inspectorate insisted that the inservice courses be open to all high school science teachers in Swaziland.
3. *Based on the realities of teaching and learning in the Swazi science classrooms*
   This principle has been derived from the information presented in section 3.3.1. The importance of this principle is stressed in the SMART design principles. However, the realities of teaching and learning in the Swazi high schools and how to take these into account have not been further clarified. Monitoring of the teachers' daily practice is not incorporated in the principles.

Box 3.4: The extent to which effective principles from 'state of the art' literature on inservice education have been taken into account in the formulation of the initial SMART design principles of 1994 *(CONTINUED)*

Procedural design principles:

1. *Continuous inservice education* The national workshops were to be followed by a 'try out' in schools (guided through exemplary material), with a regional workshop to follow-up on practice. Furthermore, the inservice courses that were organised two times per year contained certain continuous elements (i.e. attention to lesson preparation, note giving, textbook use, homework and student involvement).
2. *Addressing change concerns* The following training elements of the skill acquisition model of Joyce and Showers were adopted to address concerns in relation to the intended improvement: information, demonstration, practice and feedback. No further design principles have been defined for the development of these training elements.
3. *Integration of clear and validated materials in inservice courses* This principle is most emphasised and elaborated of the SMART design principles. Exemplary material was to be developed for all inservice courses to exemplify a specific basic teaching skill. The initial SMART design principles prescribe the design principles for the material and how the material has to be developed. It has not been clarified how the material should be integrated in the specific training elements of the inservice courses.
4. *Improvement of the educational environment for teachers in schools* This principle has not been adopted as a basis for design of the inservice courses because the realisation of the regional inservice system met with serious problems.
5. *Evaluation of inservice courses and curriculum materials* For the development of exemplary material, validation through experts and testing in classrooms was incorporated in the SMART principles. No principles have been formulated in relation to the evaluation of inservice courses.

Substantive design principles

The new goal that was formulated for the inservice courses, and the rationale on which this goal was based, indicate that the SMART team has taken into account the 'state of the art' literature that was presented to them (see also Box 3.4). However, it also can be noted that the team still adhered to 'promoting student-centred teaching' in some way, which was in fact warned against in the African literature available at that time. The advice of the consultants to define criteria for an 'acceptable' or 'satisfactory' realisation of the ideals of the team in the context of Swaziland was not heeded by the team at this stage. The SMART principles made clear that the inservice efforts had to be within reach of the target group teachers, but allowed individual members to determine to what extent e.g. 'student centred teaching' could be pursued. The decision to focus on a specific group of teachers as a target for the inservice courses was likely to meet with practical problems because the ministry of education officials insisted that all teachers could participate in the inservice courses.

Procedural design principles

The effective strategies and principles, reported upon in the literature study and reiterated by the experts, have been taken into account, in some form or another, in the initial SMART design principles that were formulated by the team in 1994 (see Box 3.4). Only 'improvement of the educational environment' was not meaningfully integrated in the inservice approach. The regional inservice system that was to be set up met with so many problems (mostly beyond the influence of SMART) that its potential for improvement of the educational environment in schools could not be expected to be noteworthy.

It can be noted that the principle related to the development of curriculum materials was given a very prominent place in the SMART principles.

3.5 Testing and adjusting the SMART design principles

This section describes two evaluation studies that were conducted to improve the inservice courses (based on the '94 SMART principles): i) a formative evaluation geared to improvement of the exemplary materials (in 3.5.1), and ii) a formative evaluation geared toward the improvement of an inservice course, including initial, try out and follow-up units (in 3.5.2). The adjustments made in the SMART design principles following these evaluation studies are elaborated on in 3.5.3.

3.5.1 Formative evaluation of the curriculum materials

The development of the first materials, based on the '94 SMART principles (see Box 3.3.), commenced in 1994. After first drafts had been written and revised based on comments of experts, the materials had to be tested in the classroom as prescribed in the principles. A study was initiated to find out how this could be approached effectively and efficiently in the Swaziland context (Scheepers, 1995;

see also Coenders, Dlamini & Stronkhorst, 1995). The ultimate aim of the study was to contribute to the improvement of the SMART design principles. More specifically, the study evaluated the teaching materials that had been developed for inservice courses for biology and chemistry teachers (to be organised in January 1995), by answering the following research question:
What are the strengths and weaknesses of the biology and chemistry materials?

To answer this question data have been collected related to:
- the degree in which the teaching materials are in line with the SMART design principles;
- perceptions of six teachers related to strengths and weaknesses of the teaching materials, collected through teachers' logbooks and interviews;
- behaviour of three teachers and their students during lessons when the teaching materials were used in class; an observer assessed to what extent teachers and students behaved as prescribed in the instructional specifications of the exemplary lessons and whether any problems were encountered;
- perceptions of some students related to strengths and weaknesses of the student materials, collected through interviews.

The perceptions of teachers and students were sought especially in relation to clarity and complexity of the materials and their alignment with practices of teachers and the school environments. The observations give direct feedback to the observer and designer on the functionality of the exemplary lessons in real classroom situations (can they be used as intended?).
The study detected some important weaknesses in the first materials related to suitability of the materials with the realities in schools, and related to clarity and complexity of the materials. Limitations in suitability of the lessons were found in: i) time planning, ii) required preparation time, iii) required material/equipment, iv) the instructions in the exemplary lessons (e.g. related to note giving, student involvement, complexity of activities, homework, textbooks in use). Limitations in clarity and complexity of materials were mainly related to language used, and format and layout of the materials. Furthermore, the instructional specifications of the lessons were considered to be too limited (in number and detail) to be effective. Based on these findings the materials have been revised.

Moreover, the study revealed that the SMART design principles of 1994 were not completely implemented in the teaching materials, due mainly to a lack of clarity in the principles. The outcomes of this study led to the following recommendations for improvement of the SMART principles:

- emphasise that the exemplary material should focus on one basic teaching skill in particular, to be exemplified for one topic or subtopic; the selected topic should be relevant for all syllabuses in use (e.g. for biology four syllabuses were used at that time); instructional specifications in the lessons should be especially detailed in relation to the focal skill;
- specific improvements of principles related to content, format and layout of materials in general and exemplary lessons in specific;
- suggestions for procedures for testing of the materials in the classroom: continue with trials of new material in the classroom after experts have validated these; limit the observations to only a few teachers, who teach in average environments and who are motivated and capable to assist in the improvement of the materials; continue with collecting data on perceptions of teachers and students through logbooks and interviews.

More information about the 'daily practice' of teachers was also collected in this study, focussing on two schools. The outcomes reinforced the assumption of the SMART team that the situation in Swaziland did not differ significantly from the situation that was described in neighbouring countries (see section 3.3.1).

This study led to significant adjustments in the design principles, resulting in the revised SMART design principles agreed upon by the project team in 1995 (see section 3.5.3). However, the recommendations related to the procedures for testing the materials in class have not been translated into specific principles by the team. The SMART inservice educators could decide on this themselves, as long as the materials were validated by experts and tested in the classroom.

3.5.2 Formative evaluation of an inservice course

After SMART had improved its procedures for curriculum material development, a need was felt by some staff members to ascertain the effectiveness of a complete inservice course. This would include the national initial workshop, try-out in schools using validated and tested material, and regional follow-up workshops. The formative evaluation that was initiated to determine the worth of the new design focussed on a 1995 inservice course for chemistry teachers (Alberding, 1996). The basic teaching skill on which the inservice course focussed was 'presenting and explaining theory'. Ninety nine teachers visited the national workshop of the course. A total of 46 teachers turned out for the eight regional workshops, of whom 28 had participated in the national workshop and only 17 had tried out the curriculum materials (teacher's guide and student materials) that had been provided.

The research question for this evaluation study was formulated as follows:
How effective is the '95 chemistry inservice course?

To answer this question, data have been collected related to:
- perceptions of participating teachers (n = 99) related to various aspects of the national and regional workshops and teaching material; collected through questionnaires, logbooks and interviews;
- case studies of four participating teachers who were asked to teach all the exemplary lessons from the teaching material; the observer noted to what extent the procedural specifications of the exemplary lessons were carried out as prescribed, and recorded any behaviour that was not in accordance with the specification; perceptions of these teachers were collected through logbooks and interviews; perceptions of some of their students were collected through interviews;
- perceptions of six other participating teachers who were visited unannounced to find out through an interview what had been used of the material and how this had been used;
- non-participants and non-material users were asked for their reasons for not participating and/or not using the material, through a questionnaire;
- outcomes of a test, administered after the teaching of the exemplary lessons, were compared with average year performances.

On the level of perceptions of teachers (G/K effect level 1) the results of the study indicated that: most teachers were very satisfied with the national workshop and the material and reported that they had learned a lot, with the theory part of the workshop ranked highest. The regional workshops, with their focus on the 'try out' in the classroom, were perceived as quite satisfactory by the participants, although the poor attendance was perceived as a weak point. The teachers also indicated that they 'used the skill' in other lessons now.

At teaching behaviour level (G/K effect level 4) the case studies of four teachers revealed that: on average the teachers followed the procedural specifications of the exemplary lessons quite well, though less experienced teachers followed the specifications more precisely. Time constraint was assessed as a major problem for all of them. According to the students that were interviewed, all four teachers gave fewer notes, more class work, and more homework when the materials were used than in normal lessons. On the other hand, most of the six teachers that were visited without prior notice revealed that they did not take the exemplary material to class, but that they used it for lesson preparation, and then only the parts they liked. They also indicated that they did not learn much from the materials.
At student learning outcome level (G/K effect level 5) the results indicated that students performed better on the test that was provided through the material than on tests that had been set by their teacher that year.

Reflections of the author (former SMART inservice educator)
From these results it could be concluded that most teachers were satisfied with the workshops and curriculum materials and what they gained from these. Teachers used the materials as intended, when they were asked to do so, which was confirmed by their students. However, teachers who did not partake in the research hardly used the exemplary lessons as intended. Students of the teachers who actively used the materials obtained higher average marks on the test that was incorporated in the teacher's guide than in tests previously set by their teacher.

On reflection, the results of this evaluation study are not really conclusive in terms of the success of the chemistry inservice course in attaining its goal. Regarding teachers' satisfaction with the course, only a condition might have been met (teachers tended to give social desirable answers) to obtain effects towards this goal. This evaluation study, as the study described in section 3.2, has not really investigated whether teaching skills improved and/or whether any intended change in teaching behaviour occurred on the short term and/or long term. However, the study established that all teachers who were visited without prior notice had not used the curriculum materials as intended. The observed difference in test results seems difficult to link to the inservice course in terms of effectiveness. It can be observed further that the number of teachers who participated in all three parts of the course is rather limited.

This study did not lead to adjustments in the SMART design principles, but the team implemented measures to improve active participation of science teachers in its courses starting in 1996 (see the following section).

3.5.3 Adjusting the SMART design principles

Following the formative evaluation of curriculum materials of 1994 (see section 3.5.1), the SMART team adjusted its design principles after a series of extensive deliberations in project meetings. This resulted in the 1995 revised SMART principles (see Appendix B). The main adjustments in the principles were as follows:

- addition of a principle emphasising that the exemplary material should focus on the exemplification of one basic teaching skill (principle 3);
- more extensive prescriptions related to the content and format of exemplary material and support material (principles 12 and 13);
- differentiation between subjects in how to promote the use of textbooks (principle 11);
- exclusion of the principle stating that the promotion of 'student centred teaching' and 'learning for understanding' will be emphasised in the exemplary material.

The first two adjustments are closely linked to the findings of the 1994 formative evaluation.

Following the second formative evaluation, which related to an inservice course that was organised in 1995 (see section 3.5.2), no further adjustments were made to the SMART principles. Nonetheless, following extensive deliberations in project meetings, the team decided to make some adjustments of a more organisational nature in all units of its courses starting in 1996. These adjustments are summarised in Box 3.5.

Box 3.5: Summary of the main organisational adjustments for SMART inservice courses to be implemented from 1996 onwards

Adjustments in the **'initial workshop'**:

- the duration of the initial national workshop were extended to one and a half day, to better accommodate the elements of theory, demonstration and practice of the selected basic teaching skill;
- the initial national workshops for the four science subjects were to be organised simultaneously and not on different days as was done before; this forced teachers to choose between the subjects, which was expected to boost active participation;
- following the initial workshop, each subject had to organise an additional session on the second day in which teachers who had participated in a workshop for a specific subject could obtain the material of another subject and receive some information on this;
- special arrangements to be made to facilitate teachers in buying class sets of student material, if required;
- to stress in the invitations for the workshops that teachers who wanted to participate had to teach the topic for which the basic skill was exemplified, in the term following the workshop.

Adjustments in the **'try out in schools'**:

- to start with piloting some form of coaching.

Adjustments in the **'follow-up workshop'**:

- the regional inservice to become a separate inservice activity, independent from the SMART inservice courses; mentors to organise these workshops guided by SMART personnel;
- the feedback and follow-up training elements to be organised in one half-day national workshop at the university;
- only participants of the initial workshop, who have tried out the material in the classroom, to be invited to come to these follow-up workshops.

It can be noted that the adjustments in the initial workshop are mainly related to extending the duration of the workshop and to promoting active participation. This last element was one of the main recommendations that came out of the second formative evaluation. The introduction of coaching, to be piloted in the 'try out' in schools, was also recommended in this study. The adjustments in the follow-up workshop are mainly related to changing venue from the eight INSET schools to one venue at UNISWA. The main problem with this, as with the initial national workshops, was that all science teachers had to be invited to the regional workshops. This made the 'follow-up element' irrelevant for many, because they had not participated in the national workshop and the 'try out' in school. Organising one follow-up for those who had participated was considered more on-target and more efficient. The limitations of the regional workshops to this regard have also been touched upon in the second formative evaluation study.

3.6 Summary

This chapter presents a reconstruction of the processes that led to the SMART design principles for inservice courses. Only Smart staff and consultants have been involved in the deliberations on design. Some local counterparts had very limited participation in these deliberations, as they were abroad for further training. No specific planning strategy was adopted to guide the discussions on design.
The first part of this chapter describes how the initial SMART design principles have been established. The second part describes how the design has been improved through formative evaluation studies. The findings of this reconstruction are briefly summarised below.

The main inputs in the deliberations of the SMART staff leading to the initial SMART design principles were the SMART project document, an evaluation study of an early-SMART inservice course, a literature study on context and inservice theory, and consultations of experts.
It was already firmly determined in the SMART project document that workshops and curriculum materials had to be the main elements of the inservice approach.
The report that was written on the evaluation of an early-SMART inservice course concluded that a main reason that the inservice course could not be very

effective was that it was not based on 'state of the art' design principles as compiled in a literature study that was attached to the report. This message had an impact on the SMART team by initiating further debate within the team. However, reaching consensus on how to continue appeared to be difficult. The team decided to obtain assistance from experts who contributed considerably to reaching agreement in the SMART team on major design issues.
The initial SMART design principles reflect the knowledge that was presented to the team through a literature study and through consultations of experts. These principles clarified the intentions of the designers (substantive design principles): i) to aim at improving basic teaching skills of the target group, ultimately leading to better learning outcomes, ii) to focus on teachers who were in the stage of 'becoming competent in the basic skills of instruction', iii) to take account of the realities in the Swaziland classrooms in the design of courses. Still, several things remained unclear in these substantive principles. First, basic teaching skills were defined rather broadly with the promotion of student-centred teaching still emphasised in the initial design principles. Second, the fact that all teachers had to be invited to the course, and not only the target group, was also not addressed in these principles. Finally, the way in which the realities in the Swaziland classrooms had to be taken into account was not clarified. The initial SMART design principles clarified to some extent how the aim of the courses had to be realised in terms of (procedural) design principles. The development of curriculum materials, meant as support in practising the teaching skill in the 'try out' phase, was given particularly much attention in the design principles. Furthermore, it was agreed upon that the training elements of the skill acquisition model of Joyce and Showers (i.e. information, demonstration, practice and feedback) should be adopted as a basis for design of the courses.

Following an evaluation study of their first curriculum materials, the SMART team made the following changes in the design principles: i) adjustments in the procedural design principles for curriculum materials, and ii) the emphasis on student-centred teaching was removed. These changes resulted in the 1995 revised SMART design principles that formed the basis for the development of the '97 biology inservice course. This course is the focus of the following chapters. It can be noted that the procedural guidance of the principles concentrated on curriculum materials, and very little on other design principles that had been adopted as a basis for course development.

The evaluation of an inservice course that had been based on the revised design principles was not conclusive in terms of effect of the course. Nevertheless, an important finding was that the majority of the teachers did not participate in a functional way (use of materials as intended) in the course. No adjustments were made in the SMART design principles after this study, but the SMART team took measures to improve active participation of science teachers in its courses. These measures were applied for the '97 biology inservice course.

Important lessons have been learned from the evaluation studies described in this chapter, especially in relation to:

- the importance of a clearly formulated goal and intended outcomes of inservice courses for evaluation purposes;
- the importance of clarifying the term 'effect' when evaluating inservice courses, e.g. in terms of G/K effect levels;
- the relative importance of the G/K effect levels (also in the context of Swaziland) for drawing conclusions on the worth of a course;
- the importance of a sufficient number of information rich cases;
- the importance of different sources and methods for data collection.

These insights also formed a basis for the design of the summative evaluation study presented in chapters 5 and 6.

Finally, it should be noted that although consensus had been reached on design principles in SMART staff meetings, practice showed considerable variation in implementation between the different subjects between 1994 and 1998. Furthermore, most of the local staff who gradually took over from expatriate staff did not continue designing courses based on the SMART design principles for various reasons, practicality being an important one. Whatever the effect of the SMART inservice courses will be, this aspect cannot be ignored and is further discussed in chapter 8.

Chapter 4
A *SMART* Inservice Course:
Development, participants & their perceptions

This chapter focuses on an inservice course for biology teachers, the development of which was guided by the SMART design principles. Following an introduction in section 4.1, the development of the inservice course and its curriculum materials are described in section 4.2. Subsequently, a profile of the participants of the course is reported on in section 4.3, whilst the participating teachers' perceptions of the course are presented in section 4.4. The chapter ends with a summary in section 4.5.

4.1 Introduction

Chapter 3 presents the design principles that SMART adopted as the basis for the development of its inservice courses (see also Appendix B). In these principles a lot of attention was given to the development of curriculum materials. Another important design principle - addressing change concerns through a 'skill acquisition model' - was hardly elaborated in the principles. Also no guidance was given on how to integrate the curriculum materials with the training elements that had been adopted for the inservice courses. Other aspects still in need of a great deal of clarification were:

- how to cater to teachers who were not part of the defined target group (ministry of education officials insisted that all science teachers should be allowed to participate);
- to determine to what extent 'student-centred teaching' could be pursued in the realities of school contexts;
- how the curriculum materials should be tested and validated.

The 1995 formative evaluation of a SMART inservice course had indicated that most teachers did not use the exemplary material as intended during the 'try out' phase in their classrooms. Further support in the 'try out' phase, through coaching, was considered a promising training element to overcome this apparent flaw in design; this despite the fact that it was known that there were considerable constraints for such collaborative activities in schools in Swaziland (Prenen, 1997).

This chapter focuses on one specific SMART inservice course that was developed for biology teachers, and organised in May-August 1997 (including the piloting of coaching). The following three aspects of this course are discussed: i) development of the course, ii) participation in the course, and iii) teachers' perceptions of the course.
As far as the development of the course is concerned, the attention is fixed on how the designer has been guided by the SMART design principles, and on how the aforementioned gaps in these principles have been bridged. The following question has guided this reconstruction:
How have the SMART design principles been put into practice in the '97 biology course?

Following this reconstruction, details are provided on participation in the course, including involvement in coaching. Subsequently, characteristics of the participants are reported upon for members and non-members of the defined target group. Finally, teachers' perceptions on the course were polled, which was guided by the following research question:
How has the '97 biology inservice course been perceived by the participating teachers?

4.2 Developing the inservice course

Figure 4.1 illustrates the procedure that was followed in the development of the '97 biology inservice course. Because the curriculum materials had to be tested in class, the planning for the SMART inservice courses had to start one year in advance of its implementation. The focal teaching skill for the 1997 inservice courses was selected in a SMART staff meeting. The team asked one of the staff members to prepare a draft theoretical framework for the chosen teaching skill as a basis for the development of the exemplary material. This staff member approached experts in the fields of science education and teacher education and produced a proposal for discussion. The SMART inservice educators took the proposal and the ensuing discussions into account and began developing the material, also consulting experts in their field of specialisation. The curriculum materials formed an important basis for the development of the inservice courses.

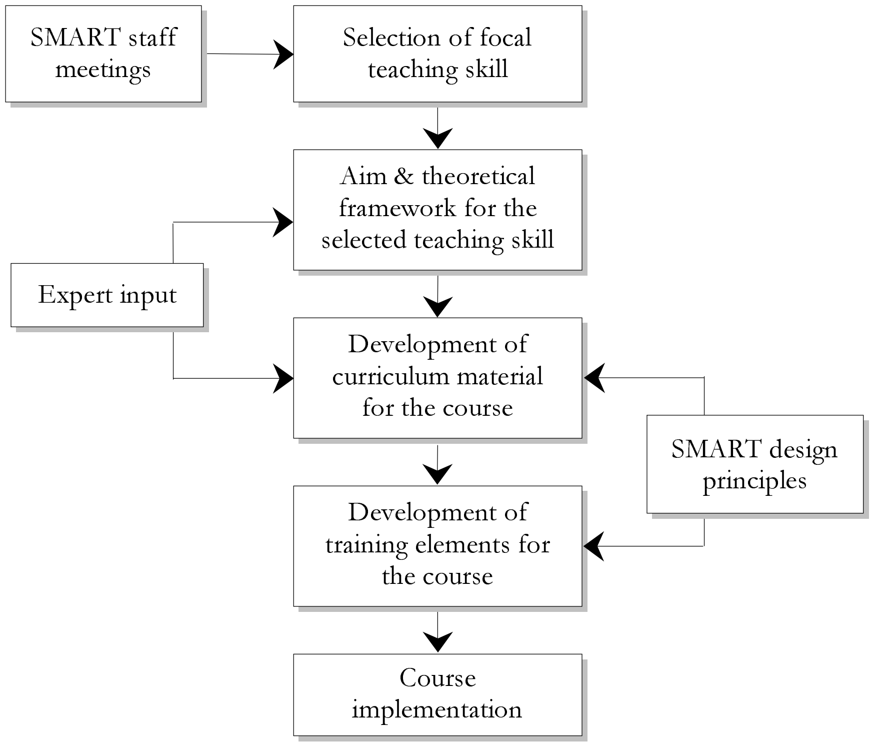

Figure 4.1: Development procedure of the '97 biology inservice course

This section outlines how the '97 biology inservice course was developed. This is illustrated for the aim of the course, and theoretical framework for the teaching skill in 4.2.1, for the development of the curriculum materials in 4.2.2, and for the development of the training elements of the course in 4.2.3.

4.2.1 The aim and theoretical framework

The aim of the inservice course

The focal teaching skill chosen by the SMART team for its May-August 1997 inservice courses was 'the use of learning activities in class'. The aim for the biology inservice course was formulated as follows:

To further develop the skills of biology teachers in selecting and using learning activities in class to promote learning.

In the draft theoretical framework for the chosen teaching skill prepared by one of the team members, the term 'learning activity' was defined as any activity used by a teacher to facilitate learning in such a way that pupils play an active role in the mastering of new content and/or skills. The biology inservice educator adopted this definition for the '97 inservice course. These activities are further referred to as 'hands-on/minds-on' activities in this book.
The selection of this skill put the promotion of student-centred teaching at the centre of this inservice intervention. The focus in previous courses had been on relatively more basic teaching skills[1], although also then student-centred teaching had been promoted albeit it in different ways:

- active use of textbooks by teachers and students, in combination with less note giving;
- regular and adequate attention to homework by both teachers and students;
- application of the 'question and answer' method[2] in activities such as presentation and explanation of theory.

The term 'basic teaching skill' has not been clearly defined in the SMART design principles (reference is made to homework and note giving, but also to practical work and group discussions). In chapter 3 it has been illustrated that the promotion of 'student-centred teaching' was strongly embedded in the IMSTIP and SMART project. Also SMART staff seemed convinced that this method of teaching showed promise of greater benefits over the 'chalk and talk' approach assumed dominant in schools in Swaziland. This tendency was also in line with pursued trends in classrooms all over the world. This 'missionary conviction' surfaced in all biology inservice courses and very prominently so in the '97 biology inservice course. Apparently, a shift towards more 'student-centred teaching' - in a way tailored to the Swazi context - was assumed to be in line with the realities in schools, and attainable for the target group of inexperienced teachers. The SMART design principles gave no further guidance in this respect.

1 In preceding courses the team had focussed on the following teaching related skills: design of lessons, question & answer method, presenting and explaining theory, conducting demonstrations and practical work, conducting evaluation and assessment (Stronkhorst, 1995a, 1995b, 1996, 1997a, 1998a).

2 With the 'question and answer' method, the teacher tries to involve students more in the teaching-learning process (e.g. when presenting and explaining new content) through asking questions. This had been given special attention in one of the SMART inservice courses, and was promoted in all exemplary materials.

The biology syllabus topics for which the skill 'use of learning activities in class' has been exemplified were environment and ecology related. In previous courses teachers had repeatedly requested support in these topics to improve their teaching. To assist the teachers in this respect, resource materials for these topics were collected and/or developed, and compiled in two booklets (Stronkhorst, 1997b). These booklets were also used as sources of 'hands-on/minds-on' activities in the '97 biology inservice course.

In short, the main aim of the course has been clearly defined, although it can be debated whether or not this aim is in tune with the goal formulated in the design principles, which emphasises improvement of basic teaching skills. Another implicit aim of the course was to improve the teaching of the environmental topics through provision of resource materials.

Theoretical framework for the focal teaching skill

After discussions with SMART team members and consultations with experts, the biology inservice educator adopted a framework for the teaching skill 'selecting and using 'hands-on/minds-on' activities'. This framework describes the 'what, why and how' of using 'hands-on/minds-on' activities and was incorporated in part 1 of the teacher's guide (Stronkhorst, 1997b). This framework formed the basis for the development of the exemplary lessons to be described in the next section.

Four types of 'hands-on/minds-on' activities are distinguished in the framework: i) readers, worksheets and questionnaires, ii) investigations, iii) simulation activities, and iv) projects. The first category was thought to contain the more simple 'hands-on/minds-on' activities that are reasonably in line with the realities in Swaziland's science classrooms. The other three categories were considered to be more removed from the reality of practice in Swaziland. For this reason the emphasis was placed on the first category of activities in the student material used in the '97 biology inservice course. The expectation was that the inexperienced target group teachers (especially those who had visited more inservice courses in the past) would be challenged to make a step in a more 'student-centred teaching' direction after having followed this course. However, a number of investigations, simulation activities, and projects were also added to the material. The expectation was that some of the more experienced teachers, who also visited the workshop, might see this as a challenge and try these additional materials out. For all four categories of activities, exemplary lessons have been developed.

In short, the biology inservice educator followed the usual procedures for clarifying the 'what, why and how' of the skill. Furthermore, an attempt has been made to make the course beneficial for the target group of inexperienced teachers as well as for experienced teachers.

4.2.2 Developing the curriculum material

Development of the material

The curriculum materials for the'97 biology inservice course were developed following the steps described in Box 4.1.

Box 4.1: Steps followed in the development of the curriculum materials of the '97 biology inservice course

1. *Writing of first draft*
   The subject specialist wrote the first draft of the materials based on the SMART design directives and the framework for the basic skill.
2. *Validation by experts*
   The first draft of the materials was sent for comments to experts in Swaziland as well as the Netherlands, who were acquainted with the SMART directives for design. These experts were asked for their feedback, especially on the 'what, why and how' of the skill, and on the exemplification of the 'how' in the lessons.
3. *First rewrite*
   Based on comments received, a second draft was produced by the subject specialist.
4. *Testing of the material*
   Two teachers were asked to try out the materials in class. The designer of the materials observed these lessons.
5. *Second rewrite*
   Based on the trials in class the materials were revised again, resulting in the final draft
6. *Dissemination of material*
   The materials were disseminated in the initial national workshop in May 1997. Teachers received one copy of the exemplary material and the student materials free of charge. Multiple copies of the student materials could be bought at a reduced price.

As previously mentioned, the SMART design principles prescribed both the validation of materials by experts and their testing in the classroom, but no directions were provided on how this should be done. Following the formative evaluation of SMART curriculum materials in 1994 (see Chapter 3, section 3.5.1), the designer of the biology curriculum materials decided to focus the testing of the materials in class on: i) observing whether the exemplary lessons could be taught as he had planned, and ii) gathering teachers' perceptions of the material (e.g. related to clarity, practicality, congruence). This process was carried out for all the biology materials developed from 1995 onwards, gradually improving the methods of data collection and analysis. For the materials used in the '97 biology inservice course this information has been collected as follows:

1. Observations of all the exemplary lessons taught by two teachers in their respective classrooms. In these observations the designer of the material checked whether the lessons progressed as expected. The selected teachers were capable and motivated to assist in the improvement of the materials. For the observations, instruction checklists were used containing the instructions from the exemplary lesson, to be checked off when properly executed. Space was provided on these checklists for comments on specific instructions and for starting-time and end-time of specific parts of the lesson.
2. The observed teachers were asked to fill in a logbook immediately after teaching each lesson. These logbook entries related to the following aspects of the lesson: i) general impression of the lesson, ii) lesson preparation, iii) the actual teaching of specific parts of the lesson, including time used, iv) impressions about students' involvement, v) opinion about the student material. Furthermore, teachers were asked to fill in tables indicating which 'hands-on/minds-on' activities they had selected from the student materials and how they had used these in their own lessons. Questions were also asked concerning other parts of the teacher's guide and to what extent the approach differed from their own approach. They were also asked to what extent they intended to adopt elements they had learned through the exemplary material.
3. Interviews were held shortly after the teaching of a lesson, based on the main issues and problems identified by the designer during the observations, and by the teacher through the logbook.

4. A detailed report was written containing all observations and comments that were made for specific parts of the exemplary lessons and the student material. This report was used for the second rewriting of the materials. Further points of attention for the in-service training were recorded, such as observed vulnerable elements related to the skill development.

This data collection and analysis proved to be very fruitful, and was used to make improvements in the materials. These improvements were geared mainly to improving the 'teacheability' of the lessons (related to clarity, practicality and congruence) in an average Swazi classroom. The emphasis in this classroom testing was on the exemplary lessons and the student materials used.

In short, the exemplary curriculum materials have been validated and tested as prescribed in the SMART design principles. It can be noted that this kind of testing in the classroom did not aim at attaining clarity on the effectiveness of the materials.

Characteristics of the curriculum material

The teacher's guide for the '97 biology inservice course follows the suggested content and format as laid out in the SMART design principles (see Box 4.2). Part 1 contains an explanation for the teacher related to the material in general, as well as more specific information on the 'what, why and how' of using 'hands-on/minds-on' activities. Part 2 contains the exemplary lessons and part 3 contains some support material as well as useful addresses for the teachers.

The five lessons of part 2 give examples of how 'hands-on/minds-on' activities, provided in the student material, can be used in a lesson. All types of 'hands-on/minds-on' activities are exemplified in a lesson, with special emphasis on the relatively simple activities. The exemplification of the different categories of 'hands-on/minds-on' activities led to some difficulties, however. For various reasons the designer could not incorporate the activities in a series of lessons that could be taught immediately after one another at the beginning of a topic, as suggested in the SMART principles. This necessitated that the exemplary lessons be spread over two topics to be taught over a period of 6 weeks. The idea was that teachers would teach the exemplary lessons intermittently with their own lessons, in which they use 'hands-on/minds-on' activities from the student material, using the examples as guidance.

Box 4.2: Content and format of the teachers' guide of the May-August 1997 biology inservice course

Title: Organisms and the Environment & Effects of Man on the Ecosystem.
Purpose of the material: to exemplify the skill of selection and use of 'hands-on/minds-on' activities.

Part 1: Explanation for the teacher

Target group and characteristics of the material:

- Syllabuses: reference is made to syllabuses and topics for which the material was developed.
- Content and scheming: contains tables in which time allocation and 'hands on/minds-on' activities from the student materials are suggested for each objective of the topics (see appendix C).
- Prerequisite knowledge and skills: indicates knowledge and skills that pupils are assumed to have mastered before starting these topics.
- Materials: introduces the teacher's guide and the student material; explains that the material should be used in combination with recommended textbooks; shortcomings of textbooks in relation to the environmental topics are also highlighted.
- Users' comments: explains that the material has been tried out in class and revised; comments from teachers who have been involved in these trials are also incorporated.
- Objectives of the lessons: brief summary of the main objectives of the exemplary lessons of part 2.

The 'what, why and how' of using 'hands-on/minds-on' activities.

Part 2: The lessons

- Exemplification of the use of readers, worksheets and questionnaires: in three lessons.
- Exemplification of the use of an investigation: in one lesson.
- Exemplification of the use of a simulation activity (role-play): in one lesson.
- Exemplification of the use of project activities: in one lesson.

Part 3: Support material

Background information.
Resources and addresses.

Each exemplary lesson follows the format as proposed in the SMART design principles (see Box 4.3). The main purpose of these lessons is to exemplify how to use 'hands-on/minds-on' activities in lessons, and how to prepare for such lessons. The exemplification of the preparation for these lessons is provided through clarification of the objectives, the lesson plan, required preparation and learning problems that pupils could encounter in the lesson. The use of the 'hands-on/minds-on' activity, sometimes in adapted form, is illustrated through detailed procedural specifications in the progress description of the lesson (see Appendix C). In addition, detailed procedural specifications are given related to notes, textbook use, and homework in the progress description of the lessons (see also Appendix C for a homework-related example).

Box 4.3: Format and content of exemplary lessons of the teacher's guide of the May-August 1997 biology inservice course

Title of the lesson: e.g. 'introduction to air pollution'

Reference to skill and topic scheme: An explanation is given at the start of the lesson on what the lesson is exemplifying and which 'hands-on/minds-on' activity from the student materials is selected for this purpose. Reference is made to the topic schemes in part 1, clarifying when the lesson should be taught and which lessons should precede it.

Preparation aspects of the lesson

- Objectives: mentions the syllabus objectives covered by the lesson; additional objectives pertaining to the selected learning activity are also included;
- Lesson plan: gives an overview of the lesson in terms of teacher and pupil activity and in terms of time allocation for the main elements of the lesson (see Appendix C);
- Preparing for the lesson: indicates what preparations are required prior to teaching the lesson;
- Material/equipment: indicates what material and equipment is required for teaching the lesson;
- Learning problems: indicates what kind of learning problems might be encountered in this lesson, and how these can be dealt with.

Lesson progress

- Introduction: contains procedural specifications for the teacher related to follow up of the previous lesson, and introduction of the current lesson;
- New content: contains procedural specifications for the teacher related to theory presentation & explanation, note giving, pupil activities, discussion, etc;
- End of the lesson: contains procedural specifications for the teacher related to summary of main points, homework to be given, and the following lesson.

Answers to questions: contains answers to questions from the learning activity that has been incorporated in the lesson; a copy of the learning activity is added at the end of the lesson.

The student materials for the May-August '97 biology inservice course have been compiled in two booklets (Stronkhorst, 1997b):

1. a booklet with 19 'hands-on/minds-on' activities related to the topic 'organisms and their environment';
2. a booklet with 36 'hands-on/minds-on' activities related to the topic 'effects of man on the ecosystem'.

The 'hands-on/minds-on' activities are categorised as reader, worksheet, questionnaire, investigation, simulation activity or project. Teachers had to provide each student or group of students a copy of the 'hands-on/minds-on' activity when teaching the exemplary lessons or when using a 'hands-on/minds-on' activity in lessons they had prepared themselves. Multiple copies could be bought during the national workshop below cost price in an effort to ensure that no teachers be excluded because of financial reasons. In case of large orders, the booklets were delivered to the schools.
The 'hands-on/minds-on' activities in these booklets cover all the objectives of the two environmental topics of the biology syllabuses. As mentioned before, this was done because very little information and material for these two topics was available for the teachers to use in their lessons. In previous courses, student material had been less abundant and textbooks were referred to as much as possible, as suggested in the SMART design principles.

In short, a lot of effort has been put in clarifying to teachers how 'hands-on/minds-on' student activities can be incorporated in lessons. In fact, the exemplary lessons largely represented what the designer saw as the intended outcomes of this course. The materials' content and format were closely aligned with the specifications of the SMART design principles.

4.2.3 Developing training elements to address change concerns

In contrast with the development of the curriculum materials, the SMART design principles provided little guidance for the development of the inservice course. The design principles did stipulate that the training elements of theory, demonstration, practice, follow-up and feedback of the adopted skill acquisition model were to be incorporated in a 'sandwich structure'. This structure should contain the following three functional units: i) an initial workshop, ii) a 'try out' phase in schools, and iii) a follow-up workshop. Furthermore, the biology inservice educator decided to introduce the training element of coaching in this

course (on a pilot basis), for which also no further guidance was given. This section will devote more attention to how the prescribed structure and training elements were worked out for the biology inservice courses in general and the '97 course in specific. Special attention is paid to how concerns are addressed that teachers might have regarding the pursued change.
Further starting points for the development of the '97 biology inservice course were: i) the aim of the course, ii) the theoretical framework for the teaching skill, and iii) the curriculum materials (see previous sections).
No other persons were involved in the development and planning of the course aside from the SMART biology inservice educator. The planning for the course was presented, discussed and endorsed in a SMART staff meeting. Reports on course units have also been presented and discussed in SMART staff meetings.
Below, the training elements of the '97 biology inservice course are described for the initial workshop, the 'try out' in schools, and the follow-up workshop.

The Initial Workshop
The initial workshop in May 1997 lasted two days, and was to be conducted simultaneously with the workshops for the other science subjects. In the invitations for the workshops it was stressed that participating teachers were expected to teach the environmental topics, for which the focal skill was exemplified, in the term following the workshop. The core program of the workshop lasted for one and a half-day, and the training elements of theory, demonstration and practice had to be organised in a tight time schedule of 7.5 hours (see Appendix D for objectives and programme outline of the initial workshop).
The 'skill acquisition' model was adopted as a basis for the SMART inservice courses to address concerns that participating teachers might have with the change sought after through the inservice intervention. The theory and demonstration training elements are directed at addressing informational and personal concerns that teachers might have with the pursued change (*Do I understand what they want to change/improve? Do I need/want to change?*). Box 4.4 summarises how this has been approached for the theory-training and demonstration-training elements.

Box 4.4: Characteristics of the theory-training and demonstration-training elements of the Initial Workshop

The theory-training element

The workshop started with a presentation on the teaching skill. Basically, the information from part 1 of the teacher's guide on the 'what, why and how' of the basic teaching skill was presented and explained in this presentation. At the end some discussion was facilitated on the use of 'hands-on/minds-on' activities by teachers and on the pros and cons of using 'hands-on/minds-on' activities. The main purpose of this session was that teachers should understand the 'what, why and how' of the selected basic teaching skill and start reflecting on what they have been doing in class, themselves, related to this skill. This was followed by a presentation and discussion on the teacher's guide and student materials, with special attention to the exemplary lessons. The main aim here was to acquaint teachers with the material and its purposes and to make them aware of what is expected from them in the 'try out' in school, in relation to the material.

The demonstration -training element

Through a demonstration, teachers were given further opportunity to develop awareness on good and poor practices in relation to the focal skill. The demonstration of a 'good example' was presented through the teaching of an exemplary lesson in a micro teaching session, or through a video-taped lesson. The teachers observed the lesson, while checking the instructions in the teacher's guide at the same time. A teacher, who was involved in the testing of the material, was invited to teach this lesson. If available, videotaped lessons containing poor practices were shown. Group discussions and a plenary discussion followed the demonstration. In these discussions teachers had a chance to clarify what they liked and did not like in the lesson(s) and why. In most cases, a reasonable consensus on what is good and what is not so good emerged from these discussions. The main purpose of these sessions was that teachers should get a good idea of what they would like to adopt in their practice and what they should certainly avoid. A further awareness of possible shortcomings in their own practice could also develop through this. Furthermore, these demonstrations should clarify how teachers can use these materials in class. Problems that teachers have (e.g. with 'teaching from the book') were addressed here. Other elements, such as 'preparation for the lesson', 'textbook use in relation to less notes', and 'homework discipline', were also given attention in the demonstration.

The practise training elements of the initial workshop were directed at addressing management as well as personal concerns that teachers might have with the pursued improvement or change (*Can I do it? Do I need/want to change?*). Box 4.5

summarises how this was approached for practising the preparation of lessons in which 'hands-on/minds-on' activities were used. It illustrates how the selection and adaptation of activities is practised, as well as the preparation of a lesson that is going to be taught.

Box 4.5: Characteristics of practice-training elements in the Initial Workshop

Practising selection and adaptation of 'hands-on/minds-on' activities
In this activity, teachers worked together in groups of 3 to 4. Teachers were asked to select 'hands-on/minds-on' activities from one of the student material booklets that they would like to use in their lessons in the coming term. To assist doing this in a rational way, detailed instructions were provided (see Appendix D). After this, teachers were asked to carefully study one of the activities they had selected, answer any questions, and make adaptations if necessary. Also here, guidelines were provided (see Appendix D).

Lesson preparation practice
Teachers were expected to teach the exemplary lessons when they returned to their schools after the workshop. Thereafter they were expected to put what they had learned into practise in other lessons. Good lesson preparation is seen as an important key to success in accomplishing this. To this end, teachers practised lesson preparation in groups of 3-4 teachers in the workshop. The end-product of this activity was expected to be a viable lesson design in which a learning activity is incorporated. For this purpose teachers were given a lesson design form with step-by-step instructions similar to those for the preparation of the exemplary lessons (Appendix D). Of course teachers still will have had their own ideas about using 'hands-on/minds-on' activities in lessons, but they might have been influenced by what they had heard and seen thus far in the workshop. The process of working on a lesson as a teamwas also meant to stimulate reflection on teaching practices.

After the preparation practice, one teacher was asked to teach the lesson that had been prepared. The other teachers were asked to assume the role of students or observers. Since the training element of coaching was going to be piloted in this course, the inservice educator had expanded this session of the initial workshop with some elements related to coaching. Therefore, aside from management concerns related to the teaching of 'hands-on/minds-on' activities (*Can I do this? Can I do this in my school?*), informational and personal concerns related to coaching were also addressed (*Do I understand what they want? Do I need/want this?*). Box 4.6 explains how this was approached in the '97 initial workshop.

Box 4.6: Characteristics of practise-training elements of the Initial Workshop *(CONTINUED)*

Teaching practise (including coaching information & demonstration)
One teacher from each group was asked to teach the lesson that had been prepared by the group in the 'preparation practice session'. A group of ± 15 teachers were asked to assume the role of pupils, and were given instructions on what was expected from them in this role. The other teachers were asked to observe the lesson. Because only one teacher practised the actual teaching of the lesson, this served more as a demonstration for most of the teachers. However, other important purposes of this session were to make teachers aware of the importance of evaluating their own lessons, and to practise some elements of coaching. Before this micro-teaching session starts, teachers were given information on the 'what, why and how' of coaching and self-evaluation. Observation instruments, designed for observing elements of the focal skill, were provided and explained (a sample of a lesson evaluation form was incorporated in the teacher's guide). The observers were asked to write down their observations on the form during the teaching of the lesson. After the lesson, the teacher and observers were given some time to reflect on the lesson and to summarise the main points they want to make. The teacher was provided with a lesson evaluation report sheet for this purpose. A request was made that respondents first focus on elements of the focal skill, and after that on other elements they consider important. The discussion started with a simulated coaching session. Two observers were invited to assume the role of coaches with the other teachers being asked to observe the coaching session and give comments later. The inservice educator led the coaching session and followed the 'coaching rules', explained earlier, as much as possible. At the end of the coaching session, the teacher who taught the lesson was asked to summarise to what extent the coaching had assisted him in analysing his lesson, and what he was intending to do with this information. Finally, the other teachers were asked to comment on the coaching and whether they agree with the main observations made.

Special arrangements were made at the end of the initial workshop to stimulate teachers to buy class sets of the student materials.
Teachers interested in participating in coaching during the try-out phase of the inservice programme were invited to a separate meeting to make further arrangements. The other teachers were encouraged to use the self-evaluation forms, incorporated in the teacher's guide, in the 'try-out' phase to evaluate their lessons.

In an effort to further improve the inservice programme, a questionnaire was administered at the close of the workshop in which teachers were asked to provide feedback on the workshop and its facilitators. An evaluation report was written based on the questionnaire results and the inservice educator's own impressions. This report was discussed with the SMART team in a staff meeting.

In the afternoon of the second day of the initial workshop, a separate session was organised for teachers who had participated in a workshop of another subject. Participants in this session were provided with the biology materials and were given some related information.

In short, an attempt was made to address informational, personal and management concerns of teachers related to the change pursued in this workshop, for which detailed instructional plans were developed. An attempt was also made, in the limited time that was available, to address informational, personal and management concerns of teachers related to peer coaching.

The 'Try-out' in Schools

The main training element in this part of the course is practise, further addressing management (but also personal) concerns that teachers might have with the pursued change (*Can I do this? Can I do this in my school? Do my students and I benefit from this?*). Teachers are expected to extend their practise further in their school, related to the focal teaching skill. The only support for this practise provided through the inservice course was in the form of exemplary lessons in the teacher's guide and the 'hands-on/minds-on' activities in the student materials. Participants in the initial workshop were asked to do the following in their schools related to practise:

- teach all the exemplary lessons, following all the procedural specifications as demonstrated in the initial workshop;
- use 'hands-on/minds-on' activities from the student materials in self-prepared lessons as demonstrated in the exemplary lessons, and following preparation procedures as practised;
- evaluate these lessons using evaluation forms.

Furthermore, teachers had been informed in the initial workshop that there would be a follow-up workshop at the end of the term in which they could share their experiences related to their practise in school.

As mentioned, coaching was piloted on a small scale in the 'try out' phase of this course. Teachers had been instructed in the initial workshop on the 'what, why and how' of coaching. Furthermore, peer coaching was demonstrated and some practise was organised on the use of observation forms. At the end of the workshop a meeting was organised for those who were interested in participating in coaching. Eleven teachers came to this meeting in which further explanation was given, peers were paired up, dates were set, observation instruments and teacher-report forms were supplied. Arrangements were also made for those who wanted to be coached by the inservice educator.
Teachers were asked to coach each other in at least one exemplary lesson and one self-prepared lesson in which a 'hands-on/minds-on' activity was used. The main training element related to coaching in this part of the course is practise, further addressing personal and management concerns that teachers might have with coaching when they are actively involved in this themselves (*Can I do this? Can I do this in my school? Do my partner and I benefit from this, e.g. in terms of professional development?*).
These teachers had also already been asked in the initial workshop to come to the follow-up workshop to share their experiences in coaching.
In short, an attempt was made to address personal and management concerns of teachers related to the pursued change during the 'try out' phase in the schools, for which curriculum materials were provided as support. Additionally, an attempt was made with a limited number of teachers to address personal and management concerns of teachers related to peer coaching.

The Follow-up Workshop
This workshop took place in August 1997, and was organised at UNISWA separately for all science subjects. Only those teachers who had participated in the initial workshop and had tried out the material were invited to this workshop. Teachers were asked to bring any of their own lesson designs, evaluation reports, (adapted) 'hands-on/minds-on' activities, etc. with them to the workshop.
The workshop lasted half a day, meaning that the main training elements of follow-up and feedback had to be organised in a tight time schedule of 3.5 hours (see Appendix D for objectives and program of the follow-up workshop). The aim of the workshop was formulated as follows:
To evaluate and consolidate what has been gained from the '97 biology inservice course and material on selection & use of 'hands-on/minds-on' activities.

So this workshop more or less looked back at what had been aimed at in the inservice course, and the personal gains of participating teachers. Furthermore, it tried to look ahead to what more would be required to support participating teachers in integrating the pursued change into their teaching

The workshop started with the filling in of a short questionnaire to find out more about the participants and what they had been doing in relation to the practise in the 'try out phase'. Teachers were asked to clarify their reasons for coming to the workshop, which exemplary lessons they had taught, which student materials they had used. They were also asked to explain what the material and training had meant to them, whether any improvement was needed in their mastering of the skill, and whether any had taken place. The results of this questionnaire were immediately analysed and used in the introduction of the workshop, in which the purpose of the workshop was also explained. This introduction was followed with activities related to the follow-up and feedback training elements, as summarised in Box 4.7 below.
Management concerns were mainly addressed in these sessions (*Why was it a success or why was it failure? What can be done to prevent failures in future? What am I going to try in another way?*). Concerns related to an actual change in teaching style were not really addressed in these follow-up workshops. It was assumed that the pursued change could be achieved with the support that was provided (see also chapter 3). However, at the end of the workshop teachers were asked whether they required any further support related to the change. None of the participants responded to this. Furthermore, the experiences with coaching could not be followed up in this workshop because none of the teachers who had been engaged in peer coaching showed up.
At the end of this workshop a questionnaire was administered to enable further improvements of the courses, in which teachers were asked to provide feedback on the workshop and its facilitators. An evaluation report was written based on the questionnaire results and the inservice educator's own impressions, which was discussed with the SMART team in a staff meeting.

Box 4.7: Characteristics of the follow-up & feedback training elements of the Follow-up Workshop

The follow-up & feedback training elements
The emphasis in this session was on sharing experiences between teachers, who had been actively using the teacher's guide and the student materials in order to learn from this. Through the invitation letter, teachers were asked to describe their 'best lesson' and their 'worst lesson', when trying to use 'hands-on/minds-on' activities in their own designed lessons. They were asked to write this down before coming to the workshop. They were also asked to list the main factors that made these lessons a success or failure. In the workshop, the teachers were asked to share their experiences related to their best and worst lesson (and the influencing factors) in groups of 3 teachers. In the plenary session that followed the focus was on one 'best lesson' and one 'worst lesson', clarifying the reasons for considering these best or worst.Teachers received feedback from colleagues and inservice educators on problems they encountered, after they had described their case. Furthermore teachers were asked to clarify what they wanted to adopt and would apply in their future teaching, related to the skill(s). Also the inservice educator obtained feedback from the teachers on problems they had encountered with the material.
During the second part of the workshop teachers watched a videotaped lesson in which a teacher was using a hands-on/minds-on' activity. The lesson had been designed by one of the teachers participating in the follow-up workshop. Teachers were asked to write down their observations on an observation instrument in which special attention was paid to specific elements of the focal skill. At the end teachers were given time to write down features of the lesson they particularly liked (would like to do in a similar way) and features they did not like (definitely would not do this themselves). These observations were further discussed in a plenary session with the teacher. Of course in this session only detailed feedback was given to one teacher. However an important purpose of this session was again to show teachers the value that such observations and feedback can have in assisting them to improve.
After this session teachers who had been involved in coaching were asked to report on their experiences, to be followed by discussion.

In short, an attempt was made to follow up on management concerns that teachers might have experienced in the 'try out' phase related to the pursued change, for which detailed instructional plans were developed. After this, teachers were expected to integrate the change in their teaching without further support. Management concerns of teachers related to peer coaching were not followed up because none of the teachers who had (actively) participated in this were present in the follow-up workshop.

4.3 Participants in the course

This section reports on the teachers who participated in the '97 biology inservice course. The numbers of teachers participating in the units of the course are described in 4.3.1, and the characteristics of participating teachers are discussed in 4.3.2.

4.3.1 Participation

Invitation letters for the May 1997 initial biology workshop were sent to all (± 120) high schools of Swaziland. In this letter, it was made clear that only those form 5 biology teachers who would be willing to teach the environmental topics after the workshop in the second term were invited. Fifty-two teachers from 49 (41%) different schools participated in the initial workshop of May 1997. Five of them participated only one day or less in the initial workshop. Ten teachers (19%) came to the workshop with no intention of teaching the environmental topics. Twenty-eight of the teachers (54 %) ordered a class set of the student materials, which was delivered to their school in most cases. Another fifteen teachers who had attended the physics or chemistry workshop attended the 'make-up' session for biology on the second day of the workshop.
Twenty-two teachers from 22 (18%) different schools who had attended the initial workshop also participated in the follow-up workshop. This means that 47% of the teachers who participated in the complete biology workshop in May turned up for this follow-up. Fifteen of the participants (68%) of the follow-up workshop indicated that they had tried out the material in some form. This means that 32% of the teachers who participated in the complete initial workshop were actively involved in all units of the programme. Participation in the different units improved considerably compared to the findings of Alberding (1996). From an efficiency point of view, however, this participation can still not really be seen as satisfactory.

A questionnaire that was sent to the schools at the end of the 'try out' phase also contained questions related to teachers' participation in the practising in this phase. Only 35% of the participants of the initial workshop responded to this questionnaire (N = 18). Almost all of the respondents indicate that they had used the exemplary lessons in some form. About 60% of the respondents indicate that they had read 'the what, why and how' of using 'hands-on/minds-on' activities. All of the respondents reported that they had taught at least one exemplary lesson (see Table 4.1). It must be noted that many teachers did not finish the teaching of these topics in the second term, when these data were collected, which could explain the limited use of lessons 2 to 5, which were all related to the second environmental topic of the syllabus. It is possible that they taught these lessons later, but this has not been checked in this study. The fact that lessons 3 and 5 contained more complex activities (role play and projects) might also have contributed to their limited use.

Table 4.1: *Number of teachers teaching specific exemplary lessons (N = 18)*

Exemplary lesson	**Number of teachers who taught the lesson**
Lesson 1	12
Lesson 2	7
Lesson 3	3
Lesson 4	4
Lesson 5	1

Only 13 teachers completed the question that asked specific details on the 'hands-on/minds-on' activities that had been used in the 'try out' in school (see Table 4.2). It appears that these teachers used approximately 12 'hands-on/minds-on' activities on average in the 'try out' phase, and that the majority of these 'hands-on/minds-on' activities were either readers or worksheets. The designer considered these activities to be the least complex to use for the teachers and students. They were also the most numerous of the activities in the student materials. Considerably fewer 'hands-on/minds-on' activities were used from the second student material booklet. As with the exemplary lessons, this probably can be explained by the fact that many of the teachers had not yet started teaching the second topic by the end of the 'try out' phase in the second term. This study has not investigated the extent to which this material was used in the third term.

Table 4.2: *Type and number of 'hands-on/minds-on' activities used in the 'try out' phase, as indicated by teachers (N = 13)*

Type of 'hands-on/ minds-on' activity	**Number of 'hands-on/minds-on' activities used**		
	Student material 1	Student material 2	Total
1. Reader	35	29	64
2. Worksheet	67	14	81
3. Questionnaire	-	4	4
4. Investigation	8	0	8
5. Simulation	4	1	5
6. Project	-	0	0
Total	114	48	162

The picture that emerges from this response (albeit rather limited) is that the use of exemplary lessons was limited in the 'try out' phase, but that considerable use has been made of the student materials. It can be assumed that the use of the materials by the non-respondents was not higher than that of respondents. The in-depth studies of nine cases, presented in chapters 5 to 7, provide more insight in the use that was made of the curriculum materials by teachers in the 'try out' phase.

Although 25 participants from the initial workshop indicated that they were enthusiastic about the piloting of peer coaching and wanted to participate, only 11 made a commitment to doing this. The most important reasons given for not participating were: i) no colleagues nearby and/or interested, ii) transport to school of colleague is a problem.
From the five pairs that were formed for the piloting of coaching, only two pairs actually engaged in one or more sessions of peer coaching (see also Box 4.8). Two of the other pairs who indicated that they were keen on the idea of peer coaching and would do this without any further assistance did not engage in coaching at all because of all sorts of practical problems. Of the remaining pair, one of the teachers had second thoughts and did not want to be involved anymore. All coaching that took place required a lot of involvement by the inservice educator. The inservice educator reported that when coaching took place, coaching protocols were mostly not adhered to and/or that observation and evaluation instruments were not used.

Box 4.8: Report of the biology inservice educator on the engagement in coaching activities that were initiated after the initial workshop of May 1997

Coaching Report

The inservice educator reported the following on the coaching initiatives of 1997 (Evaluation reports, 1997):

1. teachers C and Z, from different nearby schools : C was not very motivated from the beginning; after he had been observed two times (including SMART staff), he made clear that he did not see any benefit in coaching for himself and was not keen in observing his partner as well; clashing of time tables was a problem, though secondary; no further coaching took place; Z did not show up in the follow-up workshop;
2. teachers F and J, from different nearby schools: both teachers said they were keen and say they still are; teacher F was observed two times (including SMART staff) and teacher J only once; the coaching sessions were found useful by both teachers; clashes of time tables and transport for F were problems in arranging sessions; F did not show up in the follow-up workshop;
3. teachers G and V, from different nearby schools : V was not very motivated from the beginning and later on clarified that he did not want to be observed; although he said he wanted to observe G, he never showed up; G did not mind to be coached and 2 coaching sessions with SMART staff have taken place; G says she benefited from these sessions; V did not show up in the follow-up workshop;
4. teachers Pr and Ph from two 'far away' schools: both teachers said they were keen and say they still are; coaching never took place; SMART was not involved;
5. teachers Fi and L from two 'far away' schools: one teacher said he was keen and says he still is, the other was considerably less keen; coaching never took place; SMART was not involved.

After the formative evaluation of 1995 (see chapter 4) measures were taken to improve active participation in the SMART inservice courses. These measures met with a reasonable degree of success, although active participation in all units remained low. The 28 participants who bought class sets of the student material can probably be expected to have used the material in some way. It must be noted however that this number probably has been boosted by offering to deliver the materials to the schools. Fifteen teachers (32% of the participants of the initial workshop) were actively involved in all three units of the program. Six of these teachers belonged to the cases participating in the evaluation study described in chapters 5 to 7. Although a lot of energy was put in realising that interested teachers could be engaged in peer coaching, the actual participation in this remained very limited.

4.3.2 Characteristics of participants

Information related to personal characteristics of the participants was collected through a questionnaire, administered at the end of the initial workshop obtaining a 90% response rate (N = 47).
Eighty-three percent of the respondents have a major in biology at degree level (BSc or Bed). Seventy-two percent of the respondents are completely qualified[3], having a major in biology at degree level with professional training (see Fig. 4.2, left pie chart). Seventy-two percent of these qualified participants from the initial workshop (n = 28) have a combined major, either combining biology with chemistry or with geography (see Fig. 4.2, right pie chart).
More than half of the respondents are younger than 30 years of age. Forty-four percent of the respondents have less than six years of experience (fluctuating between 35 and 55% over the previous years), with 11% of them having less than 2 years of experience (see Fig. 4.3, left pie chart). Seventy-seven percent of the respondents (n = 36) teach the pure biology syllabus, one-third of whom does so in combination with another 'soft science' syllabus (see Fig. 4.3, right pie chart). Seventeen percent teaches only 'soft science' syllabuses. The course and material is designed for use in all these syllabuses. The syllabus 'human and social biology' has become less important after 1996, when it was being phased out.
An average of 35% of the respondents is (predominantly African) expatriate.

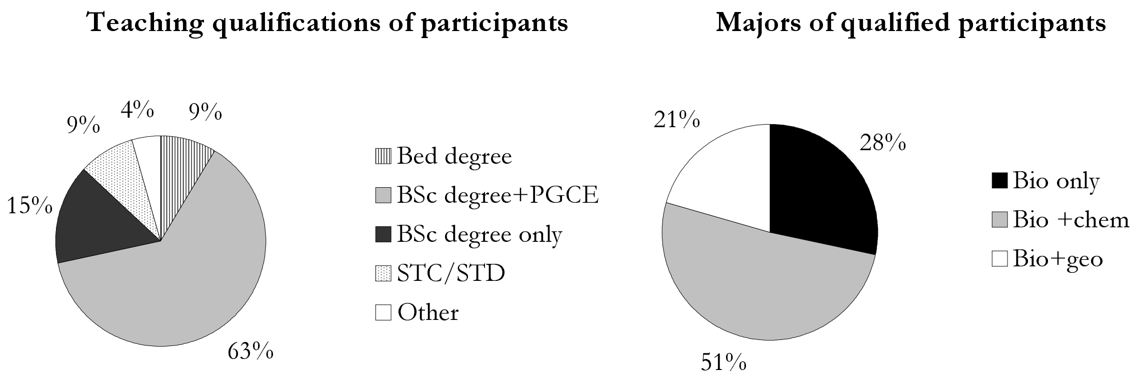

Figure 4.2: Teaching qualifications and majors of participants of the May 1997 initial workshop

[3] There has been a gradual increase in the percentage of properly qualified teachers in the biology inservice courses (in 1990 only 65% of the participants had a major in biology at degree level and 60% had also received professional training). It seems unlikely that this was caused by an increase of qualified biology teachers in Swaziland in that period (see chapter 2).

As stated previously, SMART has directed its inservice efforts mainly towards teachers who are qualified to teach science at senior secondary level and who are in the stage of 'becoming competent in the basic skills of instruction'. It appears that the majority (± 70%) of the participants are indeed qualified to teach biology at senior secondary level. If the stage of 'becoming competent in the basic skills of instruction' is taken as being those teachers who are qualified to teach science at senior secondary level and have less than six years of experience, it can be concluded that an approximate 45 % of the participants belong to the target group (this was 5-10% higher before 1996). In the largest group of more experienced teachers (> 5 years) the percentage of regular participants, females and expatriates is relatively high.

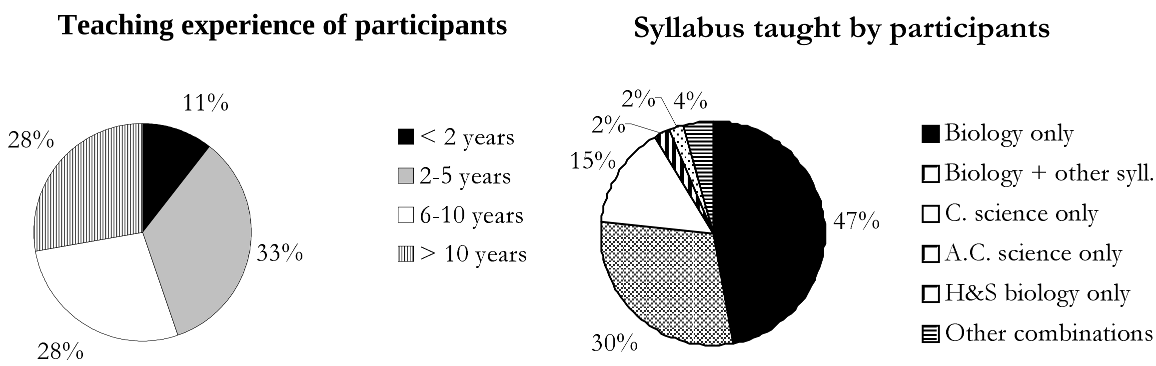

Figure 4.3: Teaching experience of participants of the May 1997 initial workshop, and the syllabuses taught by the participants

Of the teachers who responded to the questionnaire that was sent to the schools after the 'try out' phase, 75% of those who responded (N =18) have more than 5 years experience, 88% had attended more than three and 69% had attended more than five SMART national workshops before their participation in the May '97 biology workshop. This seems to indicate that more experienced teachers, who are also regular participants in the SMART inservice courses, participate most actively in the courses.

4.4 Perceptions of participants

The inservice educator reported that the '97 biology inservice course had proceeded as planned, as far as the initial and follow-up workshops are concerned (Evaluation reports, 1997). No real problems had been encountered, aside from the group of participants of the initial workshop having been rather big, and some time constraints, especially in the follow-up workshop.
This section focuses on the perceptions of teachers who participated in the '97 biology inservice course. Participants' perceived relevance and appreciation of a course program can affect their use of course ideas in practice (Guskey, 2000; Kirkpatrick, 1987; Van Tulder et al., 1992). In this study, participants' satisfaction with the inservice course is seen as conditional for a potential effect in terms of participants' use of new knowledge and skills (G/K effect level 4), being the main effect level at which the course is evaluated in chapters 5 and 6.
In the following sections the design and results of the investigations on teachers' perceptions are described, answering the research question posed at the beginning of this chapter:
How has the 1997 biology inservice course been perceived by the participating teachers?

4.4.1 Design of the study

In this section the methods and instruments are described that were used to collect data on perceptions of teachers who participated in the '97 biology inservice course, related to: i) components of the course, and ii) effect of the course. Furthermore, the method of data analysis will be briefly outlined. An example of an instrument is provided in appendix E. Complete instruments can be found at the following website: http://to-www.edte.utwente.nl/crc/projects/SMART/.

Components of the course
A questionnaire was administered to explore teachers' perceptions of components of the initial workshop, and another one was administered to explore teachers' perceptions of components of the 'try out' in schools and the follow-up workshop (see Appendix E). These questionnaires were administered at the end of the workshops, before teachers received their reimbursement for travel costs. Time had been allocated in the programme for this. In the

questionnaires participants were asked for their general appreciation of the course, their opinion on the functionality of specific elements of the course and their opinion on organisational aspects of the course. Background information of the teachers was also gathered through these instruments.
The questionnaires contained the following types of response items: i) 5-point Likert type items, ii) multiple choice items, iii) open response questions, and iv) the 'any further comments' type of question. These types of questionnaires have been used as standard evaluation instruments in the biology inservice courses for many years.

Effect of the course

A questionnaire was designed to explore what participants thought about the impact of the course on their teaching during and after the intervention. This questionnaire was mailed to the participants together with the invitation for the follow-up workshop. Teachers were asked to complete the questionnaire and return it at the registration of the follow-up workshop. Teachers who had not used the material and/or did not intend to participate in the follow-up workshop were asked to return the completed questionnaire by mail (a stamped envelope was provided). Teachers were asked to share their perceptions in relation to:

- whether there were any differences in their preparation, teaching and lesson evaluation practices during the 'try-out' phase, compared to what they previously did;
- whether there were any differences in the teaching of the environmental topics during the 'try-out' phase, compared to how they used to teach these topics;
- what they had learned from the course and the material, and what they intended to change in their teaching after the intervention.

The questionnaire contained the following types of response items: i) 5-point Likert type items, ii) multiple choice items, iii) open response questions, iv) completion items, and v) the 'any further comments' type of question.
This questionnaire was pre-tested by asking some teachers to complete it, recording the time required for completion, and discussing problematic questions with the teachers. This resulted in a revision of the questionnaire.

To establish whether any change in perception (related to their own teaching) had occurred, a questionnaire was designed to explore what participants thought about their teaching before the intervention. This would also provide insight on the degree to which these perceptions corresponded with the

assumptions of the designers related to the dominant teaching style in Swaziland's High schools. This questionnaire was administered to the participants before the start of the initial workshop with sufficient time allocated for this in the introduction of the course program. Questions were asked related to the teachers' preparation, teaching, and lesson evaluation practices. Questions were also asked related to the use of textbooks, note giving, homework, and the use of 'hands-on/minds-on' activities. Some more specific questions were asked related to their teaching of the environmental topics. Some further questions were asked related to school conditions.
This questionnaire was also pre-tested.

The questionnaires provided both quantitative and qualitative data. The quantitative data were analysed by computing descriptive statistics, including frequencies, means, and standard deviations. Qualitative data, including answers to the 'open question' and 'any further comments' types of questions, were summarised for each question. Next, common 'patterns' (cf. Miles & Huberman, 1994) were looked for in search of general trends in participants' responses.

4.4.2 Perceptions on components of the course

The initial workshop

In this subsection, participants' perceptions of the initial workshop are presented. First, the main reasons given by teachers for attending the workshop are presented. Subsequently, participants' perceptions on the overall value of the workshop, and functionality of specific training elements of the workshop are presented and discussed. Perceptions on some organizational aspects of the workshop are briefly presented last, as well as teachers' intentions on what to put into practice in the 'try out' phase.
The following reasons for attending the initial workshop were given by 18 of the workshop participants: i) to improve their teaching in general (5x), ii) to improve the teaching of the two environmental topics (5x), iii) to share experiences with colleagues (4x), iv) to improve the involvement of the students in the lesson (2x), v) to obtain more information on these topics (2x), and vi) to learn more on teaching approaches (2x). It can be noted that no specific mention is made of the focal skill, but that the motivations are expressed in more general terms, which are all in line with the objectives of the workshop (see Appendix D).

An indication of participants' perceptions on the overall value of the workshop, and functionality[4] of specific training elements of the workshop is presented in Table 4.3. The means presented in the second column of this table give an indication of the extent to which participants agree with certain statements on value and functionality related to the workshop. All teachers are positive and most of them very positive about the value of the workshop in general.

The part of the workshop focusing on theory was quite functional, according to the participants, in providing new information and raising their awareness about the functions of the material.

Table 4.3: *Perceptions of participants of the May 1997 initial biology workshop on the overall value of the workshop and on the functionality of specific training elements of the workshop*

		Indication of participants' perceptions		
Perception of:		*Mean* [a]	*S.d.*	**n** [b]
1. Overall value of the workshop		4.5	0.66	47
2. Functionality of workshop elements:				
- Theory	The lecture on the 'What, why and how of using 'hands-on/minds-on' activities'	3.8	1.01	45
	The introduction to the teacher's guide and the student material	4.5	0.62	46
- Demonstration		4.3	0.87	47
- Practise	The practising of selection and adaptation of 'hands-on/minds-on' activities	4.4	0.68	47
	The practising of designing a lesson around a 'hands-on/minds-on' activity	4.6	0.82	47
	The practising of (peer) coaching	4.0	0.93	45

Note: [a] 5 = highly positive, 1 = highly negative
[b] n = number of respondents

[4] Fulfilment of a function of a training element is achieved when a training element has done what it was supposed to do, according to the designer of the course. Statements in the questionnaire reflected what the training elements were supposed to do/achieve or not to do/achieve, according to the designer.

Most participants indicated that they were stimulated by the demonstration to try out the exemplary lesson themselves. The main practice activities in this workshop (selection and adaptation of 'hands-on/minds-on' activities and designing of a lesson around such an activity) are valued and deemed functional as far as 'management orientation' is concerned. Although the practising related to coaching was appreciated, and even most of the participants were convinced that they would benefit a lot from peer coaching, only 11 teachers could eventually be persuaded to be involved in this in the 'try out' phase.

Despite the fact that the inservice educator felt that he could not always provide optimal guidance to the groups because there were so many participants (Evaluation reports, 1997), teachers indicated that they were satisfied with the assistance provided. Although the planning of the workshop was quite tight, most teachers indicated that they did not want an extension of the duration of the workshop.
As far as intentions for the 'try out' phase are concerned, 92% of the respondents indicated that they were going to use/try out the exemplary lessons immediately after the initial workshop. However, in practice 28 teachers (54%) had committed themselves to this through the purchase of the materials. 95% of the respondents indicated that they planned to come to the follow-up workshop.

The 'try out' in schools
Eighteen participants of the initial workshop (35%) responded to the questionnaire that was sent to the schools. Most of the respondents indicated that they had not encountered any problems with the use of the teacher's guide and/or the student materials in class. Fifty-six percent of the respondents thought that without the teacher's guide their use of the 'hands-on/minds-on' activities would have been of lesser quality. Sixty-one percent thought that the materials on these topics provided them with new content information for their own reference. Seventy-two percent indicated that the support material (part 3 of the teacher's guide) contained very useful information. Almost all respondents reported that the 'hands-on/minds-on' activities in the student materials are an important contribution to the students' learning of the topics.

As reasons for using the student materials are given:

- relevant/useful content of the materials (5x);
- to involve students (5x);
- to promote student understanding (4x);
- to avoid too much lecturing/to give less notes (2x);
- the materials are easy to use for students/clear and simple language (2x).

The follow-up workshop

In this subsection, participants' perceptions of the follow-up workshop are presented covering: reasons for attending the workshop, its overall value, functionality of specific training elements, organizational aspects, what the biology inservice course tried to improve in their teaching, and on whether any improvement was needed.

Twenty participants of the follow-up workshop (91%) completed the questionnaire at the end of this workshop. They gave the following main reasons for coming to this follow-up workshop: to share experiences with my colleagues (12x), to hear how other teachers taught the topics (4x), to follow up the try out in the schools (2x), to hear/share different views (2x), to give feedback to SMART (1x). This indicates that the participants clearly feel a need to share their experiences, related to the practising in the 'try-out' phase, which is well in line with the objectives of this workshop (see Appendix D).

An impression of participants' perceptions on the overall value of the workshop and the functionality of specific training elements of the workshop are presented in Table 4.4. All respondents are positive and most of them very positive about the value of the follow-up workshop in general, and clearly see a need for sharing experiences related to the try-out of material. The follow-up part has been quite functional, according to the participants, in sharing experiences with colleagues and in clarifying which factors are important (should be adopted) for successful teaching. The sessions in which teachers talk with each other about their experiences got an especially high rating. The feedback part of the follow-up workshop was considered relevant, and most of the participants found that coaching really could be beneficial. However, teachers did not seek any further support after this workshop.

Despite the time constraint, half of the respondents still indicated that half a day is an adequate time allotment for the workshop.

Table 4.4: *Perceptions of participants of the August 1997 follow-up workshop on the overall value of the workshop and on the functionality of specific training elements of the workshop*

		Indication of participants' perceptions		
Perception of:		*Mean* [a]	*S.d.*	**n** [b]
1. Overall value of the workshop		4.5	0.69	20
2. Functionality of workshop elements:				
- Follow-up	The group discussions in which teachers shared their experiences	4.7	0.48	19
- Feedback	The plenary session on sharing experiences	4.3	0.66	20
	The observation and discussion of a lesson prepared by one of the participants	4.6	0.61	20

Note: [a] 5 = highly positive, 1 = highly negative
[b] n = number of respondents

Finally, participants of the follow-up workshop were asked what the biology inservice course had tried to improve in their teaching, and whether any improvement to the status quo was needed in their perception. Their responses to these questions are summarised in Table 4.5.

Table 4.5: *Perceptions of participants on the improvement pursued by the inservice course and the need for this improvement*

Question asked	**Responses given**
What did the inservice course and material try to improve?	▪ selection and use 'hands-on/minds-on' activities and related teaching methods (12x) ▪ to promote student involvement/active learning (4x) ▪ better teaching of the topics (3x) ▪ provision of teaching material/'hands-on/minds-on' activities (2x)
If improvement was needed, what was wrong?	▪ limited student participation (3x) ▪ did not give students enough practice/exercises/activities (2x) ▪ most lessons were teacher centred; too much chalk and talk (2x) ▪ using the same/limited teaching method (2x) ▪ too much note giving (2x) ▪ lack of 'hands-on/minds-on' activities (2x) ▪ limited preparation of lessons (1x)

The ideas held by the teachers as to what the biology inservice course had tried to improve in their teaching are well in line with the objectives of the course (see Appendices D). Seventeen of the respondents indicated a need for improvement in their teaching, and gave specifications that are in line with what the course was trying to change.

4.4.3 Perceptions on the effect of the course

This section presents the perceptions of participants related to what they have learned from the '97 biology inservice course, and related to their teaching behaviour before, during and after the course.

Perceptions on learning outcomes

Questions on effectiveness related to learning outcomes have been asked through a questionnaire administered at the end of the follow up workshop and through a questionnaire sent to all participants of the initial workshop at the end of the 'try out' phase.

Ninety percent of the respondents to the first questionnaire (n=18) think that their teaching has improved due to the training and material. The improvements mentioned most frequently are: i) more involvement of students in the lessons through the use of 'hands-on/minds-on' activities, and ii) better preparation of the lessons (see Table 4.6).

Table 4.6: *Participants' perceptions on improvements in their teaching*

Improvements in teaching	**n** [a]
▪ more student involvement/active learning through 'hands-on/minds-on' activities	6
▪ better lesson preparation	5
▪ more effective teaching/improved lessons	4
▪ the use/mastering of new/different teaching approaches	3
▪ integration of worksheets in the teaching process.	1

Note: [a] n = number of respondents

In the theoretical framework for the focal teaching skill of this course (see section 4.2.1), a 'hands-on/minds-on' activity is defined as any activity used by a teacher to facilitate learning in a way that pupils play an active role in the mastering of new content and/or skills. In the opinion of six of the respondents, the promotion of more active involvement of students in their lessons seems to have been the main outcome of the inservice course.

The results of the second questionnaire give a similar impression. All respondents (N=18) indicated that the quality of the teaching of the two topics improved as compared to previous years. Almost all respondents indicated that the national workshop and the teacher's guide contributed to the improvement of their skill of 'selecting and using 'hands-on/minds-on' activities', and their teaching of the environmental topics. Around 67% of the respondents indicated that the national workshop and the teachers guide improved their teaching in general. Seventy-two percent perceived that the student materials improved their teaching of these topics. Seventy-eight percent indicated that the students were more involved and did more active learning during the lessons as compared to previous topics.
The selection and use of 'hands-on/minds-on' activities and the promotion of student involvement were mentioned most frequently as learning outcomes when participants were asked what they had learned from the practise with the exemplary material (see Table 4.7).

Table 4.7: *Participants' perceptions on learning outcomes of the practise with the exemplary material*

Learning outcomes	**n** [a]
▪ selection of 'hands-on/minds-on' activities for a lesson	6
▪ how to use a 'hands-on/minds-on' activity in a lesson	5
▪ to promote student participation/ student understanding through the use of 'hands-on/minds-on' activities	4
▪ better preparation and time management	2
▪ making summarising notes	1

Note: [a] n = number of respondents

These perceived outcomes are well in line with the intentions of the designer as expressed in the objectives and aim of the course (see Appendix D).

Perceptions on teaching before, during and after the intervention

The teaching before the intervention

The results of the inquiry related to the 'usual way of teaching' of the participants of the course are summarised in Appendix F. Although 66% of the respondents (n=27) indicated that a lot of lesson time is used for lecturing and note giving, many of them (60%) also say to have spent considerable lesson time on more student-centred ways of teaching, i.e. question and answer method, individual work, and group work activities. This last perception is not in line with the assumptions made for the design of the SMART inservice courses, which is further discussed in section 4.5.

The teaching during the 'try out phase' compared to the usual way of teaching

Participants had been asked to teach the environmental topics in the second term, following the initial workshop in May. Only 50% of the respondents (n=9) had covered both topics at the end of the 'try out' phase. Sixty-seven percent of the respondents indicated that they spent more periods on the environmental topics compared to previous years. On average, the lesson time spent on the first topic had increased with 40% compared to what they had spent on it in previous years. Half of the respondents spent more time on preparation during the teaching of these topics, compared to the teaching of other topics. For 25% of the teachers, this was the same and for 25% it was less.

Most respondents indicate that they always made a lesson plan and defined objectives for the selected 'hands-on/minds-on' activities. The lesson design form was hardly used by most of the respondents.

Teachers were asked to compare their teaching of the environmental topics in the 'try out phase' with the teaching of other topics. The responses are presented in Table 4.8 below.

The results indicate that on average some more worksheets were used, more answering of questions took place, more fieldwork was done, and less practical work was done. Furthermore, fewer notes were given, more homework was assigned, and attention was more often paid to homework at the start of a lesson, according to the teachers.

Table 4.8: *Teachers' perceptions of how their teaching in the 'try out' phase of the inservice course differed with their usual way of teaching*

	Frequency of use compared to usual teaching			
Activity	*less*	*the same*	*more*	**n** [a]
1. reading texts in class	5	4	8	17
2. discussing a text or answers in class	3	7	7	17
3. using a worksheet in class	1	4	13	18
4. answering questions in class	0	8	10	18
5. roleplay	6	2	5	13
6. doing fieldwork	3	5	10	18
7. doing practical work in class	8	5	3	16
8. doing group work in class	3	9	6	18
9. doing individual work in class	2	11	4	17
10. the teacher asking questions to the students	1	13	4	18
11. the students asking questions to the teacher	4	9	5	18
12. giving notes	8	9	1	18
13. assigning students homework	0	8	8	16
14. answering questions for homework	1	10	7	18
15. reading texts for homework	5	6	7	18
16. studying notes for homework	3	13	1	17
17. paying attention to the homework at the start of the lesson	2	8	8	18
18. marking the homework	2	14	2	18

Note: [a] n = number of respondents

Seventy-eight percent of the respondents (n =14) indicate that the students were more involved in the lessons and that the students did more active learning during the lessons compared to previous lessons. Seventy-two percent of the respondents indicate that they also used the textbook in their teaching in the 'try out' phase. They indicated that they used the textbook for the following purposes: for their own reference (9x), for presenting/explaining new theory in class (7x), for assigning the students homework from (6x), for doing exercises in class (2x), and for giving short notes to students (1x).

Changes in the way of teaching after the inservice course

Eighty-three percent of the respondents (n =15) indicated that something changed in their way of teaching after the workshop and the use of the material. The changes that have been specified by the respondents are summarised in Table 4.9 below.

Table 4.9: *Participants' perceptions on what changed in their way of teaching after the inservice course*

Learning outcomes	**n** [a]
▪ the use of more/different 'hands-on/minds-on' activities	14
▪ more involvement of students	5
▪ better preparation/organisation of the lessons	3
▪ less note giving	2
▪ discussion of homework in class	1
▪ promotion of reading and study skills	1

Note: [a] n = number of respondents

All teachers indicated that they intended to apply some of the elements they learned from the workshop or the material in the teaching of other topics in future, and mention similar issues as presented in Table 4.9. All respondents indicated that they intended to use more 'hands-on/minds-on' activities in their future teaching and to use the student materials on the environmental topics again next year. Seventy-two percent of the respondents intended to prepare a topic scheme for other topics. Half even intended to make frequent use of the lesson design form provided at the workshop and 44% intended to make frequent use of the lesson evaluation form provided in the teacher's guide.

Most of the perceived changes and intentions of the respondents, presented above, are in line with the intentions of the designer as expressed in the objectives and aim of the course (see Appendix D).

4.5 Summary

Development of the course

The SMART design principles made clear that the '97 biology inservice course had to be geared toward improving basic teaching skills of inexperienced teachers, taking into account the realities in Swazi schools. The choice of a student-centred related teaching skill for this course may therefore seem surprising. It exposes a dilemma that clearly surfaced in the deliberations of the SMART team and that also can be found in the design principles, reflected in the following question: is the apparent assumption that student-centred teaching is preferable to teacher-centred teaching compatible with the realities of teaching in the schools of Swaziland? This predicament is not unique for the Swaziland situation as has been illustrated in chapter 3. The team, notably the biology inservice educator, thought that a change towards more student-centred teaching was attainable for the target group in Swaziland. The design principles gave no further guidance in this respect. The SMART design principles focused mainly on the curriculum materials that had to be developed for this purpose, and also gave limited guidance on other training elements that had been adopted as a basis for design.

This chapter describes how the SMART design principles have guided the development of the 1997 biology inservice course and how gaps in the design principles have been bridged. An attempt has been made in the design of the course to differentiate between target group (inexperienced) and non-target group (experienced) teachers. Furthermore, coaching has been piloted in this course.
The exemplary curriculum materials were validated and tested as prescribed in the principles, and also the content and format were highly aligned with the specifications of the SMART design principles. The material has played an important role in the training elements of information, demonstration and practice of the course. The chapter presents detailed instructional plans and curriculum materials that have been developed to address informational, personal and management concerns of teachers related to the pursued change. In the 'try out' phase teachers received support only through the curriculum materials provided. At the end of the course, teachers were expected to integrate the change in their teaching without further support, because this change was assumed to be within their ability. The study presented in chapters 5 to 7 reveals to what extent this assumption has been correct.

There are two aspects in which some deviation has taken place from the SMART design principles: i) the exemplary lessons could not be taught immediately after each other at the start of a topic, as proposed in the design principles and ii) the student materials that have been developed for these topics can be considered more or less 'textbook replacing'. The reasons for these deviations have been discussed in this chapter.

Participation in the course

Of the 52 teachers who registered for the initial workshop, 28 teachers bought a class set of the student material, and 15 teachers participated in all units of the course (also using materials in class). This 'active participation' has almost doubled (percentage-wise) compared to previous years. Teachers who had actively participated in all units of the course indicated that they only made limited use of the exemplary lessons in the 'try out' phase of the course, which might be partly related to the fact that most teachers did not finish teaching these topics in the 'try out' phase. The fact that the exemplary lessons were spread over the two topics, and could not be taught consecutively, might also have contributed to this. The influence of these factors is further discussed in chapter 8. On the other hand, the active participators seem to have made ample use of the 'hands-on/minds-on' activities of the student materials in their lessons. Especially the 'more simple' activities were used quite extensively.

The piloting of peer coaching has not been very successful in this course as far as teacher participation is concerned. The biggest problem was finding a coaching partner for the few who were really keen, because: i) there was no other biology teacher in the school, ii) colleagues in the school were not interested, iii) schools of other interested colleagues were too far away.

Approximately 45% of the participants of the initial workshop belong to the target group of the SMART inservice courses. The largest group of more experienced teachers (with an even higher percentage in the follow-up workshop) has a relatively high representation of females, expatriates and frequent participants.

Perceptions of participants

Teachers' reasons for participating in the course were in line with the objectives of the workshop. The participants valued the workshops in general, and indicated that the theory, demonstration, practice, follow-up and feedback elements of the workshops have fulfilled their functions. Furthermore, teachers were satisfied with the timing of the training elements and the assistance that was provided during the group sessions. Those teachers who have been actively involved in the 'try out' phase in schools indicated that they have not encountered any problems with the use of the teacher's guide and/or the student materials in class. Almost all of them think that the 'hands-on/minds-on' activities in the student materials are an important contribution to the students' learning of the topics. However, only 56% of them think that without the teacher's guide their use of the 'hands-on/minds-on' activities would have been of lesser quality, which could explain (to some extent) the limited use of the exemplary lessons.

At the end of the course, almost all of the 'active participants' indicated that there had been a need for improvement in their mastering of the teaching related skills that had been addressed in the '97 biology inservice course.
As far as learning outcomes are concerned, most of the teachers who had been actively involved in the inservice course indicated that their teaching had improved due to the training and material, especially in relation to: i) more involvement of students in the lessons through the use of 'hands-on/minds-on' activities, ii) better preparation of the lessons, and iii) better teaching of the environmental topics. These perceived improvements are consistent with the objectives of the course.
As far as teaching behaviour is concerned, most of the participants in the initial workshop indicated that in their teaching before the intervention, a lot of lesson time was used for lecturing and note giving. However, many of them also indicated that considerable lesson time was spent on more student-centred ways of teaching, which is not in line with the assumptions made for the design of the SMART inservice courses.
Teachers who actively participated in this course indicated that they spent more time on the preparation and the teaching of the environmental topics than in previous years. They also indicated that in their lessons during the intervention on average more student-centred teaching took place, and that their students were more involved. Furthermore, less note giving took place and more attention was paid to homework, according to the teachers. Almost all of these teachers indicated that they intended to use more 'hands-on/minds-on' activities in their future teaching and to use the student materials on the environmental topics again next year. As far as the use of topic schemes, lesson design forms, and lesson evaluation forms are concerned, their intentions were progressively

less positive. However, in general the perceived changes during the intervention and the expressed intentions for future teaching are well in line with the aim and objectives of the inservice course.

The participants of the '97 biology inservice course seem to have been satisfied with the course components and the impact these have had on their teaching. However, as mentioned before, the participating science teachers tended to give socially desirable answers. Therefore, these kinds of outcomes reveal little in terms of potential for effect on a higher G/K effect level. Nonetheless, these investigations are essential in the sense that they limit the chances of appraising non-events on higher G/K effect levels. It can be concluded that these results do not stand in the way of the further explorations of the impact of the '97 biology inservice course on G/K effect level 4, which are presented in the next chapter.

Chapter 5
Evaluating and interpreting implementation in the classroom:
Design of the studies

Teachers' expression of satisfaction with the '97 biology inservice course, as clarified in the previous chapter, served as encouragement for further exploration of effects the course may have had on the use of new knowledge and skills in the classroom. This chapter describes the design of a study that evaluated effects that this inservice course had on teaching-behaviour in the classroom, and also attempts to interpret these outcomes through what we know about the characteristics of teachers, students and schools. To this end, in-depth studies have been carried out concerning nine teachers who participated in the '97 biology inservice course. The main features of the study are described in section 5.1. The conceptual framework and research questions are presented in section 5.2. Section 5.3 discusses the selection of cases. The procedure for data collection is presented in section 5.4, followed by a discussion of methods and instruments for data collection in section 5.5, and a discussion of data analysis methods in section 5.6. The results of this study will be presented in chapters 6 and 7.

5.1 Characterising the study

This study focuses on the influence that one SMART inservice course had on the 'every day teaching' of participating teachers. In chapters 3 and 4 detailed information has been presented on the design and implementation of this inservice intervention[1].

The study has a clear summative *evaluation* purpose, trying to establish the 'worth of the course' (cf. Sriven, 1967), by comparing what teachers really did in their

[1] This refers to the inservice course for biology teachers that was organised by SMART from May till August 1997. This course will be further referred to as 'the (inservice) course' or 'the (inservice) intervention'.

lessons before and during the inservice intervention, with one year after. The emphasis in the data collection was on checking whether intended changes in behaviour occurred on the short term in the 'try out' phase of the course, as well as verifying to what extent these changes had been durably integrated in the teaching one year after the intervention.
The investigations made clear that there were considerable differences in how teachers put curriculum materials to use in their lessons in the 1997 'try out' phase. The investigations that followed in 1998 study were therefore not only evaluative in nature, but were also geared toward gaining understanding of what made teachers integrate or not integrate certain elements of the intervention in their teaching. In that sense the study also had an *interpretive* character, a term proposed by Erickson (1998) for studies that seek: i) detailed information about implementation; ii) to identify the nuances of subjective understanding that motivate various participants in a setting; iii) to identify and understand change over time. It can be noted that all three elements have been pursued in this study. Moreover, quantitative modes of data collection and issues of effectiveness, being clear elements of this study, are also featured in interpretive research according to the same author.
In short, this study can be characterised as being evaluative as well as interpretive in nature.

5.2 Conceptual framework and research questions

As has been clarified in the previous section, the primary purpose of this study is to evaluate the effectiveness of the '97 inservice course that was based on the SMART design principles. This course focused to a great extent on improvement of specific teaching-skills of teachers, making the main interest of this study to establish to what extent this had been achieved.
Gathering evidence on effectiveness of a course in terms of skills (i.e. teaching skills) is typically done in terms of behavioural changes[2] (cf. Posner & Rudnitsky, 1997). Guskey (2000) considers teachers' actual use of new knowledge and skills the most relevant outcome of inservice courses (section 1.3). In this study, information has been gathered from nine biology teachers who participated in the course, mainly geared toward clarifying effects of this intervention at a

[2] Whether a person has mastered the skill of bicycling after a course can best be tested by observing his behaviour whilst riding the bike and not by assessing all the complicated skills that are required for such an achievement. In a similar way, the mastering of specific teaching skills can best be assessed from observations of teaching behaviour that is assumed to exemplify these skills.

behavioural level. Based on the aims of the course and the procedural specifications of the exemplary lessons (section 4.2), intended behavioural outcomes have been formulated for elements related to the focal teaching skill (see I in table 5.1), and for basic teaching skills that have been promoted in all SMART biology inservice courses (see II to V in table 5.1). More detailed information on the intended outcomes of the course is provided in Appendix G.

Table 5.1: *Examples of intended behavioural outcomes of specific training targets of the inservice course*

Training targets	**Examples of intended behavioural outcomes**
I. Promotion of student involvement & active learning	SMART 'hands-on/minds-on' activities are used in the teaching of all topics, when available.
II. Note giving	Limited lesson time is spent on note giving/copying.
III. Textbook use	Students take their textbook to class.
IV. Homework discipline	Adequate attention is paid to homework at the start of the lesson (checking, discussing and/or marking).
V. Lesson planning & evaluation	The teacher can show a lesson plan containing: ▪ objectives related to 'hands-on/minds-on' activities; ▪ instructions for activities; ▪ answers to questions of activities.

The study assesses to what extent the teaching behaviour of the teachers has changed in the intended direction (evaluative investigation), and tries to uncover the nuances of subjective understanding responsible for the fact that specific teachers in specific school settings change or do not change as intended (interpretive investigation).

The conceptual framework presented in Figure 5.1 has guided the evaluative as well as the interpretive investigations, illustrating the main variables (shaded boxes) and influencing factors (text without boxes) that have formed the focus of the data collection and analysis. The inservice course can be considered the main independent variable of this study, although not all nine cases have undergone the 'inservice treatment' to the same extent. It is therefore important to determine to what extent teachers have participated in the training and made use of the curriculum materials, as intended by the designers (functional participation), to avoid appraisal of non-events.

The teaching behaviour of the nine teachers can be taken as the main dependent variable of the evaluative investigations, changing or not changing as a result of the intervention. In this study, a change in teaching behaviour is considered the main indicator for effect of the inservice course on the professional development of the teachers. To establish whether any intended effect occurred, each observed change in behaviour has been compared with the intended changes in behaviour formulated by the designer. Unintended changes that occurred will be reported on as well.

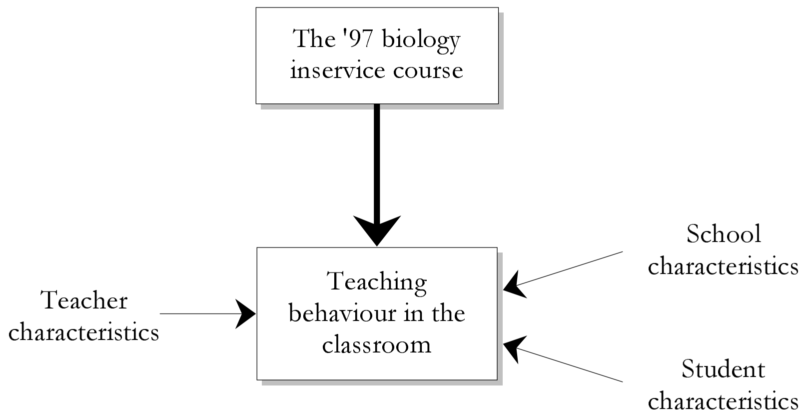

Figure 5.1: Conceptual framework for the study

All teachers are unique individuals with their own unique behaviours. Yet, they might react similarly to an inservice intervention under similar conditions (e.g. in case teachers are in similar stages of professional development, and/or teach in similar school conditions, and/or encounter similar student behaviour). The influences of such conditions have been explored through interpretive investigations.

Ultimately, the study would like to draw conclusions on the extent to which the inservice intervention brought about the intended change, and relate this to the SMART design principles and the circumstances of the nine teachers.

The main research question that has guided the evaluative research is as follows:

1. *What has been the effect of the inservice course on the professional development of biology teachers in Swaziland?*

As introduced previously, functional participation (participation as intended by the designer) of teachers in the course is considered indispensable for achieving the intended effects on professional development of teachers that can be attributed to influences of the course. It was therefore deemed crucial to establish the degree to which the case-teachers had practised the teaching skills in an authentic way by using the exemplary lessons in their classrooms during the 'try out' phase. More attention will be paid to this in the discussion of the results of the evaluative investigations in chapter 6.
In addition, participants' satisfaction (G/K effect level 1) with the course is considered conditional in this study for (intended) effects to be achieved by the course on professional development of teachers at the behavioural level. This condition has been met for the participants of the course in general, as has been reported upon in chapter 4. Also all nine case-teachers expressed their satisfaction with the course, as reported on in chapter 7.
The effect on professional development of teachers has been mainly assessed on behavioural level (G/K effect level 4). These investigations have been guided by the following more specific research question:

1a. What has been the effect of the inservice course on teaching behaviour of participating teachers?

The analysis of the 1997 data provided a quite positive picture of the short-term accomplishments of the inservice intervention (Stronkhorst, 1998b; van Wermeskerken, 1998). However, changes in behaviour in the 'try out' phase of a course do not guarantee that the intended behaviour will be permanently integrated into the daily routine of the teacher, especially when many of these changes have been induced by the researchers. A need was felt, therefore, to visit these teachers again one year after the intervention in 1998, to try to find out what had really been durably implemented by the teachers. These investigations have also been guided by the following research question:

1b What is the difference between short and long term effects of the '97 course?

The effect of the inservice course on student learning outcomes (G/K effect level 5) has not been separately assessed in this study. Nevertheless, students' satisfaction with the change in teaching (if any) and the curriculum materials has been investigated and is used to further interpret the effect of the course on the case-teachers.

The results from an analysis of the data from the 1997 investigations indicated that there were considerable differences among teachers in how they applied curriculum materials in their lessons in the 'try out' phase. To gain a better understanding of why teachers did or did not integrate particular elements of the inservice intervention in their teaching, the 1998 study was expanded with a more interpretive approach. These interpretive explorations have been guided by the following research questions:

2a. How can the effects of the inservice course on the teaching behaviour of individual teachers be interpreted?

2b. How can differences in effect between these teachers be interpreted?

The results of the evaluative investigations are presented in chapter 6 and of the interpretive investigations in chapter 7.

5.3 Selection of the cases

Fifty-two teachers participated in the initial workshop of the inservice course. The survey presented in chapter 4 revealed that 54 % of the participants (n = 28) bought a class set of the student materials. The cases for this study have been selected from this group since limited effect was expected if teachers did not provide the student materials to all of their students. For practical reasons it was decided that the selected teachers should be situated in schools within a half-hour drive of the University of Swaziland, which reduced the number of possible cases.

Although qualified inexperienced biology teachers formed the target group[3] of the SMART inservice courses, all biology teachers in senior secondary education were invited to the '97 course (chapter 3), resulting in a considerable degree of variation amongst the course participants in terms of teaching experience. Furthermore, there was considerable variation amongst participants concerning their previous exposure to SMART inservice courses, which also could be expected to have an influence on the effect of the course on teaching behaviour.

Twelve teachers were selected (on paper) who met the above criteria and were thought to represent a sufficiently varied picture of the implementation process,

[3] The target group of the SMART inservice courses was defined as 'teachers who are in the stage of becoming competent in the basic skills of instruction', having one to five years of teaching experience.

taking into account their experience, their previous exposure to the SMART biology inservice, and the distance to their school.

The 12 selected teachers were approached, when the student materials were delivered at their school, with the following requests: i) whether they would be willing to teach the environmental topics and use the material in the second term, following the initial workshop; ii) whether they would be willing to participate in the research, allowing observation of some lessons and providing requested information.
Nine of these teachers eventually consented to participate in the research. The characteristics of these teachers regarding experience and previous exposure to biology inservice courses are summarised in table 5.2.

Table 5.2: *Characteristics of selected teachers*

Cases	**Experience of teachers (in years)**	**Number of SMART inservice courses involved in before 1997**
Teacher A	7	>10
Teacher B	16	0
Teacher C	7	>10
Teacher D	5	6-10
Teacher E	10	>10
Teacher F	3	3-5
Teacher G	4	3-5
Teacher H	1	1-2
Teacher I	3	2

It can be noted that five of the selected teachers (D, F, G, H and I) belong to the target group of the SMART inservice. These teachers are all of Swazi nationality with teaching experience ranging from 1 to 5 years, and with previous involvement in SMART inservice courses varying from zero to ten times.
The other cases (teachers A, B, C and E) are more experienced teachers. Teachers A, C and E are all three properly qualified Swazi biology teachers in their mature phase of professional development, who also have been involved many times in the SMART inservice courses before. Teacher B stands more or less on his own, being a very experienced but not completely qualified expatriate who never participated in the SMART inservice programmes before 1997.

The facilities of the schools at which these nine teachers were teaching in 1997 and 1998 varied from limited to reasonable (see also chapter 7). This factor has not played a role in the selection of the teachers, as most of the 'hands-on/minds-on' activities of the student materials do not require a laboratory or special equipment

5.4 Procedure for data collection

The data collection events of this study (for teaching behaviour in relation to intended outcomes) are summarised in figure 5.2. The procedures used during these events are further explained below for data collection before, during and one year after the inservice intervention, respectively.

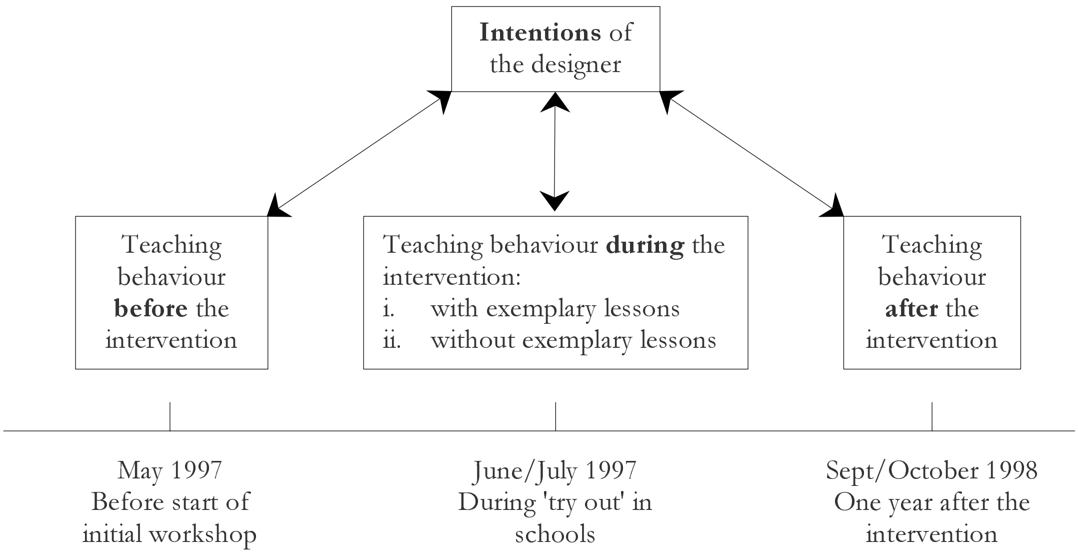

Figure 5.2: Main data collection events in 1997 and 1998 in relation to intentions of the designer for behavioural change

The initial data collection was geared toward clarifying the teaching behaviour of the nine cases *before the intervention*. The teachers had been asked to complete a questionnaire for this purpose before the start of the initial workshop. These teachers' students (of the form 5 class that was going to be observed) were also asked to complete a questionnaire for this purpose before the 'try out' in the schools started.

Subsequently, data were gathered in 1997 on the teaching behaviour of the case teachers *during the intervention*. Soon after the teachers were selected and had initially consented to participate in the research, they were visited again to make further arrangements. During this visit the researcher explained in more detail what was expected from them in relation to the research: i) lessons to be observed, ii) curriculum materials to be used, iii) providing information related to their teaching through questionnaires, logbooks, documents and interviews. They were also asked if it would be OK for their students to respond to questionnaires. Teachers were informed about the purpose of the research and were assured that data would be treated with utmost discretion and confidentiality. All selected teachers reconfirmed their consent to participate in the research, and to provide information as requested.
In four to five ensuing visits to all nine teachers (during and after the 'try out' phase in 1997), three lessons were observed, questionnaires were administered, documents were collected, and interviews were held. This data collection was geared toward: i) clarifying whether teachers practised with the exemplary lessons as intended, and ii) assessing to what extent 'hands-on/minds-on' activities were used as intended without use of the exemplary lessons. For the three observed lessons, teachers were asked to teach one of the exemplary lessons (to check functionality of practising) and to use 'hands-on/minds-on' activities from the SMART student materials in two other lessons they had prepared themselves (to investigate short term effects on behaviour).

The data collection *one year after the intervention* was aimed at finding out to what degree the case teachers had really and durably integrated elements from the course into their teaching in relation to the intended outcomes, and compare this with the 1997 findings. It also sought to clarify what their motives had been in doing or not doing this. This time the researcher expressed an interest in observing two lessons, preferably one form 4 lesson and one form 5 lesson. It was explained that any lesson would do, as long as it was not a revision lesson or a lesson in which a test was given. The teacher was asked to simply teach a lesson, as he/she would normally have done without an observer being present. Teachers were asked again whether they were willing to respond to questions related to their teaching through questionnaires and interviews, and if it would be OK for their students to respond to questionnaires. Teachers were once again informed about the purpose of the research and were assured that data would be treated with utmost discretion and confidentiality. Eight of the teachers agreed to participate in the research again, and provide information as requested. In three to four subsequent visits, two lessons were observed, questionnaires were administered, documents were collected, and interviews were held. The most inexperienced teacher (H) refused further participation in the 1998 research. During the observations in 1997, class control problems surfaced regularly in his lessons, and he seemed annoyed that he was exposed to this. He refused to hand in the last questionnaire in 1997. When he was approached again in 1998 with the request to participate in the research, it became clear that there was no basis for further co-operation in the research anymore. It is assumed that the effect of the course on this teacher has been minimal or even perhaps negative. This case will therefore not be further discussed in chapter 6, and only referred to in the interpretive chapter 7.

At the end of the data collection in 1998, interview schemes were made for the eight remaining teachers, based on all the data that had been collected and analysed. After the interviews, reports were written and teachers were asked to review these as a validity or member check (Krathwohl, 1998). They were asked to make any corrections if required and sign it if it was considered a true reflection, with or without corrections. This was done through another visit to the teachers, enabling clarification from both sides, if required. All teachers signed the report (including corrections made, if any).

The following assumptions form the basis for the rationale of the data collection procedures presented above, and/or for the interpretation of the results:

- participants' satisfaction with the course is conditional for the effectiveness of the intervention in terms of bringing about intended behavioural change;
- functional use of the exemplary material is conditional for the effectiveness of this material in terms of intended changes in teaching behaviour;
- an established change in behaviour during the intervention (as intended and relative to the established behaviour before the intervention) can be interpreted as a short-term effect of this intervention;
- an established change in behaviour one year after the intervention (as intended and relative to the established behaviour before the intervention) can be interpreted as a long-term effect of this intervention, meaning that the teacher has integrated a certain intended change into his/her daily teaching behaviour.

5.5 Data collection methods and instruments

Different sources of data and data collection methods were used to gather information on the teaching behaviour of the teachers. These multiple sources and methods were used to obtain a more broad-based view of the teaching-learning process, and to combine strengths and correct deficiencies of any single source or method (Miles & Huberman, 1994; Patton, 1990).
In this study, data have been collected through lesson observations, teachers' logbooks, questionnaires, document analysis and interviews. These methods of data collection are further outlined below, for data collection that took place before, during and one year after the inservice intervention. Examples of instruments can be found in appendix H. Complete instruments are provided at the following website:
http://to-www.edte.nl/crc/projects/SMART/

Before the intervention
Questionnaires
The case teachers were each asked to complete a questionnaire related to their perception of their teaching before the intervention (administered to all participants of the initial workshop). This questionnaire has already been introduced in chapter 4.

Students' perceptions regarding the teaching of their case teacher before the intervention have also been investigated through a questionnaire. Before the 'try out' phase in 1997, the students were asked to indicate how frequently certain specific activities (e.g. use of textbooks, note giving, specific student centred activities, and homework) occurred in their biology lessons. Furthermore, they were asked to rank different types of student activities (listening to the teacher, doing assignments, copying notes, doing group work, doing practical work, reading a text) in order of preference. This questionnaire was tested with a group of form 5 students and revised before it was administered to the students of the case teachers. This testing also made clear how the questionnaire should be introduced to the students, and which items required additional explanation. The researchers always administered the questionnaires themselves to ensure that clear, uniform explanations were given. Furthermore, students were encouraged to ask for assistance when they had problems with a question.

During the intervention

Lesson observations

The strengths of direct observation are that: i) the data are collected in the field, where the action is as it happens; ii) the observer can learn about things that programme participants may be unwilling to talk about in an interview; iii) and that observations permit the researcher to move beyond the selective perceptions of others (Patton, 1990). The lesson observations of this study were conducted to explore the extent to which functional use had been made of the exemplary material in the 'try out' phase, and to what extent teaching behaviour had changed in the intended direction. The designers' expectations related to the functional use of the exemplary material were: i) that participants should teach all exemplary lessons as suggested, following the procedural instructions for preparation and progress of the lessons, ii) that participants should use the exemplary lessons as examples for the preparation and teaching of their own self-prepared lessons in which they have incorporated learning activities of the SMART student materials.

In 1997 the observations focussed on lessons in the 'try out' phase, in which nine participants of the inservice course were asked to teach one exemplary lesson and two self-prepared lessons in which 'hands-on/minds-on' activities were used. In total, 28 lesson observations were carried out in 1997 (see also table 5.3 for a complete overview).

For the observation of the exemplary lessons, instruction checklists were used that contained all procedural specifications of the exemplary lessons. The observer had to check whether the procedural specifications were followed and whether parts of lessons were covered in the prescribed time. Any deviations could be elaborated in space provided on the checklist.

For the self-prepared lessons in which 'hands-on/minds-on' activities were used, special observation instruments, called innovation profiles, were used (see Appendix H). Innovation profiles are used to explore the relationship between the original intentions of the course designers and teachers' actual classroom behaviour (Van den Akker & Voogt, 1994). Such a profile consists of a limited number of components that reflect the core of the intended change. These essential components are further refined in specific behavioural terms. The innovation profile used for the observations of self-prepared lessons in 1997 distinguished three parts of a lesson (introduction, new content, and end of the lesson). Each part of the profile contained specific descriptions of teacher and student behaviour -derived from the intended behavioural outcomes- related to note giving, textbook use, homework and student involvement. See Figure 5.3 for examples.

- **Notes & notebook use**

  Start: End: Time required:

  - Notes given are structured.
  - Notes given are summarising and/or concentrating on difficult concepts.
  - Support is given to pupils through notes (relevance, usefulness).
  - Limited lesson time is spent on note giving/copying.
  - Teacher tells students to copy notes.
  - Students copy notes in notebook.
  - Students write answers in notebook.
  - Teacher gives support in how and where to write notes and answers to questions.
  - The teacher stimulates students to ask questions

Figure 5.3: Specific descriptions of teacher and student behaviour derived from intended behavioural outcomes for note giving

Furthermore, the innovation profile contained elements related to planning and evaluation (through self-evaluation and/or coaching activities) of the lesson. Space was provided to indicate whether or not each behavioural description took place, and for adding any information that was deemed to be of interest. The profile also contained spaces to record time used for each part of a lesson.

The first observations in 1997 were carried out by the researcher and a research assistant together, after which reports were written independently and compared afterwards. After a few joint observation sessions like this, it was found that the reports matched to such an extent that independent observations were expected to give sufficiently reliable and comparable results.

Interviews

Interviews and observations are mutually reinforcing qualitative techniques (Patton, 1990), with interviews providing more depth and richness to the information collected in observations (Krathwohl, 1998). Interviews were held

with all case teachers individually after observing three lessons during the 'try out' phase in 1997. Before the interviews, the information gathered through observations, logbooks, questionnaires and documents, was assembled and analysed. This information was used to identify issues that needed further clarification or elaboration, especially focussing on the intended behavioural outcomes (see Appendix G). These issues were compiled in interview schemes, which were specific for each teacher.
The researcher made notes during all interviews, which were made into an interview report immediately after each interview.

Teacher's logbook
Teachers were asked to complete a logbook for the exemplary lessons and self-prepared lessons that were observed in 1997. Questions were included in the logbook concerning specific details on preparation and teaching of the lesson, on any problems that had been encountered, and on the teacher's perceptions of the lesson. The logbooks provided initial data on how teachers had perceived their own lessons that had been observed. Data on teacher and school characteristics were also collected through the logbooks. The information received through this mode of data collection did not add much extra insight in general; most teachers indicated that they were quite satisfied with their lessons.

Questionnaires
The case teachers were asked to complete a questionnaire related to their perceptions of the initial workshop and follow-up workshop of the inservice course, and related to their perceptions on the effect of the course. This questionnaire (introduced in chapter 4) was administered to all participants of these workshops. Data on teacher and school characteristics were also collected through these questionnaires.

Immediately after the 1997 intervention, a questionnaire was again administered to the form 5 students of the class that had been observed. The purpose of this questionnaire was to explore their perception of the teaching-learning process during the 'try out' phase and of the student material they had received. The students were again asked to indicate how frequently certain activities (e.g. use of textbooks, note giving, specific student activities, and homework) occurred in their biology lessons. Furthermore, they were asked to indicate whether they had noted any changes in the teaching of biology by indicating whether specific activities had changed in frequency of occurrence, compared to the teaching of other topics. They were also asked to rate their satisfaction with the teaching and the materials through 5-point Likert type of question items. This questionnaire was also tested and administered to the students as described above.

Documents

Documents can also serve as valuable sources of information, revealing what teachers and students do in or outside of lessons. The following document was collected for further analysis in this direction during the intervention:

Students' notebooks

All of Swaziland's high school students have a notebook. The biology inservice courses tried to promote giving less volume, and higher value notes. Analysis of students' notebooks can give an indication of the relative importance and time-consumption of note-taking during lessons. The notebooks of three students of each teacher were collected for further analysis to find out what the baseline of note giving had been before the intervention, and whether any change had occurred subsequently. The teachers were asked to collect these notebooks from academically average students.

After the intervention

Lesson observations

In 1998, one year after the intervention, the teachers were visited again. The intention was that two more lessons would be observed. No reference was made to the curriculum materials of the '97 inservice course (see also section 5.1.4). In total, 16 lesson observations were carried out as planned.

For the observation of these lessons, an innovation profile was used that was similar to the instrument used in 1997 with only minor adaptations (see Appendix H). In 1998 the researcher carried out all classroom observations without further assistance.

Interviews

Interviews were held with the case teachers individually after the observation of two lessons. Before the interviews, the information gathered through observations, as well as the information gathered through questionnaires and documents, was analysed. This information (together with the findings of 1997) was used again to determine issues that needed further clarification or

elaboration, especially focussing on the intended behavioural outcomes, which were compiled in interview schemes specific to each teacher.
As with the 1997 interviews, the researcher used notes from the interviews to make an interview report immediately afterwards. These interviews were audio-taped for the sole purposes of verification or further clarification.

Questionnaires
The case teachers were asked to complete a brief questionnaire just before the interview. In this questionnaire teachers were asked to summarise in a few sentences how the SMART biology inservice courses had affected their teaching. They were also asked to provide specific information on the SMART teacher's guides and student materials they had used for their biology lessons in 1997 and/or 1998.

A questionnaire was also administered to the students who had been in the two observed lessons in 1998 (see Appendix H). These students were asked to indicate the frequency with which specific activities (e.g. use of textbooks, note giving, specific student activities, and homework) occurred in their biology lessons. They were also asked to rank different types of student activities in order of preference. Furthermore, they were asked specific questions on their possession and use of SMART student materials.

Documents
In 1998, data on specific teacher and student behaviours have been collected from the following documents:

Teacher's scheme of work
In this document teachers clarify their plan of teaching for a specific syllabus, for a specific class over a given time period (often a three-month term). This kind of planning is compulsory for all teachers in all schools and ought to be regularly checked by the administration of the schools. Specific formats are often used for these schemes. Most science teachers follow schemes recommended by SMART and the Ministry of Education in which specific lesson time is allocated to specific topics. The 'topic scheme' of the inservice course aimed at assisting teachers in this kind of planning when using 'hands-on/minds-on' activities. The schemes of work were analysed to find out how teachers schemed and whether any change had occurred (see also section 6.2).

Teacher's preparation book

In this document teachers clarify their planning for each lesson. This planning, too, is compulsory for all teachers in all schools and ought to be regularly checked by the administration of the schools. Specific formats are often used but can vary per school. In practice this kind of preparation is often reduced to an administrative formality. The lesson design forms of the biology inservice courses aimed at appropriate planning when using the 'hands-on/minds-on' activities of the student materials. The preparation books were analysed to find out how teachers had prepared their lessons and whether any change had occurred (see also section 6.2).

Students' notebooks

Notebooks of students of each teacher were collected for further analysis as described for the 1997 investigations.

Overview of data collection

Tables 5.3 and 5.4 provide an overview of the data that were collected in 1997 and 1998 for each case.

Table 5.3: *Overview of data collected from the nine cases in 1997*

	Observation		**Interview**	**Logbook**	**Questionnaires**		**Documents**
Teacher	No of exempl. lessons	No of self-prep. lessons	teacher		teachers	students	
A	1	2	√	√	A, B	a, b	N
B	1	2	√	√	A, B	a, b	N
C	1	2	√	√	A, B	a, b	N
D	2	2	√	√	A, B	a, b	N
E	1	2	√	√	A, B	a, b	N
F	1	2	√	√	A, B	a, b	N
G	1	3	√	√	A, B	a, b	N
H	1	2	√	√	A	a, b	N
I	1	1	-	-	A	a	-

Note: √ indicates that data have been collected through specific instruments; questionnaires *A* and *a* are related to teaching before the intervention, and questionnaire *B* and *b* are related to teaching during the intervention; *N* indicates that notebooks were collected and analysed

It can be noted from table 5.3 that complete data collection has taken place for teachers A, B, C, D, E, F and G in 1997, consisting of:

- three classroom observations (at least one exemplary lesson and two self-prepared lessons in which 'hands-on/minds-on' activities were used);
- an interview with the teacher;
- logbook completed by the teacher;
- two questionnaires (*A* and *B*) completed by the teacher;
- two questionnaires (*a* and *b*) completed by the students of one of the teacher's form 5 classes;
- students' notebooks collected and analysed; schemes and preparation books were analysed incompletely or not at all for most teachers in 1997.

With teacher D one extra exemplary lesson, and with teacher G one additional self-prepared lesson, was observed because some aspects needed further clarification. Teacher H became more and more reluctant to participate in the research in the 'try out' phase in 1997 (see also 5.4) and refused at the end to hand in questionnaire B. Teacher I's data remained incomplete in 1997 because she started teaching the environmental topics very late and her pace of teaching was very slow. Furthermore, it concerned a combined science class with only two lessons per week.

Table 5.4: *Overview of data collected from eight cases in 1998*

Teacher	**Observation**	**Interview**	**Questionnaires**		**Documents**
	No of self-prep. lessons	teacher	teachers	students	
A	2	√	C	c	S,P,N
B	2	√	C	c	S,P,N
C	2	√	C	c	S,P,N
D	2	√	C	c	S,P,N
E	2	√	C	c	S,P,N
F	2	√	C	c	S,P,N
G	2	√	C	c	S,P,N
I	2	√	C	c	S,P,N

Note: √ indicates that data have been collected through specific instruments; questionnaires *C* and *c* are related to teaching after the intervention; *S*, *P* and *N* respectively indicate that scheme of work, preparation book and notebooks have been collected and analysed

The data collection that took place in 1998, one year after the intervention, was complete for the eight remaining case teachers and consisted of:

- two classroom observations (two self-prepared lessons for which no specific requests were made by the researcher);
- an interview with the teacher;
- one questionnaire completed by the teacher;
- one questionnaire completed by students of both classes of each teacher in which a lesson was observed;
- scheme of work and preparation book of teacher, and notebooks of the students were collected and analysed.

See also the overview presented in Table 5.4

Table 5.5 clarifies the relationship between data collection methods and the evaluative research questions presented in section 5.2.

Table 5.5: *Relationship between data collection instruments and research questions*

Data collection instruments	**Research question 1a** *Effect on behaviour*	**Research question 1b** *Long & short term effect*
Observations *Exempl. lessons*	√	
Observations *Self-prep. lessons*	√	√
Interviews 1997	√	√
Interviews 1998	√	√
Questionnaires		
teachers A	√	
B	√	√
C	√	√
Questionnaires		
students a	√	
b	√	√
c	√	√
Logbook	√	√
Documents	√	√

Note: √ indicates that data have been collected through specific instruments for a specific question

The data collection, related to effects of the inservice course on teacher-behaviour in the classroom, has been guided by research question 1a. The teaching behaviour of the case teachers before the intervention has been reconstructed from the perceptions of the teachers (questionnaire *A*) and their students (questionnaire *a*). The actual teaching behaviour of the case teachers during and after the intervention has been investigated and compared to the intended behavioural outcomes of the intervention. Data were collected via classroom observations, from teachers' own perceptions (questionnaires *B* and *C,* logbook and interviews) and perceptions of their students (questionnaires *b* and *c*), as well as through document analysis.
By comparing the 1997 findings with the findings from 1998, research question 1b has been addressed, as far as comparing intended short and long term behavioural change is concerned

The interpretive research questions 2a and 2b have been answered through comparative and interpretive analysis of the data collected in 1997 and 1998. Data collected from different sources and by different methods were compiled and used as a basis for the interviews with the teachers in 1998. In these interviews teachers were regularly confronted with conflicting data (e.g. how teachers described their teaching compared to their students), which often led to considerable revelations by the teachers explaining why they did, or did not, exhibit certain behaviour in their teaching.

5.6 Analysis of data

The data collected for each of the case teachers have been analysed per data collection method consisting of lesson observation data, interview data, teacher's logbook data, questionnaire results, and document data.

Classroom observation data were analysed as soon as possible after each observation on the basis of the completed instruction checklists and lesson observation forms. A lesson observation report was written for each lesson, summarising what had taken/not taken place in the lesson in relation to the intended outcomes as formulated by the designer. Furthermore, conclusions were drawn in this report regarding the degree to which the observed behaviour approached the intended behavioural specifications.

The questionnaires provided both quantitative and qualitative data. The quantitative data were analysed by computing descriptive statistics, including frequencies, means, and standard deviations. Qualitative data, including answers to the 'open question' and 'any further comments' types of questions, were summarised for each question. Next, common 'patterns' (cf. Miles & Huberman, 1994) were sought in trying to identify general trends in participants' responses. Furthermore, the students of the case teachers were asked to indicate their preference for a variety of activities in class before and after the intervention (section 5.5). These results have been used to calculate index values indicating the average preference of a group of students for teacher/student centred teaching (see Appendix I).

Data gathered by means of interviews, teacher's logbook, and questionnaires were further analysed with techniques of data coding (Miles & Huberman, 1994). These data reflected the perceptions of teachers and their students on the teaching-learning process as well as perceptions of the curriculum materials. The codes used were mainly related to the intended behavioural outcomes for promotion of student involvement, teaching of the environmental topics, planning of lessons, note giving, textbook use, and homework. This coding enabled comparison of data related to specific behavioural elements that were derived from different sources, through which behavioural patterns could emerge.

Schemes of work and preparation books were analysed and briefly summarised immediately after each observed lesson based on written evidence related to what the teacher had been doing regarding lesson planning. Furthermore, the use of topic schemes, lesson design forms, and lesson evaluation forms was checked.
The three student's notebooks, collected for each class, were analysed on similarities and differences in note giving. If the notes were similar, one notebook was taken as a sample and further analysed as described below. When significant differences in note taking were observed, all three notebooks were analysed as described below, and the results were averaged.
Notes on specific topics covered in the notebooks have been analysed on: i) percentage of syllabus objectives covered, ii) percentage of concepts covered, iii) word/concept ratio, iv) word/diagram ratio, v) number of references to textbook, and vi) number of references to SMART material (see Appendix I).

From the notebooks that were analysed in this way in 1997, the notes given for the environmental topics were compared with the notes given for another topic (a topic with an average quantity of notes was selected for this). In 1998 only one topic with an average quantity of notes was selected for a similar analysis.
To provide an indication of the 'note giving' behaviour of a case, Notes Indices have been calculated based on the notebook analyses, giving an indication of the degree of comprehensiveness (based on percentage of syllabus objectives and percentage of concepts covered) and detail (based on word/concept ratio) of the notes (see Appendix I).

The data records were further organised into conceptually ordered case reports or 'with-in case displays' (Miles & Huberman, 1994), in which data gathered from different sources and through different methods were combined. In these case reports data have been presented under the following headings:

- Data collected: an overview of data collection activities.
- Teacher and school characteristics: characteristics of the teacher related to gender, age, qualifications, experience, assumed stage of professional development in 1997, teaching style before the intervention (teacher's view), attitude towards teaching, and previous participation in SMART inservice courses; characteristics of the school related to size and facilities, school administration, and school culture.
- Participation and perceptions: participation of teacher in units of the '97 biology inservice course, and functionality of participation in the 'try out' phase of this course; the teacher's perceptions of the effect the course had on his/her teaching, and on the learning of his students; students' perceptions of the teaching in the 'try out' phase and perceptions of the student materials.
- Behavioural changes related to the focal teaching skill and topic: a presentation of the findings on teaching behaviour before, during and after the '97 intervention, related to lesson planning, use of 'hands-on/minds-on' activities and promotion of student involvement, coaching and self-evaluation, and the teaching of the environmental topics.
- Behavioural changes related to note giving, textbook use, and homework: a presentation of the findings before, during and after the '97 intervention.
- Within case analysis: this provides a summary of general patterns found in teaching behaviour before, during and one year after the '97 intervention and conclusions regarding the effect of the'97 intervention.

An example of a complete case report is provided in appendix J.

Further conclusions and explanatory assertions were explored using cross-case analysis matrices and through the process of analytic induction. Erickson (1998) defines analytic induction as a recursive process of reviewing evidence with an assertion in mind, revising this assertion in the light of the evidence, and then reviewing the evidence again. The fundamental purpose of this process is finding the possibility for generalisation that is available, albeit often hidden, in the data. These generalisations therefore are focusing more on patterns in the setting that are supported by evidence from within the setting, and not so much on settings beyond the one that was studied.

In this study, varied data collection has taken place to obtain clarity about the everyday interactions between teachers and students in the classroom, in which the subjective meaning of the researcher surfaced when inferences were drawn from the data in which his own frames of reference were used to interpret these data (e.g. in scaling down the successes in promoting student involvement). This is only natural and can, and should, not be prevented (Erickson, 1986; Mitchener, 1991). Yet, it is important in interpretive studies to clarify where the presentation of data stops and the interpretation starts. This has been attempted in this study as much as possible.

Chapter 6
Results of the evaluation study

This chapter describes the outcomes of a study that evaluated what teachers implemented in the classroom after they had participated in the '97 biology inservice course. For this purpose the teaching behaviour of eight biology teachers has been investigated in relation to the intended outcomes of the course. This chapter starts with a brief introduction in section 6.1. The results of the evaluation study are presented in sections 6.2 to 6.4. The chapter ends with section 6.5 in which the main conclusions on the effects of the course are presented.

6.1 Introduction

As has been clarified in chapters 4 and 5, the '97 inservice course aimed at improving specific skills and changing behaviour of biology teachers focussing on:

1. improvement of basic teaching skills related to:
   - note giving;
   - textbook use;
   - homework giving and checking;
   - lesson planning and evaluation.
2. the promotion of student involvement in lessons.

The 'basic teaching skill' related aim was always addressed in the biology inservice courses and materials, as agreed upon in the SMART design principles (chapter 3). The promotion of student involvement in lessons - through skilled use of 'hands-on/minds-on' student activities by the teachers - had been chosen by the SMART team as the teaching skill to focus on in the '97 inservice courses. Although SMART team members had doubts about the feasibility of introducing learner centred teaching in the Swazi high schools - and therefore had decided to focus on basic teaching skills – these doubts were not based on research

evidence from Swaziland. It was therefore considered a challenge – at the end of the project - to find out whether some degree of student involvement could be facilitated through the inservice interventions. Student materials were collected and/or developed that could be used in lessons to promote student involvement. This was done for a specific topic of the syllabus (ecology/environment) because teachers had requested support for the teaching of this topic in terms of teaching resources.
Intended behavioural outcomes have been formulated for what was aimed at in the basic teaching skills and in student involvement (see Appendix G). Data on the behaviour of eight participating teachers were collected in relation to these intended outcomes before the '97 intervention, during the '97 intervention in the 'try out' phase, and one year afterwards in 1998.
Data collection has taken place as outlined in sections 5.4 and 5.5. These data have been analysed as clarified in section 5.6, answering the following research questions:
What has been the effect of the inservice course on the teaching behaviour of participating teachers?
What is the difference between short term and long term effects?

The findings related to the improvement of basic teaching skills are presented in section 6.2. This is followed by the presentation of the findings related to the promotion of greater student involvement in section 6.3. Section 6.4 reports on other - unintended - effects of the course. Conclusions are drawn in section 6.5, answering the two research questions.

6.2 Improvement of basic teaching skills

6.2.1 Note giving

Introduction
One of the aims of the inservice intervention was to improve note giving by teachers. It was known that many teachers in Swaziland spent a lot of lesson time on note giving, leaving limited time to assist students in their learning. To address this, a strategy was promoted in which teachers would encourage students to make active use of a (good) textbook (see section 6.2.2), and guide them in doing this by providing summarising and explanatory notes. How this

could be done, as far as better note giving is concerned, had been exemplified in the lessons of the teacher's guide that had been designed.
Note giving is defined as the combined action of the teacher, dictating notes or writing notes on the blackboard during a lesson, and students who copy these notes into their notebooks. This behaviour of the nine teachers and their students was observed during the intervention and one year afterward. Furthermore, teachers' and students' perceptions, as well as students' notebooks, have been investigated concerning what took place in relation to note giving before, during and after the intervention.
The following intended outcomes served as evaluation criteria:

1. The notes that are given concentrate on a limited number of (difficult) concepts and are summarising.
2. The teacher provides guidance and support in note giving: instructs students to copy the notes and ensures that students do this; the teacher gives support in how and where to write notes and how and where to write answers to questions.

The effect of the inservice course
The evaluation results for note giving are presented per evaluation criterion below.

Evaluation criterion 1 (Notes given are concentrating on a limited number of concepts and are summarising).

Analysis of the notebooks from these teachers' students formed an important source of evidence that proved particularly useful. Notes Index values have been calculated indicating the degree of comprehensiveness and detail of the notes on scales from 1 to 10 (see also section 5.6 and Appendix I). For 'comprehensiveness' the scale ranged from 1 (covering hardly any concepts of the syllabus) to 10 (covering almost all concepts of the syllabus). For 'detail' the scale ranged from 1 (spending hardly any words on describing/explaining the concept) to 10 (spending more than fifty words on describing/explaining the concept). The intended outcome of the course was considered equivalent to a Notes Index value of 4 for both 'comprehensiveness' and 'detail'. Table 6.1 presents these Notes Index values for the case teachers before, during and after the intervention.

Table 6.1: *Note giving of the teachers before, during and after the intervention expressed in Notes Index values*

	Notes Index values		
Teacher	*Before '97 intervention*	*During '97 intervention*	*One year after intervention in '98*
A	8/4 [a]	0/0	5/4
B	10/4	8/7	9/8
C	10/8	10/8	10/9
D	9/9	6/6	9/9
E	10/3	3/6	10/8
F	7/10	2/10	4/10
G	8/5	3/6	9/8
I	-	-	9/10

Note: [a] The Notes Index values indicate the degree of comprehensiveness and detail of the notes on scales from 1 to 10 (e.g. 10/10 stands for complete and very detailed notes, and 4/4 indicates that the notes cover a limited number of concepts and that they are summarising).

The values for the note giving *before the intervention* (table 6.1, 2nd column) indicate that all teachers - except for teacher I for whom this information could not be obtained - had Notes Index values that were considerably higher than the goal values set out by the course designers. This is especially true as far as comprehensiveness is concerned. The values for teachers C and D indicate that extensive note giving took place in lessons, which was confirmed through the questionnaire results (perceptions of teacher as well as students). For teacher F the situation was somewhat more complicated, because he initially gave the impression that he hardly gave any notes before the intervention. It appeared, however, that he had enrolled in a part-time PGCE course shortly before the start of the intervention. After having joined this course, he abruptly stopped providing notes to students during lessons, because he thought that the PGCE tutors expected this from him. When confronted with the notebook analysis results, teacher F conceded that he indeed used to give detailed and comprehensive notes before the intervention.

The Notes Index values indicate that the notes of teachers A, B, E and G were not very detailed before the intervention. This assertion is confirmed by the other data only for teacher A. For teachers B, E and G it appeared that the index values gave a false impression. These teachers clarified in later interviews that detailed and comprehensive note giving took place before the intervention, indicating that the notebook samples had not been representative. It appeared,

however, that teacher B did not use lesson time for note giving. He put his elaborate notes on stencil, which then had to be copied by the students outside lesson time.
The notebooks from students of teacher I were not analysed before the intervention. However, both teacher and students indicated that note giving took place frequently.

During the intervention, the practising with the exemplary lessons was rather limited for most teachers. Six of the teachers (A, C, E, F, G, and I) only taught the exemplary lesson that was observed by the researchers. Of these teachers, only teachers C and F practised with a lesson in which the giving of summarising notes was exemplified. The other teachers taught lessons in which no notes were given at all. Two teachers (B and D) taught more than one exemplary lesson, one in which the giving of summarising notes was exemplified and the other lessons with no note giving at all.
The index values indicate that teachers A, D, E, and G reduced the degree of comprehensiveness and/or detail of their notes considerably during the intervention (3rd column of table 6.1). Teacher A even went to the extent of giving no notes at all for these topics, which was not the intent of the inservice designer. These results are confirmed by the other data that have been collected. A potential influence of the exemplary lessons is only assumed for teacher D in relation to this evaluation criterion.
The index values for teachers B, C and F indicate that no or limited changes took place in note giving behaviour to this respect during the intervention, which is also confirmed by the other data. Teacher B supplied complete notes outside lessons, whilst teacher C used lesson time for this. Teacher F continued giving no notes at all during lesson time because he felt that his participation in the PGCE course obliged him to do this. Because his students were unhappy with this, he gave them his notebook so now and then to copy from outside lesson time. His note index figure is based on these notes he provided to his students.
Students' notebooks of teacher I were not analysed during the intervention. However, in later interviews the teacher communicated that note giving took place frequently and abundantly.

The values for the note giving *one year after the intervention* indicate that a significant reduction in note giving - as intended - was only maintained by teacher A, and to a lesser extent by teacher F (table 6.1, 4th column). For teacher A it is supposed that this has been promoted by the intervention, also taking into account his frequent participation in previous courses. The change in note giving of teacher F has mainly been initiated through his participation in the PGCE course.

The overall picture emerging from the findings presented above indicates that the intended outcome has only been achieved to a considerable extent on the long term with experienced teacher A. The long term instructional practice of all other teachers hardly changed on this criterion.

Evaluation criterion 2 (Teacher instructs students to copy the notes and ensures that students copy notes in notebook; teacher gives support in how and where to write notes and answers to questions).
No data were obtained on teacher behaviour before the intervention to this respect. The observations in 1997 and 1998 indicated that this kind of guidance and support in note giving was only done - to a limited extent - by teacher A. Because of the limited practising of exemplary lessons by teacher A, the exemplary lessons cannot be said to have contributed much to this behaviour. The other teachers hardly checked whether students copied the notes and did not provide any further guidance as intended.

Based on the results presented above, the following **conclusions** can be formulated:

i. The inservice course has influenced the note giving behaviour of four of the eight teachers in the intended direction on the *short-term*.
ii. The inservice course has also influenced the *long-term* note giving behaviour of one of these teachers in the intended direction (especially related to criterion 1). The fact that this teacher had already participated in many previous biology inservice courses is expected to have contributed to this behaviour. Considering the limited functional use of the exemplary lessons by this teacher, these cannot have contributed much to the observed change.
iii. The other three teachers (of the four mentioned under 'i') continued with 'textbook replacing' note giving as they had done before the intervention. The fact that they changed during the intervention is assumed to be a 'Hawthorne effect'[1].

[1] A 'Hawthorne effect' is defined as behaviour that teachers show during observed lessons because they think that this behaviour is preferred by the designer and/or researcher

6.2.2 Textbook use

Introduction

SMART staff was aware of the fact that considerable numbers of students in the high schools of Swaziland did not have a proper textbook or no textbook at all. The high prices of the (mostly foreign) textbooks no doubt played a role in this because many parents could not afford to pay for them. Nonetheless, there were quite a few schools that achieved a situation in which all students had a textbook. Some of these schools made textbook ownership a condition for enrolment, while others set up a loan scheme through which students could get textbooks on loan against a modest rate. SMART actively promoted this last option in schools. SMART also gave recommendations on textbooks (that were considered suitable for specific syllabuses), which were approved and supported by the Ministry of Education. The inservice course aimed at promoting more active use of recommended textbooks by teacher and students, so that teachers did not need to take up lesson time providing their students with 'textbook replacing' notes (see also section 6.2.1). The '97 curriculum material exemplified in one lesson how such active use of the textbooks could be promoted.
Data collection related to the 'textbook use' behaviour of the teachers had taken place before, during and after the '97 intervention.

The following intended outcomes served as evaluation criteria:

1. All students in a class have the same recommended textbook (textbooks that were considered suitable for specific syllabuses by the Ministry of Education and SMART).
2. Students take their textbook to class.
3. The textbook is used (together with the SMART student materials):
   - use is made of the textbook in class;
   - homework is given from the textbook;
   - students study from the textbook.

The effect of the inservice course

The results for textbook use are discussed per evaluation criterion below.

Evaluation criterion 1 (All students have the same recommended textbook).

The data collected *before and during the intervention* revealed the following textbook situation for specific teachers:

- 100% of the students have the same recommended textbook (teachers C and F);
- 100% of the students have the same textbook, which is not recommended (teachers A, E and I);
- 75 to 99% students have the same textbook, which is not recommended (teachers B and G);
- less than 25% of the students have different textbooks, which are not recommended (teacher D).

The textbook situation as it was found in 1998, one year *after the intervention*, is presented in table 6.2 below.

Table 6.2: *Possession of recommended textbooks by students in 1998, one year after the intervention*

Teacher	% of students having a textbook	# of different textbooks in the two classes		Recommended/ not recommended by SMART
		Class 1	*Class 2*	
A	100	1	1	Recommended
B	100	1	1	Recommended
C	100	1	1	Recommended
D	100	1	3	Not recommended
E	100	1	1	Not recommended
F	100	1	1	Recommended
G	80-90	1	4	Not recommended
I	100	1	1	Not recommended

The results indicate that teachers C, and F had maintained their good textbook situation one year after the intervention. Furthermore, teachers A and B had improved the textbook situation in the sense that they realised a situation in which all of their students had a textbook that was recommended. For teachers E and I the textbook situation remained the same. For teacher G the situation became worse because students in one class appeared to have four different textbooks.

The students of teacher D all had a textbook, albeit that these were different in one class and not recommended. Although this seems an improvement compared to the 1997 situation, it cannot be attributed to teacher D because she appeared not to be aware of this situation. Teacher D conceded that she had not taken any action to improve textbook possession by students. Initiative on the part of the school administration and the students themselves was mainly responsible for this.

It must be noted that the possession of textbooks by students of these eight teachers is not very representative for the average biology class in Swaziland[2]. It is expected that the fact that there were quite a few frequent inservice participants amongst the selected teachers might have contributed to this. The importance of possession of recommended textbooks by students was frequently highlighted in the courses, as has been mentioned before. It is expected that teachers A, B, C and F have been especially influenced by the textbook promotion efforts of SMART.

Evaluation criterion 2 (Students take their textbook to class).

No data regarding this aspect of classroom behaviour were obtained *before the intervention*. The classroom observations *during the intervention* clarified that most of the students of teachers A, C and E took their textbook to class. The students of the other teachers hardly did this. It is expected that teachers A, C and E have been influenced by the promotion efforts of SMART to this respect.

Evaluation criterion 3 (The textbook is used - together with the materials - as follows: i) use is made of the textbook in class, ii) homework is given from the textbook, and iii) students study from the textbook).

Here too, no data were obtained of teachers' behaviour *before the intervention* related to this criterion.
During the intervention, teacher B was the only one who practised with the exemplary lesson in which the use of the textbook in class was exemplified (certain pages of a recommended textbook were included in the student materials). However, he did not put this into practice in his self-prepared lessons that were observed.

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2 From the teachers who participated in the '97 course, only 30% of the teachers indicated that all students in their class had a textbook. 41% of the participants indicated that in their biology classes less than 75% of the students had a textbook (30% indicating even less than 50% of the students).

Teacher C, who made limited use of the student materials, was the only teacher who sometimes referred to diagrams in the textbook in class during the intervention. This way of using the textbook in class was mainly practical for the teacher, because this way he did not need to draw complicated drawings on the blackboard. Students often were assigned to copy these drawings into their notebook at home, for which spaces were reserved between the notes.
Only teachers A and E sometimes gave homework from the textbook in the observed lessons in 1997.
This means that only three teachers promoted the use of textbooks by students to a limited extent as intended by the SMART designer. The exemplary material has had no influence because the relevant lesson had not been used for practising by teachers A, C and E.
One year after the intervention teachers A, C, E and I referred to the textbook in class for diagrams. Furthermore, teachers A and E sometimes gave homework from the textbook in the observed lessons.
For most students, of all the nine teachers, their notebooks are their number one source to study from, even with the quite student centred teacher A. Teacher F (who did not give any notes) was the only teacher who managed to let his students (in one class) use their textbook as the number one source to study from. However, the students were not given an alternative (hardly any notes were given) and were not very appreciative of the fact.
The intervention has hardly promoted more active use of the textbook in the intended direction.

Based on the results presented above, the following **conclusions** can be formulated:

i. The '97 intervention has hardly had any effect in the intended direction on the *short-term*. Several teachers even made less use of the textbook, because of the student materials that were supplied. Active use of the textbook by students was hardly promoted by the teachers during the intervention
ii. All students of three teachers already had a textbook that was recommended by SMART before the intervention and maintained this after the intervention. Because all three teachers were frequent participants in the biology inservice courses, it is assumed that these courses have contributed to this situation on the *long-term* (especially textbook recommendations and reinforcements during the courses are assumed to have played a facilitative role in realising this situation). One teacher achieved a situation in which all

students had a recommended textbook only after the intervention. A *long-term* influence of the intervention is assumed here. The other four teachers did not alter their textbook related behaviour at all during and after the intervention.

iii. Only with one teacher (A) did the textbook related behaviour approach the intentions of the course: promoting active use of the textbook by students in combination with limited note giving during lessons. Teacher A had participated frequently in previous biology courses, and a SMART influence is assumed. The exemplary lessons have hardly played a role in this.

6.2.3 Homework

Introduction

Through homework, teachers assign specific tasks to students to be done outside of lesson time, and to be followed up by the teacher - in some way or another - shortly after that in a lesson. The main purpose of homework from the designer's perspective was to provide continuous feedback to both teacher and learner regarding progress in learning.

In the school regulations of the Ministry of Education of Swaziland (Ministry of Education, 1979) attention is also paid to 'homework' in some way, mainly emphasising assessment (see Box 6.1). A lot of weight is put on 'written work' of pupils as a measure of performance of both teachers and pupils. The Head of the School must ensure that the quantity and quality of this 'written work' of pupils is of a satisfactory standard, and that it is followed-up through marking by teachers in a satisfactory way. Neither 'written work' nor 'satisfactory standard' are further defined and are in practice determined by the head teachers of the schools.

The biology inservice interventions promoted homework giving and checking as an ongoing routine in lessons. In the giving of homework, special emphasis was given to assignments related to content and skills covered in the lessons (through questions and exercises), and promotion of the use of textbooks by students. Methods promoted for the checking of homework included brief discussions of homework at the start of a lesson, and/or marking of assignments.

Box 6.1: Extract from school regulations of the Ministry of Education of Swaziland related to homework

1. Exercise books of pupils are the most revealing record of pupil and teacher performance. The following aspects must be checked regularly by the Head of the School (or the Head of Department where this responsibility is delegated) to ensure that the work being done by the pupils and the teacher is of a satisfactory standard:
   - the quantity of written work;
   - the quality of written work;
   - the general appearance of the books;
   - the quality of the teacher's marking
   - the suitability of follow-up work.
2. The Head of School must ensure that:
   - written work is done regularly;
   - written work is dated and titled;
   - pupils' work is neatly presented;
   - the pupils' work is marked by the teacher and initialled and dated;
   - all written work completed by the pupils is promptly marked.

If the Head of the School is not satisfied with the quantity or quality of the written work or with the standard of marking, the teacher responsible must be informed and told clearly what remedial action is required.

Data collection related to the 'homework giving and checking' behaviour of the teachers, was carried out before, during and after the '97 intervention.
The following intended outcomes served as evaluation criteria:
1. Adequate attention is paid to assigned homework at the start of the following lesson (checking, discussing and/or marking).
2. Students are assigned to do homework, which is clear and relevant; the teacher writes the homework assignment on the blackboard and tells students to copy the homework; students copy the homework.

The effect of the inservice course
The teachers' students formed one of the data sources that was used that to clarify how teachers behaved related to the formulated evaluation criteria. The students were asked to indicate how frequent certain homework related activities occurred in their class before and after the intervention, by giving a rating form 1 (almost never) to 4 (almost always). Class averages have been calculated for the situations before ('96) and after ('98) the intervention (see table 6.3).

The difference between the means of 1996 and 1998 could indicate a change in homework related behaviour of the teachers. These differences have been analysed on significance with the Student T-test. The T-tests have been conducted one-sided, because the expectation is that the intervention has influenced the behaviour of the teachers in the intended direction (i.e. an increased frequency of the homework activities). The results indicate a significant increase ($p= 0.00$) in the homework activities in lessons, for the teachers on average, from the perspective of the students.
The results of the complete investigations related to 'homework giving and checking' behaviour of the teachers are presented per evaluation criterion below, with reference to the results presented in table 6.3.

Evaluation criterion 1 (Adequate attention is paid to homework at the start of the lesson, through checking, discussing and/or marking).

The data collected *before the intervention* revealed the following:

- the students of teachers A, D, E, F and G indicated that their teachers had already adopted frequent checking/discussing of homework before the intervention (see figures for 1996 for checking/discussion and marking of homework in table 6.3); the teachers themselves confirmed this;
- the students of teachers B, C and I indicated that their teachers did not often pay attention to homework at the start of their lessons (see figures for 1996 for discussion and marking of homework in table 6.3); their teachers contradicted this.

The data collected *during the intervention* revealed the following:

- all teachers practised with at least one lesson in which homework checking was exemplified;
- seven of the teachers (A, B, D, E, F, G and I) checked and discussed homework to a considerable extent as intended in the observed lessons; teacher B and his students indicated that this took place more frequently than usual;
- only teacher C did not check and discuss homework as intended in the observed lessons; he indicated that he normally only marked the homework regularly.

Table 6.3: *Frequency of homework giving and checking elements in the teaching of the teachers before and after the intervention according to their students (N_{96} = 203; N_{98} = 400)*

		Frequency of homework giving and checking activities in lessons of case teachers in '96 and '98 [a]																	
		A		B		C		D		E		F		G		I		**Average Score**	
Homework activities	*n*	*26*	*43*	*32*	*74*	*26*	*58*	*33*	*69*	*33*	*65*	*13*	*28*	*16*	*32*	*24*	*31*		
		'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98
Checking &	*M*	3.1	3.2	2.5	3.1	1.3	2.1	2.2	3.6	3.3	3.4	2.4	3.0	3.2	3.4	1.8	2.7	2.5	3.1
discussing hw	*Sd*	1.1	1.0	1.3	0.9	0.6	1.2	1.1	0.8	0.8	0.9	0.8	0.9	0.8	0.9	1.2	1.1	1.0	1.0
Marking of	*M*	4.0	3.2	1.8	1.9	1.7	3.4	3.4	3.7	3.5	3.0	3.8	3.7	2.6	2.6	1.7	3.3	2.8	3.1
homework	*Sd*	0.0	0.9	1.2	1.1	1.0	0.9	0.9	0.7	0.8	1.1	0.4	0.6	1.0	1.2	1.1	1.0	0.9	0.9
Homework	*M*	3.6	2.8	1.2	2.4	0.9	2.1	2.4	3.5	2.4	2.5	2.6	3.0	3.0	3.4	1.2	2.2	2.2	2.7
giving	*Sd*	0.8	1.0	0.9	1.1	0.5	1.0	1.3	0.7	1.2	1.0	0.8	0.9	1.1	0.8	0.8	1.1	0.9	1.0
Assignments	*M*	3.3	2.9	1.7	2.3	1.3	2.7	2.9	3.5	3.0	2.9	3.3	2.9	2.3	3.4	1.5	2.5	2.4	2.8
given for hw	*Sd*	1.0	0.9	0.9	0.9	0.7	0.9	1.0	0.8	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.9
Writing hw on	*M*	2.5	1.5	1.9	1.8	1.2	2.0	3.1	2.8	1.8	1.7	2.4	2.6	2.3	3.0	1.3	2.1	2.1	2.2
blackboard	*Sd*	1.2	0.8	1.0	0.8	0.6	1.2	1.0	1.0	0.8	0.9	1.0	1.1	0.8	1.1	0.7	1.0	0.9	1.0
Average	*M*	3.3	2.7	1.8	2.3	1.3	2.5	2.8	3.4	2.8	2.7	2.9	3.0	2.7	3.2	1.5	2.6	2.4	2.8
score	*Sd*	1.0	1.1	1.2	1.1	0.7	1.2	1.1	0.9	1.1	1.1	0.9	1.0	1.0	1.0	1.0	1.1	1.2	1.1
Significance level (1-tailed)		0.99		0.00		0.00		0.00		0.77		0.16		0.00		0.00		0.00	

Note: [a] The students of the eight teachers have indicated the frequency of occurrence of a homework element on a scale of 1 (occurs almost never in a lesson) to 4 (occurs almost always in a lesson); the '96 figures are the means and standard deviations of the frequencies that have been indicated by the students of one form 5 class for the situation before the '97 intervention; the '98 figures are the means and standard deviations based on responses of two classes for the situation one year after the intervention.

The data collected *one year after the intervention* revealed the following:

- the students of teachers A, E and F indicated that their teachers had not increased the frequency of checking of homework in class (means hardly increasing or even decreasing for checking/discussion and marking of homework in table 6.3, resulting in a low significance level for the research hypothesis); data collected from other sources confirmed this;
- the students of teachers D, G and I indicated that their teachers had increased their checking of homework in class (means increasing considerably for checking/ discussion and marking of homework in table 6.3, resulting in a high significance level for the research hypothesis); data collected from other sources confirmed this, except for teacher I;
- the students of teachers B and C also indicated that their teachers had increased their checking of homework in class (means increasing considerably for checking/discussion and marking of homework in table 6.3, resulting in a high significance level for the research hypothesis); however after having been confronted with conflicting evidence in the interview, teachers B and C revealed that they rarely or never checked and discussed homework during lessons; this revelation is considered to be the closest reflection of the real situation.

It can be concluded that six teachers (A, D, E, F, G and I) paid attention to homework at the start of a lesson to a considerable degree as intended, but that five of them had already done this before the intervention. Considering the frequent previous participation in SMART inservice courses of teachers A, D and E, a reinforcing influence of the inservice intervention is assumed. This also might have been the case, but to a lesser extent, with teachers F and G. However, reinforcement by the school is also expected to have played a role, especially with teachers E, F, and G.

Teacher I's behaviour related to homework at the start of a lesson has not totally been clarified. The students seem to indicate that she became more serious in the checking of homework in 1998. However, this could not be confirmed through the observations. Considering the limited influence that the SMART inservice intervention had on this teacher in general, it is also not expected that this aspect would have been greatly influenced.

Teacher C, being a mentor and often exposed to what SMART pursued to this regard, has clearly not been influenced at all. Teacher B only participated for the first time in a SMART inservice course and his change during the intervention is probably a 'Hawthorne effect'.

Evaluation criterion 2 (Students are assigned to do homework, which is specific, clear and relevant; teacher writes the homework assignment on the blackboard and tells students to copy the homework; students copy the homework).

The complete data analysis indicated that a similar pattern emerges as for evaluation criterion 1. Teachers A, D, E, F and G assign specific homework more regularly. The homework they gave in the observed lessons was mostly clear and relevant. Teachers B and C assigned homework only occasionally, and mostly in a rather unspecified way ('do your homework' or 'work hard'). Teacher I's behaviour related to homework has also not totally been clarified concerning what she did at the end of her lessons (see also figures on homework/assignment giving in table 6.3).
The writing of homework on the blackboard, to be copied by students, was observed in some lessons of teachers D, E, F, and G. The teachers and the students also confirmed that this was the case (see also figures on blackboard use in table 6.3). The other teachers hardly did this.
A facilitating influence of the intervention related to criterion 2 is assumed for teachers A, D, E, F and G.

Based on the results presented above, the following **conclusion** can be formulated:

i. The intervention (and previous inservice courses in which these teachers had participated) has had a reinforcing influence, as intended, on the homework related behaviour of five of the eight case teachers on the *short and long-term.* A difference between short and long-term effect of the intervention could not be established.
ii. Two teachers changed their homework related behaviour in the intended direction on the *short-term,* but did not maintain this on the long-term. This appeared to be a 'Hawthorne effect'.
iii. The intervention appears to have had no effect at all on the homework related behaviour of one the eight case teachers.

6.2.4 Lesson planning and evaluation

Introduction

It is in planning that teachers translate syllabus guidelines, institutional expectations and their own beliefs and ideologies of education into guidelines for

action in the classroom. Through lesson evaluations teachers learn from their successes and failures, ensuring a critical frame of mind so essential to the development and deployment of good teaching.
The main purpose for paying attention to lesson planning and evaluation from the designer's perspective was that teachers would embed 'hands-on/minds-on' learning activities in lessons that were well planned for, and reflect on these lessons afterwards.
Lesson planning by teachers in Swaziland normally entailed completing schemes of work and prep books, which formed important means for school administrations (as well as the inspectorates) to monitor whether teachers do what they are supposed to do (see Appendix L). Self-evaluation of lessons was not prescribed and hardly practised by teachers.

The topic schemes prepared and/or provided in the biology inservice courses went a step further than what was prescribed through school regulations. In these schemes teachers had to allocate time per syllabus objective or set of objectives within a topic (e.g. environmental topics), and indicate which 'hands-on/minds-on' activities from the biology student materials could be used for specific objectives. The idea was that teachers would use these topic schemes as a guideline for planning of the specific topics and, ideally, start making these schemes themselves for other topics.
The lesson preparation practised in the biology workshops was also more thorough, and geared to preparing lessons (incorporating 'hands-on/minds-on' activities) that had not been taught before. A lesson design form had been prepared for use in the try out phase (see Appendix D). The designers of the biology inservice courses considered this kind of preparation essential for successful use of the 'hands-on/minds-on' activities of the student materials in lessons.

The inservice intervention has promoted scheming and lesson preparation as described above. Teachers practised in constructing topic schemes and preparing lessons (using the design form) in the initial workshops. How this could be applied had been worked out in lessons in the teacher's guide, which teachers were requested to use as examples in the 'try out' phase.
Self-evaluation of lessons was demonstrated and practised in the workshop, and a lesson evaluation form was incorporated in the teacher's guide. Teachers were encouraged to use these for their self-prepared lessons in the 'try out' phase and report on this in the follow-up workshop.

The following intended outcomes served as evaluation criteria for lesson planning and evaluation:

1. A topic scheme is used for the selection of the 'hands-on/minds-on' activities, resulting in rational use of the activities as far as available time is concerned.
2. The selected activities are appropriate for pupils and teacher; adaptations are made to the activities when required.
3. The teacher can show a lesson plan containing at least: i) appropriate objectives for the selected activities, ii) planned instructions for the activities, iii) answers to questions of the activities.
4. The lesson design form is used when lessons are prepared in which 'hands-on/minds-on' activities are used during the intervention.
5. Self-evaluation is done; the self-evaluation form is used.

The effect of the inservice course

The results for lesson preparation and evaluation are presented per evaluation criterion below.

Evaluation criterion 1 (A topic scheme is used for the selection of the 'hands-on/minds-on' activities resulting in rational use of the activities as far as available time is concerned).

Most teachers indicated that they made and used topic schemes *before the intervention*. It is expected that most of these teachers confused topic schemes with the schemes of work required by the school administration, as described in the introduction above. Only teacher C indicated that he only made the schemes of work required by the school.

Teachers B, D, E and F indicated that they used the topic schemes prepared in the workshop, and/or the topic schemes provided in the teacher's guide for selecting 'hands-on/minds-on' activities, *during the intervention*. Teacher G started using the topic schemes for selecting the activities only after the researcher drew his attention to this. This was necessary because the teacher apparently thought that he had to use all the 'hands-on/minds-on' activities in his lessons. Teachers A and C hardly looked at the topic schemes, whilst the use of the topic scheme could not be clarified for teacher I.

One year after the intervention teachers A, B, C, D, E, F and G revealed that they only did the compulsory scheming, and never used a topic scheme anymore after the intervention. Teacher I also mostly limited herself to the compulsory scheming required by the school, but she indicated that she still used the topic schemes for guidance in selecting activities.

The findings presented above indicate that four teachers used the topic schemes to provide guidance in the selection of 'hands-on/minds-on' activities during the intervention. None of the teachers used topic schemes, or made topic schemes for other topics themselves, after the intervention.
The intervention has had hardly any long term influence in the intended direction.

Evaluation criterion 2 (The selected activities are appropriate for students and teacher; adaptations are made to the activities when required).

No data were obtained of teachers' behaviour *before the intervention* to this regard.
Lesson observations *during the intervention* clarified that most teachers spent only limited time on critically looking at the activities as practised in the initial workshop. Although teachers A, B, C, D and G selected activities that were relevant for the syllabus and manageable for the teachers and their students, these mostly concerned less complex activities that did not require adaptations as far as content is concerned. Teachers B, C and D made adaptations to some activities, mainly to fit the lesson time available. Only teacher B made appropriate adaptations in the content of some activities when he found this necessary.
Although the 'hands-on/minds-on' activities selected by Teacher E for the observed lessons were relevant for the syllabus objectives, she herself did not appear to be very confident with the content of some. She made appropriate adaptations in some of the 'hands-on/minds-on' activities, mainly to fit the lesson time available.
Also the 'hands-on/minds-on' activities selected for the observed lessons by Teacher F were relevant for the objectives and manageable for him and his students. However, some of the selected activities could have benefited from adaptations, which were not made.
Some of the 'hands-on/minds-on' activities, selected by Teacher I for the observed lesson, were too demanding for her students (combined science class). She made some adaptations that were not really appropriate.
Lesson observations *one year after the intervention* indicated a similar pattern as was observed during the intervention. Teacher B made appropriate adaptations to an activity he used in an observed lesson. In the interview he revealed that he often added questions or made changes in the content of activities to make them better. The other teachers just used the activities as they were, if they used any at all. In the interview most of them conceded that they spent only limited time in general on critically looking at the activities. They more or less expected the activities to be perfect and ready for use.

The findings presented above indicate that most teachers did not really look critically at the learning activities (as practised in the initial workshop) before they used these in their lessons, which sometimes led to inappropriate use. The intervention has hardly influenced these teachers in the intended direction. Only one teacher made adaptations as intended, which is assumed to have been facilitated by the intervention.

Evaluation criterion 3 (The teacher can show a lesson plan containing at least: i) appropriate objectives for the selected activities, ii) planned instructions for the activities, iii) answers to questions of the activities).

The only data collected on lesson preparation of the teachers *before the intervention* was limited to the amount of time they spent on preparation. The teachers indicated that they spent the following amount of time, on average, on the preparation of a lesson:

- teachers C and F: less than 15 minutes;
- teacher A: 15 to 30 minutes;
- teachers B, D, E, G and I: more than 30 minutes.

The data collected *during the intervention* was predominantly based on teachers' perceptions, because of incomplete document analysis. The teachers revealed the following about their way of preparing lessons:

- teachers B, D and E: systematic preparation of lessons as practised in the initial workshop and demonstrated in the exemplary lessons is adopted for the self-prepared lessons;
- teacher F: continued with lesson preparation as required by the PGCE course he was engaged in, which was reasonably in line with what was pursued by the inservice course;
- teachers A, C and G: continued with lesson preparation as required by their school;
- teacher I: no data were collected.

One year after the intervention prep books have been analysed. From these results another picture emerged for some teachers. Some teachers were confronted with conflicting evidence that had emerged, which mostly provided more clarity. The results are as follows:

- teachers B, D and E indicated that they gave an overly positive impression of their lesson preparation during the intervention; they only did the lesson

preparation that was required by the school; in most cases they completed their prep book only after having taught the lessons;
- teacher F still continued with lesson preparation as he had done during the PGCE course;
- teachers A, C and G: teacher A continued with lesson preparation as required by his school, which mostly boiled down to reporting afterwards; teacher C indicated that he gave an overly positive impression of his lesson preparation during the intervention, because he hardly ever completed the prep book; teacher G still continued with lesson preparation as required by his school;
- teacher I hardly did any lesson preparation and never completed the prep book.

From the results presented above it becomes clear that most of the teachers prepare for their lessons as required by their school administration, which means that quite a few paradoxically fill in the prep book only after lessons. Two teachers hardly did any lesson preparation and also did not complete the prep book.
Specific objectives and instructions for the activities were never prepared by any of the teachers. And, although it became clear that most of the teachers had looked at the activities and knew the answers to the questions, these answers were in most cases not recorded in a systematic way.
The intervention has hardly had an effect related to this criterion in the intended direction.

Evaluation criterion 4 (The lesson design form is used when lessons are prepared in which 'hands-on/minds-on' activities are used during the intervention).

Only teacher B indicated to have used the lesson design form sometimes during the intervention of 1997. None of the teachers used the design form in 1998.
The intervention has had minimal effect on the short term and no effect on the long term related to this criterion.

Evaluation criterion 5 (Self-evaluation is done; the self-evaluation form is used).

None of the nine teachers engaged in any serious evaluation of their own lessons during or after the intervention, and the self-evaluation forms were never used.
The intervention has had no effect related to this criterion.

Based on the results presented above, the following **conclusions** can be formulated:

i. The intervention has influenced the scheming practice of some teachers in the intended direction on the *short-term* (which appeared to be a 'Hawthorne effect'); the intervention has not influenced the scheming practice of any teacher in the intended direction on the *long-term*.
ii. The intervention has had minimal influence on the lesson preparation practice of the teachers in the intended direction on the *short and long-term*. For the two teachers who demonstrated some degree of lesson planning related behaviour during the intervention, as intended, it appeared to be a 'Hawthorne effect'. The other six teachers did not alter their lesson planning at all during or after the intervention.
iii. The intervention has not stimulated any self-evaluation of lessons as intended on either the *short or long-term*.

6.2.5 In conclusion

The designer's expectation was that especially inexperienced teachers would gain from the training in basic teaching skills for which intended behavioural outcomes have been formulated. This expectation has hardly been fulfilled for the training in the basic teaching skills of note giving, lesson planning and lesson evaluation. In fact, the intervention has only changed the *note giving* behaviour of one teacher (A) in the intended direction on the long-term, whilst the behaviour of the other seven teachers has not been appreciably influenced on the long-term. Three teachers (D, E and G) only reduced note giving as intended during the intervention. As far as *lesson planning* is concerned, the two very inexperienced (F and G) teachers were quite dedicated in their lesson planning, already before the intervention. This planning appeared rather mechanistic, however, with no improvements made following the intervention. Four teachers (B, C, D and E) paid more attention to lesson planning, but only during the intervention. The other two teachers (A and I) hardly spent time on lesson planning before, during and after the intervention. *Lesson evaluation* was never done by any of the teachers before the intervention and this has not changed after the intervention.
On the other hand, the intervention has influenced the textbook and homework related behaviour of inexperienced as well as experienced teachers in the intended direction. One teacher (B) realised a situation after the intervention in which all students had a recommended *textbook*. A similar improvement occurred

with three more teachers (A, C and F) but this effect is assumed to have been facilitated through earlier inservice courses in which these teachers participated. The other four teachers have not been influenced by the '97 intervention or previous interventions in this way. Only one of the eight teachers (A) promoted and realised more active use of the textbook by students as intended. Five teachers (A, D, E, F and G) gave and checked *homework* to a reasonable extent as intended, in which the '97 course and/or previous interventions are assumed to have had a reinforcing influence. Two teachers (B and I) only paid more attention to homework during the intervention. One teacher (C) hardly paid attention to homework before, during as well as after the intervention.
The exemplary lessons can only have played a facilitating role in the established (rather modest) long-term effects for the basic teaching skills of homework, teachers having practised with some of the lessons. The teacher who changed his note giving and textbook use as intended did not practise with any exemplary lesson in a functional way. The role of the exemplary lessons in the improvement of textbook possession by students of four teachers is expected to be rather remote.

The differences that can be observed between the short and long-term effects of the intervention that have been presented above can be explained as follows:

- teachers changing their behaviour in the intended direction only after the intervention; for one teacher related to note giving and for one teacher related to the textbook situation;
- teachers showing behaviour that they perceived as desirable from the SMART perspective, but which behaviour they did not normally exercise in their usual lessons (Hawthorne effect); for three teachers related to note giving; for four teachers related lesson planning; for two teachers related to homework.

6.3 Towards more student involvement in lessons

Introduction

Promoting more student involvement and active learning[3] by students in lessons through the use of 'hands-on/minds-on' activities was the main aim of the inservice course. For this purpose two sets of student materials were produced,

[3] In the text that follows in chapters 6 and 7 'promotion of student involvement' is used in the sense that it entails 'promotion of active learning', as specified in the lesson observation instrument (appendix H).

containing a large number of - in most cases relatively simple - 'hands-on/minds-on' activities, to be used in the teaching of the environmental topics of the biology syllabuses in Swaziland (see also chapter 4). All eight teachers had bought complete class sets of these materials. Furthermore, a teacher's guide had been developed containing five lessons in which the use of 'hands-on/minds-on' activities was exemplified. In the initial workshop the teachers had received background information on the use of 'hands-on/minds-on' activities and the curriculum materials, the teaching of an exemplary lesson had been demonstrated, and the preparation of lessons with 'hands-on/minds-on' activities had been practised.

Data collection on teacher behaviour in relation to 'promotion of student involvement' was carried out before, during and one year after the intervention.
The following intended outcomes served as evaluation criteria:

1. Biology student materials containing 'hands-on/minds-on' activities are used in the teaching of biology topics when available.
2. 'Hands-on/minds-on' activities are used in a student-centred way (the intentions of the designer in relation to student centred teaching have been exemplified in the teacher's guide and further specified in the lesson observation form in Appendix H).
3. The teacher involves students in the lessons by applying the question and answer method (stimulating thinking and discussion, rather than recall and recitation); this was promoted in all biology inservice courses.

The effect of the inservice course

The results of the investigations related to 'student involvement in lessons' are presented per evaluation criterion below.

Evaluation criterion 1 (Biology student materials containing 'hands-on/minds-on' activities are used in the teaching of biology topics when available).

No data were collected on this criterion *before the intervention.*
Table 6.4 below presents the extent to which teachers used the '97 curriculum materials *during the intervention.*

Table 6.4: *Use of student materials and exemplary lessons by the case teachers during the '97 intervention*

Teacher	**Use of the '97 biology curriculum materials during the intervention**	
	Number of 'hands-on/minds-on' activities used (% of total of 55)	*Use of exemplary lessons* [a] *(N=5)*
A	67	1 or 2 (NF)
B	38	3 (F)
C	25	1 (F)
D	35	2 (F)
E	22	1 (F)
F	22	1 (F)
G	45	1 (F)
I	-	1 (F)

Note: [a] Numbers indicate the number of exemplary lessons that were used; F = functional use has been observed (teachers followed procedural specifications quite closely); NF = functional use has not or hardly been observed (procedural specifications were not or hardly followed).

As far as the use of 'hands-on/minds-on' activities is concerned, teachers A, B D and G indicated that they had used quite a lot (20 to 35) of the activities in their lessons during the intervention, whilst a reasonable number (10 to 15) was also used by teachers C, E and F. For teacher I this information could not be obtained (see 5.1.5).
Only teachers B and D practised with more than one exemplary lesson, in which the use of 'hands-on/minds-on' activities was exemplified, as intended. The other teachers practised with only one exemplary lesson, of whom teacher A did not do this as intended.

From 1993 until 1998, eight sets of biology materials (i.e. teacher's guides and student materials) were produced and disseminated amongst biology teachers through the inservice courses, amongst which the two student materials of the '97 inservice course. *One year after the intervention* the nine teachers were asked which of these materials they had in their possession and actually used in their teaching in 1997 and/or 1998 (see table 6.5 column 2). The students of the teachers were asked which student materials they had received in 1998 and how frequently these had been used (see table 6.5 columns 3 and 4). Furthermore, the teachers were asked whether they still used the teacher's guides they had obtained in inservice courses (see table 6.5 column 5).

Table 6.5: *Use of SMART biology curriculum materials by the case teachers in 1998*

	Use of SMART student materials in 1997 and/or '98			
Teacher	*Number used according to teacher in '97 and/or '98 (8 were available)*	*Number of booklets in possession by students of two classes in '98* [a]	*Frequency of use in lessons according to students in '98* [b]	*Use of Teacher's Guides in 1998 (according to teacher)*
A	7	1/3	Often/almost always	Yes
B	4	1/1	Often/often	No
C	1	0/1	-/sometimes	No
D	7	3/3	Almost always/often	Yes
E	8	0/0	-/-	Yes
F	4	0/2	-/often	Yes
G	4	2/0	Almost always/-	No
I	4	0/4	-/often	Yes

Note: [a] These numbers indicate the numbers of booklets in possession by students of the two classes that have been observed.

[b] Average frequencies indicated by students of two classes of each teacher are presented; in case students did not posses any booklets no frequency is indicated (-).

The results indicate that teachers A and D made frequent use of the student materials. These teachers had almost all the materials, supplied some booklets to their students, and often provided copies of certain pages of the student materials to the students as well. Teacher E had all the booklets, but never provided any to the students after the intervention. However, she provided considerable evidence that she regularly used the booklets in her lessons and that she provided copies of certain pages of the booklets to her students.

Teachers B, F, G and I made moderate use of the SMART booklets that were available in 1998, having half of the total number in their possession. It appeared that teachers B, F and G made most active use of the student materials that were provided in the '97 course, which were also the only materials they provided to the students. Only teacher C has made very limited use of the available SMART student materials in 1998.

Five teachers indicated that they still looked at the teacher's guides occasionally. Teachers A, E and F also indicated that they still used some exemplary lessons, following the procedural specifications. Considering the limited use of these lessons by these teachers in 1997, it is expected this use has been of limited proportions.

The findings presented above indicate that moderate to frequent use of student materials (that were available for biology) has been maintained in lessons in 1998 by three teachers (A, D and E). These teachers also provided the materials to their students (complete booklets or copies of pages). Four teachers (B, F, G and I) made reasonable use of the materials, whilst one teacher (C) hardly used them at all. It should be noted that while teachers used the materials with 'hands-on/minds-on' activities, this does not necessarily mean that they did so to promote student involvement in lessons (see also criterion 2).
Only limited long-term use was made of the teacher's guides.

Evaluation criterion 2 ('hands-on/minds-on' activities are used in a student-centred way).

Perceptions of the teachers and their students indicate the following about student-centredness in the teaching *before the intervention*:

- Both teacher A and his students indicated that student centred activities (e.g. practical work and other individual and/or group work activities of students in class) took place regularly in lessons;
- Teacher B, C, D, E, F, G and I also indicated that student centred activities occurred quite often in their lessons, but their students contradicted this.

The perceptions of the students on this matter have been investigated through a questionnaire. Students were asked, before and after the intervention, to indicate how frequent specific student centred activities took place in their lessons on average. The difference between the means of 1996 and 1998 could indicate a change in behaviour of the teachers in terms of student involvement in lessons. These differences have been analysed on significance with the Student T-test. The T-tests have been conducted one-sided, because the expectation is that the intervention has influenced the behaviour of the teachers in the intended direction (i.e. an increased frequency of the student centred activities).
These results are presented in table 6.6 on the next page, and will be further referred to in the text. It has been noted here already that the results indicate a significant increase in student centred activities in lessons - for the teachers on average - from the perspective of the students ($p= 0.00$).

Table 6.6: *Occurrence of student-centred activities in lessons of the case teachers ($N_{96} = 203$; $N_{98} = 400$)*

Student-centred activities	*n*	**Frequency of specific student-centred activities in lessons according to students** [a] A		B		C		D		E		F		G		I		**Average Score**	
		26	*43*	*32*	*74*	*26*	*58*	*33*	*69*	*33*	*65*	*13*	*28*	*16*	*32*	*24*	*31*		
		'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98
Group work	*M*	1.8	1.9	1.4	3.1	1.4	1.7	0.9	1.6	1.5	1.7	1.0	2.1	1.2	1.3	0.8	2.6	1.3	2.2
	Sd	1.2	1.1	0.8	0.9	1.0	0.8	0.4	0.8	0.9	0.9	0.5	0.9	0.9	0.6	0.3	0.8	0.8	0.9
Practical work	*M*	2.6	1.8	1.2	2.1	0.9	1.8	1.0	1.9	1.8	1.9	1.0	2.0	0.9	1.5	0.9	1.9	1.3	1.9
	Sd	1.3	1.0	0.7	1.2	0.4	0.9	0.6	1.0	1.0	0.9	0.7	0.9	0.3	1.0	0.5	1.1	0.7	1.0
Worksheet	*M*	3.2	2.7	1.1	2.1	0.8	1.3	1.4	2.8	1.7	1.5	1.3	2.0	1.4	1.9	1.2	2.4	1.5	2.1
assignments	*Sd*	1.2	1.1	0.7	1.1	0.3	0.6	1.0	1.2	0.8	0.9	1.0	1.0	1.0	1.1	0.7	1.2	0.8	1.0
Doing individual	*M*	3.4	2.9	1.0	1.7	1.0	1.5	2.2	3.2	1.4	2.3	1.8	2.9	2.0	2.8	1.4	2.2	1.9	2.4
assignments	*Sd*	0.9	0.9	0.7	1.1	0.4	0.7	1.2	1.0	0.8	0.9	1.0	0.9	0.9	1.0	1.0	1.0	0.9	0.9
Average	*M*	2.8	2.3	1.2	2.2	1.0	1.6	1.4	2.4	1.6	1.9	1.3	2.3	1.4	1.9	1.1	2.3	1.5	2.1
score	*Sd*	1.3	1.1	0.7	1.2	0.6	0.8	1.0	1.2	0.9	0.9	0.9	1.0	0.9	1.1	0.7	1.1	1.0	1.1
Significance level (1-tailed)		0.99		0.00		0.00		0.00		0.01		0.00		0.00		0.00		0.00	

Note: [a] Figures in the '96 and '98 columns indicate the frequency of occurrence of specific student centred activities on a scale of 1 (occur almost never in a lesson) to 4 (occur almost always in a lesson) according to the students; the '96 figures indicate frequencies before the '97 intervention and are averages of one form 5 class; the '98 figures are averages of two classes.

During the intervention seven teachers (B, C, D, E, F, G and I) practised with exemplary lessons (in which the use of 'hands-on/minds-on' activities was exemplified) as intended, albeit with only one lesson for five of the teachers.
Four teachers (A, B, D and E) successfully promoted student involvement after this practise through the use of 'hands-on/minds-on' activities in both of the observed lessons they had prepared themselves. Two teachers (G and I) managed to do this in one of the observed lessons, albeit in a rather limited way.
The 'hands-on/minds-on' activities were not (successfully) used in a student centred way by the other two teachers (C and F) in their observed self-prepared lessons. These teachers mainly used the student materials to improve their own content knowledge, for their presentations and note giving, and/or for giving homework.
The successes of the teachers in using 'hands-on/minds-on' activities in a student-centred way during and one year after the intervention are summarised in table 6.7 below, and further referred to in the text.

Table 6.7: *Use of 'hands-on/minds-on' activities in a student-centred way by the case teachers during and after the intervention*

Teacher	**# of 'hands-on/minds-on' activities used during the intervention**	**# of observed lessons in which 'hands-on/minds-on' activities were used in a student centred way**	
		During intervention	*After intervention*
A	37	2	1
B	21	2	2
C	14	0	0
D	19	2	2
E	12	2	0
F	12	0	0
G	25	1	0
I	?	1	0

The students of teachers A and B indicated that more student centred activities were used in lessons during the intervention than in previous lessons. The students of the other teachers indicated that they had noted no difference in this regard.

The situation *one year after the intervention* is presented in detail for the case teachers below. The results of students' perceptions that are presented in the text refer to table 6.6 and the results of lesson observations to table 6.7.
There was clear evidence that *teacher A* still made active use of almost all SMART student materials that had been produced in the past (in class and for studying at home) in both classes that were observed. In one of the observed lessons a rather simple 'hands-on/minds-on' activity was successfully used to promote student involvement and active learning. Teacher A confirmed that student centred ways of teaching took place frequently in his lessons. His students indicated that they frequently had to do assignments/worksheets in class, but that practical work and group work was not often done. This resulted in a lower frequency of student centred activities for 1998, from the perceptions of the students, leading to a rejection of the research hypothesis (see table 6.6). The teacher confirmed this as far as practical work is concerned. He had reduced this because there was only one laboratory in the school and the head teacher was not very supportive towards improving this situation. The overall results indicate that the level of student centred teaching did not differ much from what took place before the intervention.
Teacher B only made active use in 1998 of the student materials that were provided in the '97 course. He only bought the materials, and provided these to the students, after the researcher had indicated that he would like to observe his lessons. 'Hands-on/minds-on' activities were successfully used to promote student involvement and active learning in both observed lessons. However, he had not provided students with any of the other student materials with 'hands-on/minds-on' activities for other topics (see also criterion 1). The teacher acknowledged that promotion of student involvement through the use of 'hands-on/minds-on' activities only took place in the teaching of the environmental topics. His students indicated that especially group work often took place in 1998, but that other activities (like practical work) occurred less frequently. Teacher B acknowledged that practical work was a rather rare phenomenon in his lessons. The results indicate that the level of student centred teaching did increase during and after the intervention, but only in the teaching of the environmental topics. When the teachers were asked in 1998 what effect the course had made on their teaching, teacher B was the only one who explicitly mentioned that the course had helped him in developing skills in student-centred teaching methods.

Teacher D made active use of the SMART student materials and managed to promote student involvement through the use of (not very complicated) 'hands-on/minds-on' activities in 1998 in both of the observed lessons. Students indicate that more student involvement took place than before the intervention, but especially through more individual assignments in class (e.g. answering questions from worksheets in class), and not so much through group work and practical work. The teacher disputes this as far as practical work is concerned. The results indicate that the level of student centred teaching did increase in her teaching during and after the intervention.
Teacher E had all the student materials in her possession in 1998. She indicated that she still pursued more student involvement in her lessons through the use of 'hands-on/minds-on' activities. However, in the observed lessons in 1998 no SMART 'hands-on/minds-on' activities were used. Furthermore, only limited active learning was promoted and students were hardly involved and not very co-operative in these lessons. She disagrees with her students who indicate that worksheet assignments, group work and practical work seldom took place in her lessons in 1998. The results indicate that the level of student centred teaching increased transiently in some lessons during the intervention but that this was not maintained in her teaching after the intervention.

In 1998 *teacher C* (mentor for SMART in one of the INSET schools) indicated that only very limited use was made of the available biology student materials with 'hands-on/minds-on' activities. In the observed lessons he mainly lectured and gave notes, as he had done before and during the intervention. Teacher C's students indicated an increase of student centred activities in lessons, albeit still at a relatively modest level. However, teacher C confirmed that student centred activities were rather rare in his lessons. The overall results indicate that the degree of student centred teaching remained very limited in teacher C's lessons during and after the intervention.
Teachers F, G, and I indicated that they still made reasonable use of the materials in 1998. The 'hands-on/minds-on' activities were not (successfully) used in a student centred way by these teachers in the observed lessons. In these lessons, the student materials were mainly used to improve their own content knowledge, for their presentations and note giving, and/or for giving homework, if they were used at all. Teachers F and G confirmed that not much student involvement was successfully promoted in their lessons. Teacher G's students indicated an increase, albeit that the level remained low. Teacher F's students indicated that his teaching

was considerably more student centred - especially more individual assignments in class - than before the intervention. Teacher I, and her students, contradict the results of the observations. Both indicate that more student involvement was promoted in lessons than before the intervention. The overall results indicate that the level of student centred teaching increased only marginally, if at all, in the teaching of teachers F and G during and after the intervention. The situation for teacher I could not be totally clarified to this regard.

The findings presented above indicate that 'hands-on/minds-on' activities have been successfully used to promote student involvement in lessons by teachers, A, B and D. Teachers A and D have adopted this most clearly in a broader way in their teaching. For teacher B the influence seems to have remained limited to the teaching of the environmental topics. The established increases in student involvement in the lessons of teachers B and D are assumed to have been facilitated by the intervention. Taking into account teacher A's frequent participation in previous inservice courses, his successful promotion of student involvement in lessons is considered to have been facilitated by the biology inservice courses he participated in.
The '97 inservice course seems to have aroused an interest in student centred teaching for teacher E, albeit with still limited application in lessons in 1998.
Teachers C, F and G have met with minimal success in promoting student involvement in lessons through the use of 'hands-on/minds-on' activities in lessons before, during and after the intervention. The intervention has had no effect on these teachers in relation to this criterion. This is also expected to be the case for teacher I, although this could not be totally clarified.
Teachers B and D used two or more exemplary lessons to practise the use of 'hands-on/minds-on' activities, whilst teachers C, E, F, G and I used only one. Teacher A made no functional use of any exemplary lesson (see also under criterion 1). It is assumed that exemplary lessons have facilitated the change that has been established for teachers B and D, and to a limited extent for the interest that has been aroused in teacher E.

Evaluation criterion 3 (The teacher involves students in the lesson by applying the question and answer method)

All teachers indicated that questioning and answering took place quite frequently in lessons *before the intervention*. The perceptions of the students on this matter have been investigated by way of a questionnaire. Students were asked, before and after the intervention, to indicate how frequently specific questioning and answering activities took place in their lessons on average. The difference between the means of 1996 and 1998 could indicate a change in behaviour of the teachers in terms of questioning and answering in lessons. These differences have been analysed on significance with the Student T-test. The T-tests have been conducted one-sided, because the expectation is that the intervention has influenced the behaviour of the teachers in the intended direction (i.e. an increased frequency in questioning and answering). The results of students' perceptions that are presented under this criterion are summarised in table 6.8.

It appears that the students of all the case teachers also think that questions were frequently asked in class - by the teacher as well as the students - albeit to a lesser extent for teacher C. The students of all the case teachers, however, indicated that discussions among students (e.g. when doing assignments) were rather rare before the intervention.

Although teachers and students apparently ask questions frequently, this does not necessarily mean that the 'question and answer method' was applied as intended by the designer[4]. The results of the 1997 and 1998 investigations, presented below, indicate that this was probably not the case for at least five teachers.

During the intervention seven teachers (B, C, D, E, F, G and I) practised with exemplary lessons (in which also the application of the 'question and answer method' was exemplified) as intended, albeit with only one lesson for five of them.
Teachers A, B, D and E promoted active involvement of students in the observed lessons in 1997 through regular application of the 'question and answer method'. Also teachers F, G, and I applied questioning and answering in their lessons but succeeded only marginally in promoting student involvement as intended. Teacher C hardly applied the question and answer method to promote active involvement of students in the observed lessons in 1997.

[4] The intentions of the designer in relation to 'question and answer method' have been further specified in behavioural terms for teacher and students in the observation instrument presented in appendix H. See also section 4.2.1 for a definition.

Table 6.8: *Occurrence of questioning and answering in lessons of the case teachers (N_{96} = 203; N_{98} = 400)*

Questioning & answering activities		Frequency of questioning and answering activities in lessons according to students [a]																Average Score	
		A		B		C		D		E		F		G		I			
	n	*26*	*43*	*32*	*74*	*26*	*58*	*33*	*69*	*33*	*65*	*13*	*28*	*16*	*32*	*24*	*31*		
		'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98	'96	'98
Students ask questions	*M*	3.5	3.3	3.8	3.1	3.3	2.5	3.4	3.3	3.7	3.1	2.8	3.1	2.8	2.9	3.1	3.3	3.3	3.1
	Sd	0.8	0.9	0.4	0.8	0.8	0.9	0.8	0.8	0.6	0.8	0.8	0.9	0.9	0.8	0.9	0.9	0.8	0.9
Teacher asks questions	*M*	3.8	3.6	3.8	3.6	2.3	3.4	2.8	3.6	2.8	3.5	3.9	3.6	3.9	3.9	3.6	3.8	3.4	3.6
	Sd	0.5	0.7	0.5	0.7	1.1	0.8	0.9	0.7	0.9	0.7	0.3	0.6	0.3	0.2	0.7	0.6	0.7	0.6
Students discuss together	*M*	1.9	2.4	2.2	2.2	2.2	1.7	1.9	1.6	1.7	1.9	2.2	1.6	1.7	1.9	1.3	2.2	1.9	1.9
	Sd	0.7	0.9	1.1	0.9	1.2	0.8	1.0	0.7	0.8	0.8	0.8	0.9	0.8	1.0	0.6	1.0	0.9	0.9
Average score	*M*	3.1	3.1	3.3	3.0	2.6	2.6	2.7	2.9	2.7	2.9	3.0	2.8	2.8	2.9	2.7	3.1	2.8	2.9
	Sd	1.1	1.0	0.7	0.8	1.2	1.1	1.1	1.2	1.1	1.0	1.0	1.2	1.2	1.1	1.2	1.1	1.1	1.1
Significance level (1-tailed)		0.43		0.88		0.52		0.09		0.15		0.85		0.29		0.01		0.23	

Note: [a] Figures in the '96 and '98 columns indicate the frequency of occurrence of specific questioning and answering activities on a scale of 1 (occur almost never in a lesson) to 4 (occur almost always in a lesson) according to the students; the '96 figures indicate frequencies before the '97 intervention and are averages of one form 5 class; the '98 figures are averages of two classes.

One year after the intervention teachers A, B and D promoted active involvement of students in the observed lessons through regular application of the 'question and answer method'. Teacher E was less successful in this in the observed lessons in 1998. Teachers C, F, G, and I hardly applied the 'question and answer method' in a way that promoted student involvement. However, students of all eight teachers indicate approximately the same frequency of asking questions (of teacher and students) in lessons, as was the case before the intervention. They also indicate that discussions among students related to assignments remained rather rare after the intervention, except maybe for teacher A. The significance level of the Student T-test ($p > 0.01$) indicates a limited change (frequencies not differing very much or even decreasing) for all teachers in questioning and answering during lessons, as perceived by the students (see table 6.8).

The findings presented above indicate that the 'question and answer method' has been successfully applied to promote student involvement in lessons by teachers A, B, D and (to a lesser extent) E. Teachers A, B and D had most clearly integrated this in their teaching on the longer term. It could not be established whether any increase or improvement that had taken place with these three teachers could be attributed to the intervention. Nonetheless, it is assumed that teachers A and D, who had frequently participated in other courses before the intervention, have been influenced by the courses to this respect. Only for teacher D can a facilitating role of the exemplary lessons (albeit limited) be inferred. Teachers C, F, G and I were not successful in applying the 'question and answer method' to promote student involvement in lessons during and after the intervention. The intervention has had no effect on these teachers in relation to this criterion.

Based on the results presented above, the following conclusions can be formulated:

i. Student involvement increased in the lessons of six teachers on the *short-term*, which is assumed to have been facilitated by the intervention (including the exemplary lessons for five teachers). One of these teachers already demonstrated an inclination towards student-centredness before the intervention. This teacher had participated frequently in previous biology inservice courses

ii. Student involvement was definitely maintained in the lessons of three of these six teachers on the *long-term*, and is assumed to have been facilitated by the '97 intervention. The exemplary lessons could have contributed towards this change with two of these teachers.
iii. The three other teachers, who managed to promote some student involvement during the intervention as intended, did not integrate this more broadly in their teaching after the intervention.
iv. The remaining two teachers did not alter their teacher-centred teaching at all during or after the intervention.

In conclusion

The designer's expectations towards effects of the '97 course were as follows:

i. that an interest for student centred ways of teaching would be promoted with inexperienced teachers to the extent that these teachers would use simple 'hands-on/minds-on' activities successfully in a student centred way;
ii. that an interest for student centred ways of teaching would be promoted with experienced teachers to the extent that these teachers would use simple as well as more complex 'hands-on/minds-on' activities successfully in a student centred way.

The expectation for behavioural change of inexperienced teachers has hardly been realised. Only the most experienced of these teachers (D with 5 years of teaching experience) was successful in this. The other inexperienced teachers had rather limited success (G and I) or failed entirely (F) to promote substantial student involvement in their lessons during and after the intervention in the intended direction.

On the other hand, the expectation for behavioural change of experienced teachers has been realised by some teachers. Two of the experienced teachers (A and B) have changed their teaching in a more student-centred direction as intended, but only through using the more simple 'hands-on/minds-on' activities. One of the experienced teachers (E) managed to promote student involvement as intended during the intervention but did not continue with this after the intervention. One experienced teacher (C) was not influenced at all by the intervention and maintained his 'chalk en talk' teaching style during and after the intervention.

The exemplary lessons could have played a facilitating role in the established long-term effects for two teachers (B and D) because these teachers practised with some of these lessons. This cannot have been the case with the third teacher (A) who did not practise with any exemplary lesson in a functional way. The 'hands-on/minds-on' student materials have played an important role in realising the long-term effect in student involvement with all three teachers. These materials have also been important in realising a short-term effect (albeit limited) with three other teachers (E, G and I).

A difference between the short and long-term effects of the intervention can be observed with one teacher (E) who changed her behaviour in the intended direction on the short term but was not able or willing to integrate this more widely in her teaching on the long term. The efforts, albeit with limited success, of two inexperienced teachers (G and I) could also be interpreted as such.

6.4 Other effects of the course

Introduction

Before the intervention, teachers had frequently indicated that there was a lack of support material for the teaching of the environmental topics included in the biology syllabuses in use. In 1996 all science teachers were invited to a seminar to revise the Recommended Schemes in which specific sequences of teaching and time allocation of (sub) topics were recommended for the content of the specific syllabuses. Although the majority of the teachers agreed that the rather generous time allocation of 39 periods (of 40 minutes) should be maintained, because of the importance they attributed to the environmental topics, they also made clear that this could not really be achieved in practice because of lack of support material. Although the recommended textbooks paid reasonable attention to the environmental issues to be covered for the syllabuses, teachers felt this was not enough, or did not know how to use this information in lessons, or were in the situation in which their students did not have a textbook. Furthermore, teachers indicated that there was a need for locally relevant information and for 'hands-on/minds-on' activities on these topics. This request for support formed the basis for the development and collection of the '97 biology student materials.

Because the teachers had indicated that there was a need for the kind of student material that was produced (teachers have also been involved in the testing of the materials), it could be expected that teachers would make active use of these materials and spend more lesson time on the teaching of these topics. Data collection related to the 'teaching of the environmental topics' has taken place before, during and after the '97 intervention in relation to:
1. the time spent on the teaching of the environmental topics;
2. the use of the student materials in the teaching of these topics.

The effect of the inservice course
The results of the investigations related to 'the teaching of the environmental topics' are presented in table 6.9, and further discussed below.

Table 6.9: *Lesson time spent on the teaching of the environment rdated topics, and use made of environment related SMART materials by the teachers before, during and after the '97 intervention*

Teacher	**Lesson time spent on the teaching of the environmental topics** *(in weeks of 6 periods of 40 minutes)* *Before the intervention*	*During the intervention*	*After the intervention*	**# of activities used from the materials in '97**	**Environ-mental materials supplied to students in '98** [b]	**Use made of materials in lessons in '98**
A	2 - 3	8	4 - 5	37	1 & 2	Yes
B	5 – 6	4-5	4	21	1 & 2	Yes
C	3	3 - 4	3	14	2	-
D	3	4 - 5	4 - 5	19	1 & 2	Yes
E [a]	3	3	-	12	-	-
F	2	5 - 6	4	12	1 & 2	Yes
G	-	3 - 5	8	25	1 & 2	Yes
I	5	-	5			

Note: [a] Teacher E did not teach any form 5 classes in '98; when information could not be obtained this is indicated with (-).
[b] The numbers refer to the booklets with student materials for the two environmental topics.

Time spent on the teaching of the environmental topics.
One year after the intervention, teachers A, D and F spent more lesson time on the teaching of the environmental topics than they had done before the intervention (compare columns 2, 3 and 4 of table 6.9). Teacher G had not

taught the environmental topics before he participated in the '97 inservice course. However, he definitely spent ample lesson time on the teaching of these topics in 1998 - almost to the extent that this could be called overdone.
Teachers B, C, E and I did not spend more time on the teaching of the environmental topics in 1998 than they had spent on these before the intervention. Teacher B seemed even to have decreased the time he spent on these topics, but he later denied this.

Use of the student materials in the teaching of the environmental topics.
All teachers made reasonable to extensive use of the environmental related materials during the intervention (see column 5 of table 6.9), although the exact number could not be determined for teacher I.
Teachers A, B, D, F, G and I provided (on their own initiative) the two environment related student materials again to their form 5 students one year after the intervention. With teacher B this might have been induced by the visit of the researcher. In the lessons that were observed in 1998, six of these teachers made use of the 'hands-on/minds-on' activities in some way or another.
Although teacher C indicated that he provided his form 5 students with the second environment related booklet, his students indicated that they had not received this. He was not teaching the environmental topics in the lessons that were observed in 1998. It is expected that limited use has been made of the materials, as was also the case during the intervention.
Teacher E did not have any form 5's in 1998. It is expected that she will use the materials in future again in some way.
All teachers (except for teacher C) had indicated after the intervention in 1997 that they intended to use the 'environment related materials' again in 1998. All of them did this except for teacher C, who did not have the intention, and teacher E who did not teach form 5's in 1998.

Based on the results presented above, the following **conclusions** can be formulated:

i. Four teachers spent more lesson time on the teaching of the environmental topics on the short-term and maintained this on the long term.
ii. All teachers made good use of the environmental related materials during the intervention and at least six teachers maintained this on the long term.

6.5 Conclusions

In chapter 4, results have been presented of participants' perceptions of the '97 course. It appeared that the participants had been very satisfied with the course components. Most participants also indicated that the course had improved their basic teaching skills and had made their teaching more student centred. The results presented in this chapter give a more varied, but also less optimistic, view of the situation based on in-depth studies of eight of the participants.

The intervention has had a facilitating influence on the *basic teaching skills* of 'textbook use' and 'homework giving and checking'. For the textbook, this remained limited to improving frequency of textbook possession by students of half of the teachers, with only one of them starting to promote active use of the textbook by students in combination with reduced note giving. Furthermore, more than half of the teachers gave and checked homework to a reasonable extent as intended, in which the intervention is assumed to have played a reinforcing role. After the intervention, the other teachers paid minimal attention to homework in the way that was intended.
Contrary to what was expected, the intervention has had a rather limited effect in terms of changing behaviour of the teachers as intended in relation to the basic teaching skills of note giving and lesson planning/evaluation. Only one teacher reduced his note giving as intended by the intervention, whilst all the other teachers continued providing their students with 'textbook-replacing' notes after the inservice course. Moreover, only the very inexperienced teachers paid serious attention to lesson planning, but did this in a rather formalistic and prescribed way. The other (more experienced) teachers hardly prepared for their lessons and only briefly reported on what they had done in their lessons if their head teacher required this from them. None of the teachers adopted the more thorough lesson planning deemed necessary by the designers for lessons in which the 'hands-on/minds-on' activities were going to be used.
For the basic teaching skills it is concluded that half of the teachers improved the frequency of textbook possession by students in their classes, which has been an effect of the biology inservice courses in general. Also, homework giving and checking has been reinforced through the biology interventions in general with more than half of the teachers. It is also concluded that the intervention has had a very limited effect on the note giving behaviour and hardly any effect on the lesson planning and lesson evaluation behaviour of the teachers.

The intervention has promoted more *student involvement* as intended with some of the (more experienced) teachers. However, this was not achieved to the extent that these teachers were also able to use complex 'hands-on/minds-on' activities successfully in a student centred way, as had been expected. The other experienced teachers only changed on the short-term or were not influenced at all by the intervention and maintained their 'chalk en talk' teaching style after the intervention.
On the other hand, the intervention was not very successful in promoting an interest for student centred ways of teaching with inexperienced teachers to the extent that these teachers started using simple 'hands-on/minds-on' activities successfully in a student centred way, as had been expected. Only the most experienced of these teachers was successful in this, whilst the other more inexperienced teachers succeeded barely or not at all in this.
It is concluded that the intervention has had an effect in this regard with more experienced teachers, but hardly with inexperienced teachers.

The intervention has also had at least one *additional effect* for which no intended outcomes had been formulated. Four teachers started spending more time on the teaching of the environmental topics and six of the teachers continued making considerable use of the curriculum materials provided for these topics. It is assumed that the fact that teachers had requested for support themselves, in terms of teaching resources, has played an important role in this. It is concluded that the intervention has had a considerable effect on the teaching of the environmental topics.

It is further concluded that observed short and long-term effects of the intervention can be explained through: i) teachers changing their behaviour (only) after the intervention as intended, ii) teachers changing their behaviour in the intended direction on the short term but not being able or willing to integrate this more widely in their teaching on the long term, and iii) Hawthorne effects.

Finally, it is concluded that the contribution of the exemplary curriculum materials towards the established effects can only have been modest, because of the limited practising that took place with the exemplary lessons during the 'try-out' phase in schools. The exemplary lessons can only have played a facilitating role in the established (rather modest) long-term effects for the basic teaching skills of homework and in the established long-term effects towards more student involvement. On the other hand, the student materials with 'hands-on/minds-on' activities seem to have played an important role in realising more student involvement in lessons of some of the teachers.

Possible reasons for adopting or not adopting elements of the intervention by teachers can be:

- the teaching skill (and related change that is required) is not basic in the eyes of the teacher;
- the teacher does not see a need for improvement;
- the teacher perceives that the efforts required for the change outweigh the benefits that can be expected from this;
- the concerns of the teacher related to the change that is pursued by the intervention are not properly addressed in the workshops and/or through the curriculum materials;
- the teacher finds the (internal and/or external) support that is offered in the process of change insufficient.

In chapter 7 the results that have been presented in this chapter are further interpreted for four cases. It will appear that the intended changes in note giving and textbook use indeed asked much more from the teachers than simply mastering some basic skills. Furthermore, lesson planning and homework appear to be of special interest to teachers in certain phases of their professional development. It will also appear that the intended change towards more student-centred teaching was beyond reach for most of the inexperienced teachers. Moreover, it will become clear that a successful change towards more student-centredness by experienced teachers (such as A and B) is quite an achievement in the high schools of Swaziland. That most of the teachers decide not to change in this direction (like experienced teachers C and E) will become more understandable. It must be noted here that this latter group is underrepresented amongst the eight selected cases.

Chapter 7
Results of the interpretive study

This chapter describes the outcomes of an interpretive study that seeks to gain understanding on what made teachers implement or not implement certain elements of the inservice intervention. For this purpose the outcomes of the evaluation study are further interpreted by drawing inferences from the data that were collected on teacher, student and school characteristics for eight teachers who participated in the inservice course. For four of these teachers, interpretive case descriptions are worked out in more detail. After an introduction in section 7.1, the results of the interpretive investigations are presented in sections 7.2 to 7.5. The results of a cross-case analysis are presented in section 7.6.

7.1 Introduction

The findings presented in the preceding chapter clarified that the effects of the inservice course differed considerably among teachers. Furthermore, it appeared that there were considerable differences in how teachers integrated the curriculum materials (i.e. exemplary materials and student materials) of the inservice course in their lessons in the 'try out' phase of the intervention. Thus, the intervention had successes (albeit modest) in changing basic teaching skill related behaviour of inexperienced target group teachers as intended, but effected only minimal changes towards more student-centredness with this group. Some of the more experienced teachers, on the other hand, achieved an impressive level of student involvement in their lessons after the intervention, whilst others hardly changed. The investigations in 1998 were therefore also geared to gaining an understanding of what made teachers implement or not implement certain elements of the intervention.
Data collection - based on which the effects of the course could be interpreted especially from the meaning perspective of the teacher - has taken place as outlined in sections 5.4 and 5.5. These data have been analysed as clarified in section 5.6, answering the following research questions:

1. *How can the effects of the inservice course on the teaching behaviour of individual teachers be interpreted?*
2. *How can differences in effects between these teachers be interpreted?*

To further guide the analysis, more specific interpretive questions have been formulated which evolved from some of the conclusions drawn in chapter 6. These questions are presented in Box 7.1 below.

Box 7.1: Interpretive questions derived from conclusions of the evaluation study

Conclusion I
Contrary to what was expected, the intervention has had a rather limited effect in terms of changing behaviour of the teachers as intended in relation to the *basic teaching skills* of note giving, and lesson planning/evaluation. Yet, the intervention has had an influence (albeit modest) on the basic teaching skills of textbook use and homework giving and checking, as expected.

Interpretive questions:
1. Why did/didn't teachers reduce their 'textbook-replacing' note giving as intended by the intervention?
2. Why do inexperienced teachers embark on lesson planning while hardly any lesson planning is done by experienced teachers?
3. What motivated teachers to realise a situation in which all students possessed a good textbook?
4. Why did/didn't teachers promote active use of the textbook by students as intended by the intervention?
5. Why did/didn't teachers give and check homework as intended by the intervention?

Conclusion II
The intervention has promoted more *student involvement* as expected with three (more experienced) teachers. Contrary to what was expected, this was mainly realised through the use of simple 'hands-on/minds-on' activities. Also contrary to what was expected, student involvement has hardly been promoted with inexperienced teachers. The *student materials* with 'hands-on/minds-on' activities have played an important role in realising the effects in student involvement.

Interpretive questions:
1. Why didn't inexperienced teachers promote student involvement as intended?
2. Why did/didn't experienced teachers promote student involvement as intended?
3. Why did some teachers (try to) promote more student involvement on the short-term, but did not continue with this on the long-term?
4. Why were the more complex 'hands-on/minds-on' activities hardly used in lessons?
5. What made the student materials attractive for the teachers to the extent that they used these to promote student involvement in their lessons?

Based on characteristics of the teachers and the evaluative findings presented in chapter 6, the case teachers can be categorised in four groups as follows:

1. The *'inexperienced survivor'* (teachers F, G, H and I).
   These teachers hardly changed their behaviour towards more student involvement in their lessons. They changed their behaviour in the intended direction as far as 'basic teaching skills' are concerned, albeit to a limited extent. All of them had 'survival problems', e.g. in terms of workload, class control and adaptation. Complete data collection has not taken place for teacher H, for reasons explained in chapter 5. The fact that he did not want to participate anymore in the research in 1998 was presumed to be strongly related to the problems he experienced as a novice in the profession.
2. The *'pragmatic adjuster'* (inexperienced teacher D and experienced teacher B).
   These teachers adopted a more student-centred teaching style to some extent as intended. They did not change their behaviour in relation to 'basic teaching skills' in the intended direction, or only to a limited extent. These teachers had already gained considerable confidence in their teaching to the extent that they were able to make the (often pragmatic) adjustments in their teaching they deemed fit.
3. The *'revolutionary changer'* (experienced teacher A).
   This teacher moved towards more student involvement in his lessons almost as intended. These changes, however, were rather radical for himself and for his students. The teacher also made adaptations in his teaching, as intended, in relation to 'basic teaching skills'.
4. The *'experienced talker & chalker'* (experienced teachers C and E).
   These teachers stuck to their teacher-centred style of teaching. They did not, or hardly, move in the intended direction of 'student involvement in lessons'. These teachers also hardly changed their 'basic teaching skill' related behaviour.

Teachers A, C, D and F have been chosen as cases in this chapter, because they form the most informative examples to illustrate these four categories. Detailed interpretive descriptions are provided for these cases in sections 7.2 to 7.5. Each section starts with some background information on the teacher, his/her students and school. This is followed by an interpretation of the effect that the inservice course has had on the teacher, based on the teacher's own perspective and based on inferences drawn from the data by the author. The interpretive questions presented in Box 7.1 have been used to further guide the presentation of the four cases. Each case description ends with some concluding remarks. This chapter ends with a presentation of findings of a cross-case analysis in section 7.6.

7.2 Case: 'the inexperienced survivor'

7.2.1 Teacher, school and student characteristics

Teacher F was a 26-year-old Swazi male who had just started a two year part-time PGCE course (see section 2.2.3) in 1997 to obtain his teaching qualification. He had already been teaching as an unqualified teacher for three years. Teacher F belonged to the target group of the SMART inservice and had already participated a few times before in the biology courses. He participated in two units of the '97 course and used a reasonable number of 'hands-on/minds-on' activities from the student materials in lessons in the 'try out' phase. He only used one exemplary lesson as intended.

He taught in a small rural government school, in which 15 teachers were employed. Formalistic teacher-centred teaching was the norm amongst staff. Although the head teacher was focused primarily on her administrative duties, she showed an - more than average - interest in the SMART inservice courses, seeing to it that her teachers participated and reported back to her. The head teacher and head of department always allowed teacher F to buy student materials. Teacher F was the only biology teacher in the science department, which had reasonable laboratory and copying facilities. He sometimes talked about teaching issues with his head of department, and mentioned specifically his class control problems in this regard.

There were 15 students in his observed form 5 biology class in 1997 and 13 in 1998. The biology examination results of his school were quite good (varying between 60 to 90% passing rate between 1996 and 1998) compared to the average year results for all schools in the country (see figure 2.2).

7.2.2 Interpretation of the effect of the course

Teacher F indicated in 1997 that the inservice course had made a considerable positive impact on his teaching and that the students had gained from the student materials. When asked in 1998 to summarise in a few sentences what the (overall) effect of the biology inservice had been on his teaching, he answered as follows:

"It has improved my teaching a great deal. I can now handle some topics more confidently than before I went to the inservice"

Basic teaching skills

Being a typical target group teacher, the expectation was that teacher F would feel a need to enhance basic skills that could improve his teaching. This appeared to be true for homework giving/checking and textbook use, but much less so for the other basic teaching skills that were addressed in the course (lesson planning and note giving). This is further discussed below for each skill.

Teacher F's *lesson planning* in 1997 and 1998 was reasonably in line with what was intended through the intervention. This appeared not to be an effect of the intervention. The PGCE course, in which teacher F participated in 1997/98, required that he adopt a format for his lesson planning which was much more detailed than what the school normally required from him. Document analysis confirmed that teacher F still prepared his lessons like this in 1998 when he already had finished the PGCE course.

Yet it was not clear whether teacher F would continue with his detailed planning for long. In 1998 he was already considering stopping with the PGCE way of scheming because it took too much time and paper in his opinion. In fact, he did not see the need for such detailed scheming, as SMART also proposed through its topic schemes. And, although he said that he would continue with the detailed lesson planning - because he was convinced that it was essential for good teaching - the fact that he mentioned that it would not look good if he would stop with this immediately after the PGCE course, did not auger well for his tenacity in this respect. Nonetheless, it might very well be that teacher F will continue with this kind of lesson planning for some time. Especially for starting teachers, lesson planning is often a must in order to survive in the profession. And although teacher F was not a complete novice in the profession, he embarked in 1997 (not completely voluntarily) on new ways of teaching, and therefore made lesson planning a must. Another reason for teacher F to be serious about lesson planning was the fact that he still was on probation in his school. Probationary teachers had to be checked more frequently by school administrators, according to the school regulations, and his head teacher happened to be rather strict in this.

Teacher F was clearly too preoccupied with his new 'PGCE-type' of lesson planning during the intervention, which more or less was forced upon him, to be bothered by the 'SMART-type' of lesson planning. Furthermore, he seemed more interested in gaining structure and control in his lessons through planning than in reaching learning targets, as was pursued by the 'SMART-type' of lesson planning.

Teacher F's *note giving* of was comprehensive and detailed before the intervention, and before participating in the PGCE course. During the intervention he gave no notes at all, because he thought that this was expected from him when he enrolled in the PGCE course. In 1998 he still gave no notes during his lessons. The observed change cannot be attributed to the intervention and was also not in line with what was intended.
Teacher F encouraged his students to jot down notes themselves during lessons, and convert these to what he called 'proper notes' after lessons, using their textbook and other resources. He knew that many of his students were unhappy with this situation. He therefore, eventually, gave them his notebook now and then to copy notes after lessons. This radical change has definitely been tough for teacher F as well as his students. Nonetheless, after the PGCE course (and the intervention) teacher F indicated in 1998 that he was convinced that no, or limited, notes were better for the students because: i) students should listen and gain understanding during lessons, and ii) students should learn from the textbook instead of transcribing it.
All his students were in possession of a recommended *textbook* before during and after the intervention, which is assumed to have been facilitated by teacher F's participation in the biology inservice courses. Most of his students took the textbook to class during the intervention, but considerably less did this after the intervention. The textbook was seldom actively used in class. Because hardly any notes were given, the teacher had forced his students to study from their textbook. His form 5 class confirmed that this was the situation. His relationship with these students was rather tense in 1998. They clearly did not appreciate the alternative he offered for the notes they used to get. Surprisingly, his form 4 class indicated that their notes were their number one source to study from, which could indicate that they had obtained notes (outside lessons) more frequently than teacher F mentioned.
Teacher F gave the following reasons to promote students to use their textbook: i) it is prescribed by the school administration, ii) to develop a culture of reading, and iii) to make students use other resources than only notes. The first reason indicates that the school administration has also played an active role in realising the good textbook situation. Teacher F clearly had problems in achieving the other two purposes mentioned above.
It is clear that teacher F had not yet totally abolished note giving in his mind, as well as in practice. A return to elaborate note giving is not unthinkable in his circumstances (considerable pressure of students being an important factor) and might have already started in 1998.

Teacher F assigned and checked *homework* to a considerable extent - as intended - before, during and after the intervention. Because of his participation in previous biology inservice courses, it is assumed that the courses have contributed to his 'homework giving and assigning' behaviour. No doubt also the PGCE course in which he participated as well as the head teacher of the school, who saw to it that homework was regularly marked, have reinforced this behaviour.
As main reasons to take homework seriously he mentioned: i) to ensure that pupils understand things, ii) to check whether they have done it correctly, and iii) for better and more learning.
His students regularly complained that the homework was too much and/or too difficult. It frequently occurred that students had not finished their homework, which annoyed the teacher a lot. Through the homework he felt more in control of the students and their learning, which diminished if students did not take his assignments seriously. He did not really listen to their complaints.

Student involvement
The expectation was that also very inexperienced teachers, like teacher F, would be interested in promoting student involvement - especially through the use of relatively simple 'hands-on/minds-on' activities. This expectation was not fulfilled. This young teacher had already adopted a teacher-centred style before the intervention (and before the PGCE course), which did not change in a more student-centred direction, during or after the intervention. The intervention has had no effect on teacher F in the intended direction.

Teacher F possessed half of the available SMART biology student materials one year after the intervention, but used these mainly to prepare for his lessons and/or as resource for homework assignments. In his lessons he mainly lectured with very little interaction with students, often limited to correct student behaviour, if necessary. When asked why he did not try to involve his students more actively in his lessons, he initially gave the following reasons: i) time constraints, ii) limitations in science equipment and material, and iii) no lab assistant. He later agreed that teacher-student relations could also have been a limiting factor. From the observations in class it had already become clear that the relation between teacher F and his students was rather tense. He was unhappy that his students did not behave or respond as he wanted in the observed lessons. In fact, he blamed his students for what he saw as an exposure of failure in his teaching, and could at times become very agitated during lessons.
Teacher F's students, of the form 5 class that was observed in 1997, were shy and

hardly dared to respond to the occasional question (often asking for recall) of their often impatient teacher. Surprisingly, the students indicated that they found the lessons better and more enjoyable on average during the intervention, compared to the lessons they had experienced before. Yet, some made clear that they still were not satisfied:
"The lessons were partly boring since we were not doing activities ... we only listened to the teacher and read our text which was boring"

The students were especially positive about the student materials and some of them expressed this as follows:
"The booklets assist the students to gain more information and to understand the topics better ... they act as our notes and contain some questions which help us revising ... also every straightforward information is found there ... in this way a student can do without a teacher as the booklets make everything to be clear"
In these comments some discontentment seems to surface regarding the support the students received from their teacher, who had suddenly ceased giving notes to them after he joined the PGCE course. In 1998, his form 5 class was significantly less docile when observed. Whilst the majority of the students of the 1997 form 5 class had a higher preference on average for more teacher centred activities, the 1998 form 5 class - that had been exposed longest to the 'no note giving/only lecturing' style - had a clear preference for more student centred teaching, which seemed to be more a signal of protest. The new form 4 class that was observed in 1998 - and which had been provided with some notes again - indicated a higher preference on average for more teacher centred activities.

Teacher F had radically changed his teaching after he enrolled in the PGCE course, which was most pronounced through his total abolition of note giving. This drastic change was not easy for both the teacher and his students. The teacher had problems with filling the gap in his lessons that was normally occupied with note giving. He mainly replaced the 'chalk' through 'talk', at the same time expecting that his students should write their own notes. The students clearly were unhappy with the sudden lack of support and increasingly rebelled against it, which gradually forced teacher F to provide them with some notes again outside lesson time. The teacher was clearly not in a position at this stage to appreciate the alternative that had been offered to him through the intervention. It appeared totally unrealistic to expect a change towards more student-centredness from this teacher, because this would mean another (for him definitely not simple!) change in an already turbulent situation.

7.2.3 In conclusion

Teacher F planned his lessons and paid attention to homework, already to a reasonable extent as intended, before the intervention. The fact that he was compelled to make drastic changes in his teaching, after joining a part-time professional training course, had made lesson planning and homework essential (as well as compulsory) elements to regain structure and control in his lessons. The intervention has had a reinforcing influence here.
The most drastic change in teacher F's teaching was that he completely stopped with note giving, which he thought was expected of him after joining the PGCE course. This more or less mandated adaptation meant a major change in teaching style, which was tough for both teacher F and his students. The most urgent problem for the teacher at that time was how to fill lesson time. He simply reduced his usual teaching style of lecturing and note giving to only lecturing. Teacher F has not really considered the alternative of reduced note giving, presented to him through the intervention. He seemed to be more interested in appeasing his PGCE tutors than in critically thinking about viable options for his own situation. That all students possessed a good textbook was mainly realised through school policy, with some reinforcement by the PGCE course and SMART inservice. The sudden change from studying 'textbook-replacing' notes to studying from the textbook was not appreciated by his students. The fact that the teacher had started giving notes again to students in 1998, albeit outside lessons, seems to indicate that this (more or less enforced) change might be of a temporary nature.

Teacher F never considered to fill the gap that arose in his lessons - because of 'no notes' - with more student centred activities, as pursued by the intervention. Teacher F simply did not see this as an option in his situation. He struggled gaining control over his teaching again, and the last thing he was interested in was to experiment with new ways of teaching in which students had a more central role. It was therefore unrealistic to expect that teacher F would show an interest in more student centred teaching to the extent that he would implement this. He clearly had other things to worry about, for which he would have appreciated more support. The main support he received from the intervention was through the student materials, which he mainly used to prepare for his lectures and to offer as an alternative for his notes to his students.

7.3 Case: 'the pragmatic adjuster'

7.3.1 Teacher, school and student characteristics

Teacher D, a 29-year-old Swazi female, was a fully qualified biology teacher with five years of experience. She (only just) belonged to the target group of the SMART inservice and had already regularly participated in the biology courses. She participated in all units of the '97 course, practised with two exemplary lessons (as intended) and used a considerable number of 'hands-on/minds-on' activities from the student materials in lessons in the 'try out' phase.
She taught in a relatively big government school near a city (and close to the SMART centre) in which 66 teachers were employed. Formalistic teacher-centred teaching was the norm amongst staff. The head teacher and deputy of the school were mainly concentrating on their administrative duties, and hardly guided and monitored the quality of management and teaching in the departments. The school administration did neither stimulate nor discourage teacher D from participating in the SMART inservice courses. Teacher D was head of the science department in which three other biology teachers were employed. The department had reasonable laboratory and office facilities. Being head of department, the likelihood of further transfer to other teachers seemed promising.
There were 35 students in her observed form 5 biology class in 1997 and 30 in 1998. The biology examination results of her school were quite reasonable (varied from 50 to 65% passing between 1996 and 1998) compared to the average year results for all schools in the country (see figure 2.2).

7.3.2 Interpretation of the effect of the course

Teacher D indicated in 1997 that the inservice course had made a considerable positive impact on her teaching and that the students had benefited from the student materials. When asked in 1998 to summarise in a few sentences what the (overall) effect of the biology inservice had been on her teaching, she answered as follows:
"To give students exercises/learning activities in almost every lesson" and "to give students homework almost every day"

Basic teaching skills

Being a target group teacher (albeit at the more experienced end with five years of experience already), the expectation was that teacher D would feel a need to enhance basic skills that could improve her teaching. This appeared to be only true for homework giving and checking, but hardly for the other basic teaching skills that were addressed in the course (lesson planning, note giving and use of textbook). This is further discussed below for each skill.

Teacher D's *lesson planning* was almost as intended during the intervention. However, this appeared to be a 'Hawthorne effect'. The intervention appears to have had no long-term effect on her in this respect.

In the last interview, teacher D revealed that she had spent a lot of time on lesson planning only in her first years of teaching. In her mind, lesson planning was clearly something that only inexperienced teachers do. She confided that her lesson planning had been mainly administrative in nature, i.e. as required by the school administration (see 6.2.4). In practice, her 'planning' mostly boiled down to recording what had been done in a lesson after it had been taught. This means that teacher D had already adopted a repetitive pattern, teaching lessons she had planned for in her first years of teaching.

Surprisingly, there was also almost no indication of purposeful planning for lessons in which new 'hands-on/minds-on' activities were used. She used these activities based on some kind of gut feeling that these were useful. The fact that she was reasonably successful in promoting student involvement through the use of these (albeit relatively simple) activities, without spending much time on preparation, could be a reason for her not to bother too much about planning. However, she was not always successful. She even acknowledged that better lesson planning (especially for new lessons) would improve her teaching. Yet, she clearly was not convinced that the quality of her teaching would improve in such a way or to such a degree that it would be worth the effort asked for in the inservice course. Also because her exam results were quite reasonable compared to other schools, there was probably not much need, in her mind, to increase her planning efforts and base this on clear learning targets.

The *note giving* of teacher D was quite comprehensive and detailed before the intervention. She reduced it considerably during the intervention (again presumably a 'Hawthorne effect'), but returned to her usual 'textbook-replacing' note giving after the intervention. Thus, the inservice course has had no long-term effect. Teacher D did not have her notes written down in a notebook as most teachers do, but instead used texts from different textbooks to dictate from. It comes as no surprise that most of her students indicated that these notes were their most important source to study from.

The teacher indicated that she would like to transition to giving more summarising notes, but that this was not possible because not all of her students had a *textbook*. Yet, although very few of teacher D's students had a textbook before the intervention, all her students appeared to have one in 1998. The teacher appeared not to be aware of this, and the school administration together with the students are assumed to have been the driving factors behind this. Nonetheless, the textbook situation was definitely not optimal yet in 1998. The students had various and not recommended textbooks whilst the teacher hardly promoted the use of the textbooks by students. In the last interview in 1998, teacher D maintained that she really wanted to promote more active use of a good textbook by her students in order to reduce the amount of note giving and engage in more student centred activities in lessons. However, thus far teacher D had not done much herself to improve the textbook situation in the intended direction.

The changes in note giving (in combination with more active use of the textbook) were clearly perceived by teacher D as too radical a change in her teaching behaviour, despite the fact that she had expressed an interest in promoting more active learning by students. Providing students with 'textbook-replacing' notes was something she always experienced as normal when she was a student herself, was still the norm in her school and department, and was something she had always been practising as a teacher. A textbook could even be seen as redundant in such situations because it could only undermine the teacher's authority. Through the intervention she probably became aware of the problems she and her students might encounter if she would change her teaching as intended. It is clear that the inservice course has not adequately addressed teacher D's concerns related to the changes (*Do I want this? Can I do this?*) that were aimed for in her note giving and use of the textbook. Expecting an intervention to change something so fundamental in her teaching and her environment was clearly not realistic for teacher D. So it is not surprising that she stuck to her way of note giving and did not make much progress towards more active use of a textbook by students.

Teacher D assigned and checked *homework* more or less as intended before, during and after the intervention. She indicated that the inservice courses had especially assisted her in doing this in a way that was successful for her. Because of her frequent participation in the biology inservice courses, it is assumed that the courses indeed have contributed to her 'homework giving and assigning' behaviour.

Teacher D did not only give and check homework because the school required her to do so (see 6.2.3). Her reasons for taking homework seriously were: i) to make students take learning more seriously, ii), because she expected better results which would be beneficial for the students, and iii) to train students in writing tests and answering questions. She did not consider it too great a burden, because she did not do much marking of homework herself. She found a pragmatic solution that satisfied the school administration and saved her time: she let her students mark their homework during lessons.

Teacher D felt more in control of the teaching-learning process through the element of homework. It was an important means for her to gain confidence in teaching and control over students (and their learning). She welcomed ideas and ways to improve on this, which did not require much extra time investment outside lessons, as promoted through the inservice courses in which she participated.

Student involvement

The expectation was that inexperienced teachers, like teacher D, would be interested in promoting student involvement, especially through the use of relatively simple 'hands-on/minds-on' activities. The '97 inservice course was indeed reasonably successful in this respect with teacher D. She had a predominantly teacher-centred style before the intervention, but changed in a more student-centred direction during and after the intervention. Student involvement was mostly promoted through individual assignments in class (e.g. answering questions from worksheets in class), and not so much through group work. The intervention had a (long-term) effect on teacher D in the intended direction.

Teacher D possessed all the available SMART biology student materials one year after the intervention. She clearly enjoyed the experiences in promoting more student involvement. She indicated that she wanted to continue pursuing more student involvement in her classes because: i) it led to better learning, and ii) it gave her more professional satisfaction.

Teacher D's students were active and responsive - in general - in the observed lessons. They indicated that they found the lessons during the intervention better and more enjoyable on average, compared to the lessons they had experienced before. Quite a few students expressed this in words:

"We have to write fewer notes since the booklets provide us with the information needed... the booklets provide exercises thus promoting the understanding of the topic... it was fun being taught in this manner... I am very much helped, the worksheets assist us a lot because they add more information to the notes the teacher gives us"

Students who were less satisfied did not elaborate on the reasons for their dissatisfaction.
Surprisingly, the majority of these students indicated a higher preference on average for more teacher centred activities after the intervention. So although many students found the changes in teaching appealing, they still seemed to prefer the old ways of 'spoon-feeding'. The two classes that were observed one year after the intervention, however, were significantly more in favour (on average) of more student centred activities. This could indicate that the majority of these students gradually had accepted more student centred ways of teaching, after the teacher had integrated this more broadly in her lessons.

Teacher D favoured mainly simple 'hands-on/minds-on' activities to pursue more student centred teaching, which in her opinion did not require much preparation time. And, although better preparation might have improved the quality of the lessons, she nonetheless realised a situation in which students were more actively involved in her lessons. The fact that many of her students enjoyed this, and even indicated that this was an improvement, also gives an indication of her success in this respect. Yet, at the same time she maintained her teacher-centred strategy of spoon-feeding her students with her 'textbook-replacing' notes. At this stage, this probably was the most realistic, and least problematic, way to adjust something in her teaching for which she had developed an interest. Although she recognised the contradiction in what she pursued, and indicated that she might want to change this in future, she clearly was not ready to face the practical implications of this yet.

7.3.3 In conclusion

The attention that has been paid in the inservice course to the basic teaching skill of lesson planning has clearly not been experienced as useful by teacher D. The intervention did not convince her that the intended improvements in lesson planning were worth the proposed effort. On the other hand, teacher D appreciated the attention that was paid to the basic teaching skill of homework.

The inservice course clearly addressed a personal professional development need here, probably because paying attention to homework helped her to be more in control of the teaching-learning process.
And, although teacher D showed an interest in reducing her note giving and making more active use of the textbook, she did not make any changes here. The intended changes in note giving and textbook use were clearly too far removed from her daily reality of teaching. Although an interest might have been aroused, the support provided through the intervention was too limited to take it any further in an environment that did not really stimulate such a change. For her, this change was not basic at all, but moved the fundaments of her teaching.

Taking into account the rather limited effects on her basic teaching skill related behaviour, it seems surprising at first sight that a considerable change has occurred in student involvement in her lessons. This was considered more challenging, by the designers, than improving the basic teaching skills. She even integrated certain 'student-centred' elements in her teaching on the long term. Of course, she already had five years of experience, and the fact that she did not need to invest very much in this - in terms of time, energy, money and/or obtaining support - to make it a success for her, will also have played a role in this. Also conducive will have been the fact that many of her students were quite positive about the change.
But, it must have been the inservice course that has adequately addressed teacher D's concerns (informational, personal and management related) for the intended changes towards more student involvement in lessons, making one of the main design principles of the course successful. She definitely knew what the intended change was all about, had developed an interest in this, and managed to apply this in her lessons. The 'easy to use' student materials have been instrumental in promoting more student involvement in teacher D's lessons. Her moderate practising with exemplary lessons is expected to have played a facilitating role (albeit not optimal) by showing her how to promote student involvement in lessons and how to give and check homework.
Teacher D indicated that she (as head of department) frequently discussed teaching matters with the other teachers in the department. This appeared to be mainly related to administrative issues, such as the setting of internal exams. She also encouraged teachers in her department to participate in SMART inservice, but had not yet been very successful in this. Professional development was a rather individual affair in teacher D's school, and governed by mainly pragmatic criteria in case of teacher D.

7.4 Case: 'the revolutionary changer'

7.4.1 Teacher, school and student characteristics

Teacher A, a 30-year-old Swazi male, was a fully qualified biology teacher with seven years of experience. He therefore did not really belong to the target group of the SMART inservice. Teacher A had often participated in the biology inservice courses before. He participated in all units of the '97 course and used a considerable number of 'hands-on/minds-on' activities of the student materials in lessons in the 'try out' phase. However, his use of the exemplary lessons was not as intended.

He taught in a rather small rural mission school for girls, in which 17 teachers were employed. Formalistic teacher-centred teaching was the norm amongst staff. The head teacher and deputy of the school were mainly concerned with their administrative duties, and hardly guided and monitored the quality of management and teaching in the departments. Nonetheless, the head teacher always allowed teacher A to participate in the SMART workshops and to sell the student materials to the students. Teacher A was the only biology teacher in the science department. He never talked about teaching with colleagues. The department had limited laboratory facilities, but reasonable office facilities.

There were 55 students in his observed form 5 biology class in 1997 and 33 in 1998. The biology examination results of the school dropped from 72% pass in 1996 to a staggering low of approximately 25% pass in 1997 and 1998. This precipitous fall happened after the school had decided to let all students enrol in biology and not offer a 'soft science' option anymore (see 2.3.3).

7.4.2 Interpretation of the effect of the course

Teacher A indicated in 1997 that the inservice course had made a considerable positive impact on his teaching and that the students had benefited from the student materials. When asked in 1998 to summarise in a few sentences what the (overall) effect of the biology inservice had been on his teaching, he answered as follows:

"It made my teaching easier" and "some of the teacher's guides had clear guidelines to be followed".

Basic teaching skills

Not being a target group teacher, the expectation was that teacher A's interest for enhancing basic teaching skills would be limited. This appeared only to be true for lesson planning. He was interested in making improvements and/or changes related to homework, note giving and textbook use as intended. This is further discussed below for each skill.

Teacher A's *lesson planning* was not as intended during and after the intervention. The intervention had no effect on teacher A in this regard.

In the interview in 1998, teacher A made clear that he only did the scheming and lesson preparation that was required by the school administration. After some probing, he conceded that this lesson 'preparation' in most cases boiled down to reporting afterwards what had happened in the lessons. The main reason he gave for not paying much attention to lesson planning was that he did not see the need for this after so many years of experience. And this made sense, when he added to this that he mostly repeated what he had done in lessons the year before. He only engaged in serious lesson planning in his first years of teaching.

He initially indicated that better lesson planning would lead to better teaching in his opinion, and maybe to better examination results. However, he did not want to make the effort because he felt that the environment was not conducive for this. He was very disappointed with the biology examination results of his students, although this was more related to poor selection/streaming practices of the school (see also section 2.3.3). He blamed the school administrators for the poor results because they neglected the science department in his eyes, which frustrated him. He also blamed the government because they did not take the teachers seriously and did not do anything to improve the situation in the schools in Swaziland.

From this background, teacher A indicated that he liked the SMART student materials because these enabled him to make his lessons better and more attractive without requiring too much from him in terms of lesson planning. He was clearly more interested in realising greater student involvement then in reaching specific learning targets.

The *note giving* of teacher A was already not very extensive before the intervention, it stopped totally during the intervention, and was quite close to what was intended after the intervention. The intervention has had a long-term effect on this teacher in this regard. Teacher A had a clear interest in promoting

more student involvement in his lessons, and seemed to have come to the conclusion at a certain stage that extensive note giving in lessons does not combine very well with a strategy of promoting student involvement. In 1998 he had adopted a more student centred teaching approach, in which limited lesson time was spent on note giving whilst the use of the textbook by students was promoted. The teacher gave summarising notes, and wanted to continue with this, because in his opinion: i) the students expected this, ii) it was the tradition in school, iii) it is a good strategy to assist students in this way, and iv) it is not useful to give detailed notes when students have a good textbook.
All students had a good *textbook*, took it to class, and it was referred to in class for explanations and homework. Also, this situation is assumed to have been facilitated by the biology inservice interventions. Teacher A wanted to improve the use of the textbook by students because he considered it their main information source and more important than their notes. Both teacher and students initially seemed quite happy with this situation.
Important factors in this success of the inservice intervention are assumed to be: i) teacher A's motivation for change, ii) the tools (i.e. use of textbooks and student materials) that were provided to him through SMART to realise the change, and iii) his frequent participation in the inservice courses.

Teacher A assigned and checked *homework* to a considerable extent as intended before, during and after the intervention. Because of his frequent participation in previous biology inservice courses it is assumed that the courses had contributed to his 'homework giving and assigning' behaviour.
As main reasons for regularly giving and checking homework he mentioned: i) to make sure that students do the work, and ii) it is a good time investment.
Teacher A was an experienced teacher who valued interaction with his students and felt confident in this. He did not treat homework as an instrument to get control over the students and their learning; he was reasonably in control of the teaching-learning process already. Through homework he felt that he could maintain his grip on the process, mainly because students did work he had assigned them to do. This also facilitated students being more involved in lessons, which he found very important. Yet, he did not use the instrument of homework for formative evaluation of progress in learning of individual students, as had been introduced in another inservice course in which he had participated. Reasons similar to those mentioned for not embarking on lesson planning as intended are suspected to have played a role here as well.

Student involvement

The expectation was that teacher A, being an experienced teacher, would be interested in promoting student involvement through the use of relatively simple, as well as more complex, 'hands-on/minds-on' activities. The '97 inservice course, together with previous courses in which he participated, were indeed reasonably successful when it concerned use of simple activities to promote student involvement. The more complex activities were not used, however, or when used led to disappointing results. Student involvement was mostly promoted through individual assignments in class (e.g. answering questions from worksheets in class), but also through group work. The interventions had a considerable (long-term) effect on teacher A in the intended direction.

Teacher A possessed almost all the available SMART biology student materials when visited one year after the intervention. He clearly enjoyed teaching most when a lot of student involvement was realised. He indicated that he found it important to promote more student involvement in lessons because: i) students were more involved and really did things in lessons, which he liked, and ii) it promoted better learning: pupils grasped things faster, whilst with only listening they quickly forgot. The student materials helped him because they contained assignments that his students could manage.

Teacher A's students were generally active and responsive in the observed lessons. They indicated that they found the lessons during the intervention better and more enjoyable on average, compared to the lessons they had experienced before. Quite a few students expressed this in words:

"Through the booklets we could do role-play and fieldwork which is really practical to us as students... the booklets make it easier to understand rather than only our textbook... the booklets were simple... the booklets provided us with drawings that would make us understand more easily than the teacher talking and giving us notes"

Students who had been less satisfied did not elaborate on the reasons for this. Whilst the majority of his students expressed a greater preference - on average - for more student centred activities during the intervention, this surprisingly had changed considerably to a preference for more teacher-centred teaching one year later. This seems to indicate that the students were considerably less enthusiastic about the student centred ways of teaching of their teacher on the longer term. The fact that the examination results had been very low in 1997 and 1998 might have played a role in this.

The change that teacher A realised towards more student centred teaching in combination with limited note giving, can be seen as revolutionary in his school and for any other high school in Swaziland for this matter. He enjoyed this kind of teaching very much, and initially this also seemed to be the case with his students. The poor exam results disappointed him and his students, and no doubt also worried the school administrators. There were already clear signs of frustration on the part of teacher A in 1997 (see above). When students would also become less enthusiastic about his approach, this frustration could easily grow, which could ultimately lead to him leaving the teaching profession, like so many have done before him. As mentioned before, the poor biology exam results of teacher A are thought to have had little to do with the quality of his teaching. The majority of the students in his class should have not been offered the option of biology because they were academically too weak for this. SMART advised the school to include the subject combined science as a 'soft science' option in their curriculum, as well as on criteria for selection for the science subjects. This advice was followed and implemented in 1998. This might stimulate teacher A to continue. Yet, he found the prospect of having to teach a lot of combined science not very appealing.

7.4.3 In conclusion

Teacher A has not experienced the attention, which has been paid to the basic teaching skill of lesson planning in the inservice course, as useful. Although he thought that better planning might improve the poor exam results of his students, he did not want to invest any effort in this out of protest against how teachers were treated in his country. The intervention clearly could not change his mind here. On the other hand, teacher A paid attention to the basic teaching skill of homework as intended, in which the intervention has had a reinforcing influence. He mainly had adopted this because it fitted in his student centred style of teaching, making him a better facilitator of students' learning.

Teacher A reduced note giving and promoted active use of the textbook to a great extent, as intended. Although the interventions in which he participated are thought to have played a facilitating role towards this change, it has been his interest in more student-centred teaching that has been pivotal in this. Through his successes with student-centred teaching he felt confident enough to give the

element of note giving a considerably less prominent status in his teaching. He adopted the strategy proposed by SMART of reducing note giving and promoting active use of the textbook at the same time, in order to free more lesson time for student centred activities.
In short, the intervention has surprisingly been quite effective with teacher A towards changing basic teaching skills as intended. Looking at the other cases described in this chapter, it has become clear that some of these intended changes were far from basic.

Teacher A was quite successful in promoting more student involvement in his lessons. This mainly has been facilitated by the relatively simple 'hands-on/minds-on' activities that have been made available through the intervention. The exemplary lessons can hardly have played a role towards this change because they were hardly used as intended. As mentioned before, teacher A was not very motivated to invest a lot of time in lesson planning. In his opinion, these activities did not require much planning and he enjoyed the successes in promoting student involvement. This resulted in his tending to put a higher value on student involvement than on what eventually had to be gained from the lesson.
Teacher A's motivation for more student-centred teaching, together with the initial positive responses he received from his students for his quite revolutionary changes, were major cornerstones in his success. His interest for this is assumed to have been aroused in previous interventions in which he participated. The poor examination results (which could hardly be blamed on him), together with the waning enthusiasm of his students for student centred activities, were very discouraging for teacher A. Through this, he could easily become one of the many teachers in Swaziland on the brink of leaving the profession.

Teacher A hardly talked with other teachers in his school about his experiments and/or problems in teaching. He blamed his head teacher for neglecting the science department, whilst the head teacher probably blamed him for the poor exam results. Professional development was an individual affair in teacher A's school, and mainly driven by his personal enthusiasm and motivation, which seemed to be waning.

7.5 Case: 'the experienced chalker & talker'

7.5.1 Teacher, school and student characteristics

Teacher C, a 30-year-old Swazi male, was a fully qualified biology teacher with seven years of experience. He therefore did not really belong to the target group of the SMART inservice. Teacher C participated in many biology inservice courses and had been a mentor for SMART in one of the regional INSET schools from 1994 onwards. He participated in all units of the '97 course and used a reasonable number of 'hands-on/minds-on' activities from the student materials in lessons in the 'try out' phase. He only used one exemplary lesson in the intended way.
He taught in a relatively big mission school for girls in a city (quite close to the SMART centre) in which 28 teachers were employed. Formalistic teacher-centred teaching was the norm amongst staff at his school. The head teacher and deputy of the school were mainly concerned with their administrative duties, and hardly guided and monitored the quality of management and teaching in the departments. The administration and head of department were also only marginally involved in the regional inservice function of their school. Nonetheless, teacher C was allowed to fulfil his tasks as a SMART inservice mentor. There were three other biology teachers in the science department, which was outfitted with reasonable laboratory and copying facilities. Because of his mentorship, he talked more frequently than before about teaching issues with colleagues, both within his school and at other schools.
There were 28 students in his observed form 5 class in 1997 and 23 in 1998. The biology examination results of his school were outstanding (varying from 85 to 100% passing rate between 1996 and 1998) compared to the average year results for all schools in the country (see figure 2.2).

7.5.2 Interpretation of the effect of the course

Teacher C indicated in 1997 that the inservice course had made a considerably positive impact on his teaching, but that the students had not gained much from the student materials. When asked in 1998 to summarise in a few sentences what the (overall) effect of the biology inservice had been on his teaching, he answered with the following:

"It improved my personal approach to biology teaching. I also learned new ways of improvising, i.e. making equipment from simple material. It provided material that could be used if pupils don't have these in their textbook"

Basic teaching skills

Not being a target group teacher, the expectation was that teacher C's interest for enhancing basic teaching skills would be limited. This appeared to be true to a great extent for all the basic skills that were addressed. This is further discussed below for each skill.

Teacher C's *lesson planning* was not as intended during or after the intervention. The intervention had no effect on teacher C in this regard.
In the interview in 1998 he indicated that he only did the compulsory scheming and did this for the whole year round only mentioning topics and subtopics. He also clarified that he hardly filled in the prep-books, and if he did this he only reported afterwards. Furthermore, he mentioned that the administration of his school hardly checked such things.
The question - how does a teacher know what to do each year in each lesson? - was hardly a problem for a 'chalk and talk' teacher, such as C. The scheme of work and prep-book he made in his first years of teaching simply told him what to cover in a particular lesson, and his notes took care of the rest.
Teacher C clarified that he did not take the planning of lessons very seriously because he repeated the same lessons year-in-year-out. There was no need for lesson planning in such a situation, according to him. He probably felt a strong - albeit slightly misplaced - validation for this view in the very good biology examination results of his school[1].

The *note giving* of teacher C during lessons was comprehensive and detailed before and during the intervention, and continued to be so after the intervention. The intervention has had no effect on this aspect of his teaching.
Teacher C, being a mentor, initially had problems explaining why he continued giving 'textbook replacing' notes in lesson time, when all students have a good textbook. Initially he said that he did this to make it easier for the students because his language was easier to grasp. At the same time he agreed that the new textbook was good and also easy to understand for students. After some

[1] Teacher C taught at a school that historically was known for its good results. Many students from all over the country competed for a place at this school, from whom the best were selected. The selection of good students played a major role towards the good examination results record of the school (see also section 2.3.3).

probing he revealed that he in fact was bored with his 'chalk and talk' approach in teaching. Yet, he did not see a way out of this because he had done this for so long, and because all of his colleagues did the same in his perception. Even more important was that his students and their parents expected this from him in his opinion (this appeared to be incorrect for a considerable number of his students). He summarised his predicament quite poignantly:
"maybe it is because we are all used to this way of teaching, and it is difficult to get out of it"

All students of teacher C had a good *textbook*, and almost all took it to class in the observed lessons in 1998. This situation is assumed to have been facilitated though the inservice courses.
The textbook was used in class mainly to refer to diagrams and to explain these. He instructed his students to leave space for the diagrams between the elaborate notes they had received, so that they could copy these into their notebooks at home. Efficiency, for teacher C, played an important role here, in which the textbook was more or less used as an appendix to his notes. Further active use of the textbook by the students was not really promoted. Teacher C indicated that he tried to promote the use of the textbook, but that he was not successful in this because his students relied on his notes (which were complete) and preferred to be spoon-fed.
Expecting this intervention to change something so fundamental in his teaching and his environment was clearly not realistic for teacher C. So it may come as no surprise that he stuck to his 'tried and sure' way of note giving and did not do much towards more active use of a textbook by students.

Teacher C hardly gave and checked *homework* - as intended - before, during or after the intervention. The intervention has had no effect on this teacher in this regard.
The teacher paid attention to homework only occasionally and indicated that he did this only out of routine, and because he thought that parents expected this from him. In fact, he saw homework almost equivalent to marking as prescribed in the school regulations (section 6.2.3), which he knew to be a very time consuming activity. He did not really see the use for all this laborious marking, because students could easily copy from each other. He felt lucky that his school administration and head of department did not bother too much about homework as well.
Teacher C did not need homework as a means to gain control over his students and did not see it as an instrument that could make him a better facilitator of their learning. Instead, he had a rather strong conviction that students only learn

for tests or exams, which made homework giving and checking a waste of time in his mind. Of course this is not strange in schools and educational systems that are mainly interested in summative evaluation results, which was the prevailing situation in secondary education in Swaziland.

Student involvement

The expectation was that teacher C, being an experienced teacher, would be interested in promoting student involvement through the use of relatively simple as well as more complex 'hands-on/minds-on' activities. This expectation was not fulfilled. This teacher had already adopted a teacher-centred style for many years, which did not change in a more student-centred direction either during or after the intervention. The intervention has had no effect on teacher C in the intended direction.

Teacher C made only very limited use of the available SMART biology student materials when visited one year after the intervention. If used, it was only to provide extra reading sources to students to which very little follow-up was given. In fact he used the activities in the way he used his textbook, namely as an appendix to his lecturing and note giving. In his lessons he mainly lectured and gave notes and accomplished very little interaction with his students in general. Most of the learning had to take place at home, through cramming of the notes. When first asked why he did not try to involve his students more actively in his lessons, he gave the following reasons: i) there simply was no time after he was through with lecturing and note giving, and ii) the school environment was not conducive for changing his teaching style.

Teacher C's students were generally not very active or responsive in the observed lessons. They indicated that they found the lessons (during the intervention) rather boring and that these did not differ very much from the lessons they had experienced before the intervention. Some students expressed this in words:

"I like to be involved in whatever topic we are doing and in this topic I listened more to the teacher than do and sometimes I find it hard to concentrate... there is less practical work and as student we are only given a few chances to do our own talking... the teacher keeps on talking making the topic less interesting to us as students; we also like to take part... we would like to have more practicals... the booklets are wasting a lot of our time because we have to read everything"

Other students who had been reasonably satisfied did not elaborate on this.

Of the classes that were observed, the majority of the students in two of them had a higher preference on average for more teacher centred activities. The students of the form 5 class that has been observed in 1998 had a higher preference on average for more student centred activities. Overall, his students were clearly divided in their preferences in this regard. Yet, in situations in which the majority of the students have negative feelings about the way they are taught, the teaching-learning climate cannot be considered very conducive.

Teacher C did not move an inch in the intended student-centred direction, whilst as a SMART mentor he was supposed (and also pretended) to be an advocate of this approach. Through this research the difficult predicament of teacher C was divulged. Initially he explained that it was the school environment, and the students and their parents that expected this kind of teaching from him (see also under note giving). Yet, he was aware that many of his students found his teaching boring and conceded that he started to get bored with it himself as well. In the last interview in 1998 he indicated that he really would like to change his 'spoon-feeding' teaching style, because deep in his heart he realised that students would gain more when they were more involved and that he also would get more satisfaction out of teaching that way. As with note giving, he found it very difficult to make the first step because he was so used to his way of teaching, and did not know how to start. No doubt he also realised that such a change would ask much from him in terms of effort and time. The support that has been provided to him through the intervention clearly has not been enough to make him take the first step. It was clearly unrealistic to expect this intervention to effect a change towards more student-centredness with this teacher, which for him was equal to a complete about-face. He clearly required more support in a more conducive environment.

7.5.3 In conclusion

Teacher C has hardly changed anything in his behaviour related to the basic teaching skills. This is in line with what the designers expected. Yet, this does not mean that the teacher had already completely mastered these skills as intended by the designers. He did not do any lesson planning anymore - simply because he repeated the same lesson year-in-year-out. Moreover, he considered homework a waste of time because students only worked for tests in his opinion. Note giving could be considered one of his areas of expertise, which he still practised in almost every lesson. Yet, his note giving was the opposite of what the designers of the course aimed for. His notes formed the basis for the two main elements that occurred in his lessons: lecturing and note giving. Trying to change something that was at the heart of his teaching approach appeared clearly too tall an order for this intervention. Nonetheless, teacher C had created a situation in which all of his students had a good textbook. This is assumed to have been facilitated by the inservice courses in which he was involved as a mentor of SMART. However, this hardly has changed anything in teacher C's teaching, because he only used the textbook as an appendix to his 'textbook replacing' notes.

Trying to promote more student involvement in teacher C's lessons failed utterly. Although he said he was bored with his 'spoon-feeding' approach, and thought that more student involvement would bolster his motivation, he simply could not make the first step. He realised very well that such a change would not be easy and would take a lot of time and effort. And, was it worth it? His examination results could hardly be better. Who knows they would become worse? And what about his students, his colleagues and head master? Not much support could be expected from them in the light of his proved success.
Teacher C is unlikely to change to more student-centredness through participation in the inservice courses. The risks are too high and the results too uncertain. More support, and a more conducive environment are needed to assist teacher C in a change he might be looking for.

7.6 Cross-case analysis

Lesson planning

The 'inexperienced survivor' teacher appeared to take lesson planning quite seriously. He did this partly because this was expected from him by the PGCE course in which he participated during the intervention. This course also led him to change his teaching style quite radically, which made lesson planning essential for him to survive in class.
None of the more experienced teachers were serious about lesson planning, never mind whether they were more inclined towards student-centred teaching (i.e. the 'pragmatic adjuster' and the 'revolutionary changer') or towards teacher-centred teaching (i.e. the 'experienced talker & chalker'). Relatively good examination results gave some of them justification that they were already doing a good job, and could not benefit much from planning. The teachers who were successful in promoting student involvement achieved this without much extra lesson planning. However, their teaching was hardly geared towards attaining concrete learning targets.

Interpretations

1. The 'inexperienced survivor' was engaged in lesson planning simply because it was a must for him to get through a lesson. This planning was mainly geared towards mastering the content of the curriculum and preparing (his own) notes for lessons, which would form the basis for his future teaching.
2. The 'experienced talker & chalker' hardly planned his lessons because he repeated the same lessons (consisting of mainly lecturing and note giving) year-in-year-out, with his notes forming the main basis.
3. The 'pragmatic adjuster' and the 'revolutionary changer' also hardly planned their lessons because they repeated the same lessons year-in-year-out as well, their notes and/or learning activities forming the main basis. They used the 'hands-on/minds-on' activities because these enabled them to promote student involvement without requiring much lesson planning.
4. All teachers were more engaged in covering content and/or promoting student involvement than in attaining specific learning targets (as promoted in the inservice course), which does not require much planning on the long run.
5. The intervention has not convinced any of the teachers that the quality of their teaching would improve to such a degree that it would be worth investing the planning effort asked for by the designers of the inservice course.

Note giving and textbook use

Elaborate note giving clearly comes naturally when teachers step into the profession in Swaziland. Trying to change this, through a SMART-like intervention, appeared unrealistic for these beginning teachers. The change that occurred in the note giving of the 'inexperienced survivor' teacher was not initiated by the intervention, but through his participation in a PGCE course. Being (more or less) forced to stop with his elaborate note giving, caused big problems for this teacher and his students, and could eventually result in a rejection of the change and a return to the original situation.

Also for the 'experienced talker & chalker' it appeared unrealistic to try to change his note-giving pattern through the intervention. He continued with his spoon-feeding 'chalk and talk' pattern that he had adopted - and achieved success with - when he entered the profession. Change is too much of a risk for this teacher and demands too big an investment in environments offering little support to change.

The 'pragmatic adjuster' found solutions in which she realised more student involvement in her lessons whilst she continued with elaborate note giving at the

same time. Only the 'revolutionary changer', who had a strong personal interest in changing towards more student-centredness, really succeeded in reducing note giving combined with more active use of textbooks by students. For this type of teacher, SMART-like interventions can make a difference in this regard.
Promotion of use of the textbook by students is strongly linked to the note giving behaviour of the teachers. If 'textbook-replacing' note giving has already been adopted by teachers, not much can be expected in terms of genuine promotion of textbook use by students.

Interpretations

1. The 'inexperienced survivor' only stopped note giving because he felt obliged to do this. The fact that he was not able to create a situation that was satisfactory for him and his students led him to provide students with notes again outside lessons. Forcing such teachers to change so drastically can have negative effects. Trying to adapt the note giving and textbook use of this teacher (again) through the intervention was unrealistic because he had so many other problems to contend with.
2. The 'experienced talker & chalker' and the 'pragmatic adjuster' did not reduce note giving because this was a major diversion from the conventional way of teaching in the Swazi high schools, which involved many risks. For these teachers it was unrealistic to pursue such a change through the intervention, because their concerns (especially at the implementation and impact phases) have not been adequately addressed.
3. The 'experienced talker & chalker' and the 'pragmatic adjuster', who continued giving 'textbook-replacing' notes, only used the textbook as an appendix to their notes, if at all. This made promotion of active use of textbooks by students through the intervention a futile exercise for these teachers.
4. The 'revolutionary changer', who succeeded in reducing note giving and promoting textbook use through the intervention, did this because he had a strong internal motivation to actively involve students in his lessons, which he felt could not coincide with elaborate note giving. His frequent participation in biology inservice courses has no doubt contributed to his motivation in this regard.

Homework

The 'inexperienced survivor' teacher took homework giving and checking quite seriously, which has been reinforced through: i) measures at school level, and ii)

participation in the inservice courses. Also his participation in the PGCE course has played a facilitating role. Yet, the most important drive for this teacher to take homework seriously originated from within himself; he experienced that he gained more control over the students and the teaching-learning process through homework.
Also the 'pragmatic adjuster' and the 'revolutionary changer' gave and checked homework as intended, mainly to maintain a continuous work discipline amongst students, which they considered important to obtain good results. The 'experienced talker & chalker' considered homework a waste of time for himself and the students, and therefore hardly gave or checked homework. He considered tests and exams more effective at making his students work, which he saw as the main purpose of homework. His school administration actually reinforced this practice.
None of the teachers used the instrument of homework for formative evaluation of progress in learning of individual students.

Interpretations

1. The 'inexperienced survivor' was seriously engaged in homework giving and checking mainly because he hoped to gain more control over students and their learning, which was a genuine need.
2. Whether or not experienced teachers (the 'pragmatic adjuster', the 'revolutionary changer' and the 'experienced talker & chalker') regularly gave and checked homework depended mainly on i) their vision on the instrumentality of homework to improve learning and results, ii) reinforcement of homework by the school administration.
3. SMART-like interventions can be effective in reinforcing and improving homework giving and checking because many teachers are aware of the importance of these activities for themselves and/or their students.
4. Homework is hardly used by teachers to evaluate progress in learning of individual students in a formative way, but more to make students do the work that has been assigned to them.

Student involvement

The 'inexperienced survivor' teacher did not change in a more student-centred direction after the intervention. He continued with his teacher-centred style of teaching, which he had adopted already before the intervention. For young teachers it is a safe strategy to do what your colleagues do and what you think

that your students expect. Furthermore, inexperienced teachers can easily maintain control over their students through lecturing and note giving. Letting them write and not talk is a safe strategy to prevent mayhem in class. Trying to promote more student involvement in lessons is basically a risky and threatening undertaking for them. Trying to achieve this through a SMART-like intervention turned out to be unrealistic for this type of teacher.
On the other hand, the intervention has been quite successful in facilitating more student involvement with some of the more experienced teachers (the 'pragmatic adjuster' and the 'revolutionary changer'). Especially the student materials appeared to be instrumental in this. The teachers found these materials especially attractive because they required limited preparation to realise student involvement successfully. Important was that these teachers had already expressed an interest in promoting more student involvement in their lessons, which might have been initiated through their participation in previous inservice courses. Whilst the 'revolutionary changer' had changed quite radically towards a more student centred teaching style (with considerable reduction of note giving combined with promotion of textbook use), the 'pragmatic adjuster' more cautiously integrated more student centred elements in her teacher-centred framework. This last - more pragmatic - approach towards change seems more promising, giving both teacher and students time to adjust to the change.
Yet, the 'experienced talker & chalker' (who probably represents the majority of experienced teachers in Swaziland) continued with his spoon-feeding 'chalk and talk' pattern as has already been elaborated under note giving. Despite the fact that this teacher indicated that he was bored with his teaching and wanted to change, it remains unlikely that he will seriously embark on this in future. Similar to reducing note giving, this change is too much of a risk and asks a too big an investment in a not really supportive environment. For this type of teachers, much more support is required than a SMART-like intervention can hope to provide; the school environment will also have to be involved.
The more complex activities (e.g. field work, simulations and projects) were not successfully applied in lessons by any of the teachers unless they were guided through intensive coaching.

Interpretations

1. The 'inexperienced survivor' did not increase student involvement in his lessons because this was a major diversion from the conventional way of teaching in the Swazi high schools, which entailed many risks, especially at

the start of a teaching career. For this teacher it was unrealistic to pursue such a change through the intervention, because he was preoccupied with many other concerns.

2. The 'experienced talker & chalker', who had been successfully teaching in a teacher-centred way for many years, did not increase student involvement in his lessons because this was a major diversion from what he, and his colleagues, had done for so may years and their student were used to. Also for this teacher, it was unrealistic to pursue such a change through the intervention, because his concerns with the change (especially at the implementation and impact phases) could not be adequately addressed.
3. The 'pragmatic adjuster' and the 'revolutionary changer', who succeeded in promoting more student involvement through the intervention, had a strong personal motivation to actively involve students in their lessons, which could have been incited through previous participation in inservice courses. Providing these teachers with appropriate instruments to achieve student involvement (i.e. ready to use and relatively simple student materials) appeared to be already quite effective.

Chapter 8
Discussion

This chapter summarises and discusses the main findings of this study. The chapter opens with an introduction portraying the study's main features. Section 8.2 reviews the findings of the evaluative and interpretive investigations. The extent to which factors at the micro-, meso- and macro levels of Swaziland's education system may have influenced the effect of the intervention is reported on in section 8.3. The main design principles of the SMART inservice programme are considered and elaborated on in the light of the findings in section 8.4. Subsequently, section 8.5 provides guidelines for enhancing the potential of inservice education in improving science education. Finally, in section 8.6 some concluding remarks are made on this study and future research.

8.1 Introduction

This study has been undertaken to explore the role of inservice education in improving science education in senior secondary schools of Swaziland. The study started from the assumption that inservice education programmes can be an important means for improving the quality of education in developing countries when these programmes are well designed, and take account of the realities in schools. However, the research base to support this assumption was still limited at the start of this research.

The study focuses on an inservice course that was developed and implemented in 1997 in the context of the development co-operation project SMART, housed in the Faculty of Education of the University of Swaziland. An important aim of the SMART project was to improve the quality of science education in the high schools of Swaziland. At the start of the project, inservice staff tried to achieve this - quite individually for the different science subjects - through promoting a 'practical and learner-centred teaching methodology' in science lessons. This was mainly done by providing 'hands-on/minds-on' student materials to teachers in a workshop in which teachers could try out the student activities themselves. A study that was initiated by the SMART team indicated that a more student-centred approach might be difficult to realise in the schools in Swaziland. This study also exposed that the inservice interventions were basically lacking a common rationale based on design principles derived from 'state of the art' inservice literature. These insights led to the decision to focus more on the improvement of basic teaching skills - especially among inexperienced teachers. This was considered more realistic and more relevant in the school context of Swaziland. Furthermore, the project team adopted an inservice approach, in which:

- two inservice courses were organised per year, each with a duration of three months and consisting of an initial two-day workshop, a 'try out' phase in schools, and a half-day follow up workshop;
- the training elements of theory, demonstration, practice, feedback and follow-up were incorporated in each course to improve teaching skills and to address respectively informational, personal and management concerns that participants might have with the pursued improvements;
- curriculum materials were integrated into the training elements of the inservice course.

Guidelines related to this new focus and approach were agreed upon by the project team and were meant as a basis for design of all subsequent science inservice courses to be developed by SMART project staff (chapter 3). These guidelines were very detailed for the design of curriculum materials, but provided hardly any guidance for development of the training elements of theory, demonstration, practice, feedback and follow-up. Moreover, the term 'basic teaching skill' was rather loosely defined, making the skills under consideration rather diverse: lesson planning, questioning, use of teaching aids, conducting practical work, note giving, textbook use and homework.

It also appeared that the promotion of student-centred teaching had not entirely disappeared from the SMART inservice menu, and in fact would feature prominently again in the '97 intervention at the end of the project.

A further complicating factor for SMART staff was that, although it had decided to focus on inexperienced teachers as its main target group, local authorities mandated that all science teachers in senior secondary education be allowed to participate in the courses.

This book describes how an inservice course was developed - based on the SMART design principles – and implemented (chapter 4), and presents a study that evaluated how successful this inservice course was in meeting its aims (chapters 5 and 6). Furthermore, an interpretive study is presented that was carried out to gain further understanding on how teachers implemented certain elements of the intervention (chapter 7). Effects at the classroom level are influenced by many factors. To come to a better understanding of the effects, also relevant factors at the micro-, meso- and macro levels of Swaziland's educational system are described in this book (chapter 2).

This chapter summarises and discusses the main findings of this study.

8.2 The findings of the evaluative and interpretive studies

The biology inservice course that was organised in 1997 aimed at improving basic teaching skills (i.e. lesson planning and evaluation, note giving and textbook use, homework giving and checking) as usual, but focussed specifically on a realistic and attainable approach to promoting more active student involvement in science lessons.
The effect of this intervention has been assessed in terms of behavioural changes of participants - on the short as well as the long-term. For this purpose, outcomes of the course have been formulated in terms of intended behavioural changes (see 5.2 and appendix G).
The fifty-two teachers who participated in the course expressed their satisfaction with the course components and with the impact of the course on their teaching. Five inexperienced and four experienced teachers were selected from the participants for more detailed investigations in the classroom. Comprehensive data collection was carried out for eight of these teachers before, during and one year after the intervention.

The findings of the evaluative and interpretive studies are summarised and discussed, respectively, for the improvement of basic teaching skills in section 8.2.1, and for the promotion of student involvement in section 8.2.2.
The presentations start with a brief statement of the effect answering the main research question of the evaluative study:
What has been the effect of the inservice course on the teaching behaviour of participating teachers?

Subsequently, the main findings of the interpretive study are presented answering its main research question:
How can the effects of the '97 course be interpreted?

The interpretations are presented for the four categories of teachers (inexperienced survivor, experienced talker & chalker, pragmatic adjuster and revolutionary changer) that have been introduced in chapter 7 (section 7.1).
The presentations end with some concluding remarks on the potential of the inservice intervention to improve science education in the high schools of Swaziland.

8.2.1 Improvement of basic teaching skills

Findings
Lesson planning and lesson evaluation has exhibited barely any change in the intended direction as a result of the intervention (a more purposeful and reflective approach towards teaching).
The 'inexperienced survivor' teachers were more seriously engaged in lesson planning, but this mainly consisted of mastering the content of the curriculum and preparing notes. Lesson planning was a 'must' to get through a lesson. These teachers completed their prep-book, as required by their administrators, but mostly only after lessons had been taught. More purposeful planning to achieve specific learning targets, as well as more reflective teaching, simply asked too much of these novices to the profession.
All experienced teachers spent little or no time planning and reflecting on their lessons because they repeated the same lessons (consisting of mainly lecturing and note giving) year-in-year-out. For the 'experienced talker & chalker' type of teacher, notes formed the main basis for teaching, whilst the 'pragmatic adjuster' and the 'revolutionary changer' based their teaching on learning activities next to their notes. The hands-on/minds-on activities were considered attractive because these enabled them to promote student involvement without requiring much lesson planning.
The teachers were more engaged in covering content and/or promoting student involvement than in attaining specific learning targets. This approach required intensive lesson planning only at the start of a teaching career, and made lesson evaluation redundant. The findings indicate that the intervention was not successful

in convincing any of the teachers that the quality of their teaching would improve to such an extent that it would be worth investing the planning effort asked for by the designers. This finding indicates limited potential of the intervention.

Note giving and textbook use was also hardly changed in the intended direction through the intervention (more summarising and explanatory notes, combined with active student use of the textbook). Yet, the intervention played a facilitating role in improving the rate of textbook possession by students.
Attempting to adapt the note giving and textbook use of the 'inexperienced survivor' type of teacher through this intervention was unrealistic because these novices in the profession simply had too many other problems to worry about. All of the inexperienced case teachers adopted note giving and lecturing as the main elements of their teaching from the moment they started at their first school. 'Doing what most of your colleagues do and your students seem to expect', clearly was a logical and safe strategy for these beginning teachers. Furthermore, note giving is an ideal instrument to exercise control over a class in the turbulent situations that can frequently arise at the start of a teaching career.
Most experienced teachers (the 'experienced talker & chalker' type and the 'pragmatic adjuster' type) also did not reduce note giving, as it involved many risks and required considerable effort, in their perception. These teachers only used the textbook as an appendix to their notes, if at all. Yet, the 'revolutionary changer' succeeded in reducing note giving and promoting textbook use by students. Elaborate note giving did not fit in the paradigm of student-centred teaching, for which he had a strong preference, partly promoted through his frequent participation in SMART inservice courses.
The results indicate that it was unrealistic to pursue the proposed changes in note giving through this intervention for most inexperienced as well experienced teachers. Such a change would entail a fundamental shift in their way of teaching, and a departure from the conventional way of teaching in the high schools in Swaziland. The intervention fell short in adequately addressing the concerns of most teachers with this major change (especially at the implementation and impact phases). The findings also indicate that promotion of active use of textbooks by students through inservice courses is a futile exercise if the note giving of teachers is not addressed. Yet, this type of intervention has potential when it comes to promoting possession of affordable, good quality textbooks by students. This can improve the learning of those students who take the initiative to start using their textbook in addition to their 'textbook-replacing' notes.

The intervention did improve *homework* related skills of teachers in the intended direction (frequent evaluation of students' progress through giving and checking of homework assignments).
The 'inexperienced survivor' type of teachers were seriously engaged in homework giving and checking, mainly because they wanted to gain more control over students and their learning, which was a genuine need.
Some experienced teachers also regularly gave and checked homework, either because they were convinced that it improved student learning or simply because it was required by the school administration. Yet, some experienced teachers hardly gave and checked homework at all; they were convinced that students only applied themselves in preparation for tests. Homework was more laborious and less effective to that end in their opinion.
The results indicate that this type of intervention can be effective in reinforcing and improving homework giving and checking because many teachers are aware of the importance of these activities for themselves and/or their students. This indicates considerable potential for interventions in this area.
The results also indicate that checking homework is hardly used by teachers to evaluate progress in student learning in a formative way, but more to enforce that students do the work that has been assigned to them.

Lastly, the intervention had an additional effect on the *teaching of specific topics* through the provision of good quality student materials, for which the teachers had expressed a need. Inexperienced teachers used these materials mainly in the planning of their lessons, whilst more experienced teachers also used these materials as homework assignments and/or for class activities. The findings indicate that this type of inservice intervention has considerable potential if teachers have expressed an explicit need for support.

Discussion

Although pleas have been made in the past to pursue more realistic aims through inservice in African science classrooms, e.g. through addressing shortcomings in basic teaching skills (Ogunniyi, 1986; Rogan & MacDonald, 1985; Walberg, 1991), hardly any information is available on what this entails, let alone on successes that have been achieved.
The findings of this study indicate that the basic teaching skills that have been addressed were diverse, and in hindsight it can be noted that the intentions of the designer sometimes went beyond improving just 'basic' skills. For lesson

planning and evaluation as well as homework, the focus was indeed more on improving basic skills, which required minor adjustments in teaching behaviour. Yet, note giving and textbook use involved a more radical change in teaching behaviour, regardless of the fact that the skills to be mastered were relatively simple. The intervention appeared more successful when minor adjustments in teaching were pursued, which were responding to specific professional development and/or support needs expressed by teachers.
Rollnick, Manyatsi, Lubben, and Bradley (1998) have done research related to note giving behaviour of teachers in Swaziland. They confirm the findings of this study that the provision of 'textbook replacing' notes is deeply rooted amongst science teachers in Swaziland. They conclude that altering this behaviour will take time, but fall short of saying how to go about doing this. They found that especially the high cognitive level demanded by the O-level examinations gets limited attention in the notes of the teachers. To remedy this, for the time being, they suggest that much more attention should be paid in preservice teacher education towards improving teachers' note writing skills, especially related to higher cognitive level objectives of the syllabus. Yet, if we accept that higher cognitive thinking can mainly be developed though active involvement of pupils in the teaching-learning process, as discussed later, improved note writing skills alone cannot be expected to contribute much to this objective.

8.2.2 Promoting student involvement

Findings

The intervention has been successful in promoting more student-centred approaches with experienced teachers, but has had little effect on inexperienced teachers.
The experienced 'pragmatic adjuster' and 'revolutionary changer' succeeded in promoting more student involvement in their lessons through the intervention, while the 'pragmatic adjuster' adopted the most promising strategy for long-term growth. These teachers had a strong personal motivation to actively involve students in their lessons, which is assumed to have been instilled - at least in part - through their previous participation in SMART inservice courses. Providing these teachers with appropriate instruments to achieve student involvement (i.e. ready to use and relatively simple student materials) had already been proved to be quite effective. Yet, it must be noted that these teachers were more engaged in

promoting student involvement than in reaching learning targets per se (see also under lesson planning). Furthermore, the use of more complex 'hands-on/minds-on' activities (i.e. simulations, investigations, field work and projects), in which higher cognitive level objectives are more prominent, was not successfully adopted by these teachers. Considerable support - e.g. through in-school coaching - seems required to accomplish this.

However, the 'experienced talker & chalker' type of teachers, who had been teaching in a teacher-centred way for many years, did not increase student involvement in their lessons because they perceived this as a major diversion from what they, and their colleagues, had done for so long. They also thought that a diversion in teaching style would be experienced by their students as a disruption. It appeared unrealistic to pursue such a change through the intervention for this type of teacher, because their concerns with the change could not be adequately addressed.

Also, the 'inexperienced survivor' type of teacher did not increase student involvement in their lessons because this was a major departure from the conventional way of teaching, which is risky especially at the start of a teaching career. Furthermore, these teachers tend to have other, more pressing (survival) concerns to be bothered about such demanding changes.

It seems that most of the (biology) teachers in Swaziland have practised a teacher-centred approach of teaching from the start of their career. The results indicate that this type of intervention has the potential to arouse interest for more student-centred forms of teaching, and to facilitate more experienced and motivated teachers in successfully integrating this in their teaching repertoire on the long-term. Especially good quality (not too complex) student materials appeared instrumental in achieving this. Yet, the findings also indicate that it was unrealistic to pursue this fundamental change in teaching for the majority of the (inexperienced as well experienced) teachers in the rather radical way this was exemplified. As with the note giving and textbook related changes, the intervention fell short in addressing the concerns of most teachers with this major and radical change in an adequate way (especially at the implementation and impact phases).

Discussion

One may wonder why SMART staff embarked again on promoting student-centred teaching in 1997 whilst it had earlier embraced basic teaching skills as a more realistic goal for its inservice courses. The available literature at that time in fact

discouraged the pursuit of student-centred teaching in these contexts (see section 3.3.1). In simple terms it probably boils down to the fact that most SMART staff had the gut feeling that more student-centred forms of teaching were to be preferred, and assumed that this could be combined with more formalistic teaching in an attainable way. It appears that many other educators and researchers also try to promote more student-centred teaching in similar contextual situations (Avalos, 1993; Caillods et al., 1998; De Feiter et al., 1998; Dekkers, 1997; Guthrie, 1990; Harvey, 1999a; Rowell, 1995; Shaeffer, 1993). An important reason for this insistence appears to be the realisation that science teachers are supposed to facilitate the development of higher cognitive skills, which is inadequately addressed by more formalistic teaching approaches (Tobin, 1998; Tobin, Tippins & Gallard, 1994). Especially the pure science syllabuses in use in Swaziland (e.g. biology 5090) put more emphasis on higher cognitive skills. So it seems to be important that attainable middle ground be found between the extremes of formalism and constructivism to help facilitate development of higher cognitive skills, taking account of the realities of classrooms in developing countries.
However, if the pursuit of more student-centred teaching is mainly done to improve students' mastery of higher cognitive skills, teachers in Swaziland will not a priori be convinced of the importance of this; teacher-centred teachers, such as the 'experienced chalker & talker', have proved themselves quite able to produce excellent examination results. Of course, we must add to this that the percentage of test items that really assess higher cognitive skills is still limited in most examinations. In addition, the 'chalker & talker' teachers who scored well in the biology exams all taught in the 'top schools' of Swaziland. Moreover, there are many more compelling arguments for making educators persistent in promoting more student-centred forms of teaching in classrooms all over the world (Kyle, 1999). Most of these arguments indicate a conviction that a more active role of students in the teaching-learning process prepares them better for life after school. This claim seems to make intuitive sense, but is difficult to prove. At the same time, students' and parents' concerns are mainly geared toward obtaining good examination results in which many of the 'better prepared for life after school' skills are not given much direct attention.

Also today politicians and educators in many developing countries embark on these kinds of rather drastic changes in their educational systems (Bekalo & Welford, 1999; Caillods et al., 1997; Dahlström, 1999; Jegede, 1997; Lubben, Campbell & Dlamini, 1996; Musonda, 1999; Putsoa & Maphalala, 1996; Rowell, 1995; Tatto, 1999; van den Akker, 1998), but success stories are still few and far between. Notable exceptions are reported from South Africa for NGO-based inservice projects geared to improve science education in Black schools at primary and secondary level (Harvey, 1999a; Rogan & Macdonald, 1985). These studies are further discussed in following sections.

This study indicates that the pursuit of more student-centred teaching, through means of the '97 intervention and in the way this was exemplified, was probably unrealistic for most of the biology teachers of Swaziland at that time. Nevertheless, it appears that a more pragmatic approach, in which student-centred elements are gradually integrated into a basically teacher-centred framework, can be successfully pursued through a short SMART-type of inservice intervention. The 'pragmatic adjuster' showed how this could be approached. It seems worthwhile for preservice as well as inservice educators to have a closer look at this case.

8.3 Factors influencing the effect

Many factors at the different levels of the Swaziland education system can have influenced - positively or negatively - the effect of the '97 intervention, ultimately resulting in the effects presented in the previous section. In this section the central role of the teacher is discussed in 8.3.1, whilst important factors at higher levels of education are reviewed in 8.3.2.

8.3.1 Factors at the micro level of education

Personal concerns in context

Most case teachers did not embark on more student-centred forms of teaching because there were too many perceived obstacles for this in their school environment (e.g. students prefer spoon feeding, all colleagues do 'chalk en talk', limitations in facilities and resources). The findings of this study indicate that the widely held belief of teachers that most of their students prefer to be spoon-fed through lecturing and note giving, is at least debatable. Furthermore, when simple resources are provided, as was the case in Swaziland through SMART inservice, there is not really much in the way in the school environment for teachers to embark - preferably gradually - on a more student-centred approach. This study points out that teachers' reluctance toward a student-centred approach originates more from inhibitions at a personal level than from genuine constraints at school level. Thijs (1999) concluded from a study in Botswana that mainly constraints at school level were responsible for holding teachers back from seriously embarking on 'innovative teaching methods'. However, it seems that she based this conclusion mainly on teachers' perceptions. From a Western perspective, Spillane (1999) found that external factors (from the policy to the pupil level) do not determine what teachers learn about innovative practice, in relation to an educational reform. From his research with teachers in the USA, Spillane concludes that the influence of an intervention on practice is much more mediated through the beliefs, knowledge and dispositions of particular teachers, which is in line with the findings of this study. The '97 inservice intervention has not been able to trigger a change in a more student-centred direction with most teachers, indicating that their concerns with the change have not been properly addressed regarding obstacles to implementation.

A more basic explanation for African teachers' reluctance to embark on student-centred approaches relates this to African traditional culture. Shumba (1999) found a significant positive correlation between commitment to indigenous culture and traditional non-inquiry approaches amongst a group of student science teachers in Zimbabwe, and suggests paying attention to this in preservice teacher education programmes. The findings presented in this book indicate that some teachers apparently manage to free themselves from cultural inhibitions in this respect, and adopt more student-centred styles of teaching. This study also shows that inservice education programmes can play a facilitative role in this process.

Personal concerns and stage of professional development

The SMART designers initially intended to focus on the many inexperienced teachers of Swaziland as the main target group for its inservice provision. Designing inservice courses for teachers who are in a similar phase of professional development makes sense because the participants then consist of teachers who are confronted with similar kinds of problems and professional concerns (section 3.3.2). Because all teachers had to be allowed to participate in the inservice courses by ministerial mandate, this strategy could not optimally materialise. Nevertheless, in the '97 course the designer tried to cater to the target group of inexperienced teachers as well as to experienced teachers in improving basic teaching skills and in promoting various student-centred teaching approaches.

The findings indicate that the influence of the intervention on the professional development of the *'inexperienced survivor'* type of teacher has been limited for improving basic teaching skills as well as promoting student involvement. These teachers were devoting all of their energy to getting started in the teaching profession, which is known as a potentially difficult and vulnerable phase. And although the intervention assisted the novice teacher by providing support material and improving their homework methods, the changes pursued by the '97 course were mostly not geared toward these teachers' real professional needs. Trying to promote more student involvement in these teachers' lessons clearly went beyond the capacity of this intervention to extend the zone of proximal development[1] of these teachers in this regard. Over the last decades, more attention has been paid to designing special support programmes for teachers in their induction period (Anderson & Mitchener, 1994; Avalos, 1995; Geva-May & Dori, 1998; Koetsier & Wubbels, 1995; Vonk, 1994), also in Africa (Sephelane, Klindt & Mpeta, 1996). The results of this study indicate that this is an appropriate development. Caillods et al. (1997) suggest making such programmes compulsory - perhaps as part of a probation period of 'on-the-job training' or extended teaching practice period in schools - as a means to make preservice training more effective and cheaper in developing countries. It seems advisable that preservice educators and school personnel also be involved in the design and implementation of such programmes, and that more emphasis be put on compliance with agreed modes of planning, instruction and evaluation.

In their first years of teaching, all teachers in this study initially adopted a teacher-centred teaching approach mainly based on lecturing and note giving. Most of them continued with this, like the *'experienced chalker and talker'*, repeating the same lessons year-in-year-out, and not further broadening their instructional repertoire. The results indicate that this kind of inservice course has no tangible effect on these teachers when it comes to changing their attitude towards teaching into a more student-centred direction. The support provided through the intervention has not sufficiently extended the zone of proximal development of these teachers to achieve this. Also improvement of basic teaching skills was not of interest to them. This type of teacher does not really fit in one of the professional development phases presented in section 3.3.2. Some characteristics of the stagnation and decline phase can be noted, as described by some scholars

1 The 'zone of proximal development' is defined by Vygotsky (1978) as the distance between what individuals can accomplish on their own and what they are able to accomplish when provided with assistance. This help can vary from the support of a peer, interactions with instructors and support through curriculum materials (cf. Jones, Rua & Carter, 1998).

(Fessler & Christensen, 1992). Yet, many of these teachers are strongly focussed on facilitating learning of the students – albeit through 'spoon feeding' - and are proud of the good exam results they achieve in this way. Many of them were frequent visitors of SMART seminars in which attention was paid to analysis of exam papers and the setting of school exams, indicating that this type of teacher has clear needs for support that fits their way of teaching.
Yet, some experienced teachers, like the *'pragmatic adjuster'* and the *'revolutionary changer'* expand their instructional repertoire through influence of the inservice intervention, especially if they have been regularly involved in the SMART inservice courses in the past. The zone of proximal development of these teachers has been enlarged through the intervention to the extent that they successfully integrated more student-centred approaches in their teaching. It seems that when these teachers gain interest for more student involvement in their lessons in their adjustment phase of development, a SMART type of intervention can assist them in achieving a greater student-centred focus in their mature development phase (section 3.3.2). The strategy of the 'pragmatic adjuster' seems most promising on the long-term, and might give direction for future inservice design in these contexts. This will be further elaborated in section 8.5.

The findings of this study confirm that it is important for inservice intervention design to clarify the target group and their professional development needs in detail for specific contextual situations, so that essential and realistic targets can be set and adequate modes of inservice can be chosen. It is inefficient to organise interventions, like the '97 course, for the whole population of biology teachers of Swaziland. Although SMART intended otherwise, it could not realise a more focussed inservice because of constraints emerging from the macro level of education. The importance for teacher education programmes to take account and address concerns (i.e. self-, task-, and pupil impact concerns) that teachers have in specific stages of their professional development, has recently been supported by considerable empirical evidence (Pigge & Marso, 1997), whose findings support the assumptions in this arena originally postulated by Fuller (1969). These results indicate that teachers' concerns for their own survival decrease as the teachers experienced success with their teaching efforts. This shift is seen to be accompanied by an increase in concerns about the actual tasks of teaching. However, it was found that concerns about their students' learning might develop differently depending on the teacher's capability as a teacher, with the more capable teachers experiencing higher levels of concern over a longer period than the less capable teachers. The observations of teachers in Swaziland are in line with these findings. However, the low morale that existed amongst many teachers in high schools in Swaziland at the time of SMART - originating e.g. from labour disputes with government - had a negative influence on their motivation for teaching, and probably also on their concern for the 'pupil impact' of their teaching.

8.3.2 Factors at the macro- and meso level of education

Judging from the empirical evidence of this study, it can be concluded that the role of SMART inservice has probably not been substantial when it comes to facilitating student-centred teaching and improving basic teaching skills of science teachers in the high schools of Swaziland. Factors at the micro level that have mitigated the effect have been discussed above. As introduced already in chapter 2, the following conditions at the macro and meso levels can also be expected to have has a mitigating influence:

i) At the policy level: the project has not been embedded in a broader policy for change to this respect; furthermore, the change was only pursued for the sciences and not for other subjects.
ii) At the university level: lack of integration of the SMART inservice programme with existing preservice teacher education programmes (see also Rollnick, et al., 1998).
iii) At the school level: ignorance of the school administration regarding what kind of change was pursued by SMART, resulting in lack of school support; limitations of the school administrators to improve the quality of education in their schools; limitations in examinations.

That these limiting conditions could not be addressed can be considered inherent to the 'project aid approach' for which VUA and the Dutch government had chosen, as technical assistance agency and donor of SMART, respectively. The VUA has learned many important lessons as an implementing partner in 30 donor-supported projects in 13 developing countries over the last 25 years. Many of these lessons have been applied in more recent development co-operation initiatives (de Feiter, Macfarlane, Stoll, & van den Akker, 1998; Stoll, et al., 1996). The Dutch government has also acknowledged the limitations of the 'project aid approach' in this respect and has started a transition towards what is called a 'sectoral support approach', as had already been adopted earlier by organisations such as the World Bank (Ministry of Foreign Affairs, 2000). Although sectoral support probably makes sense - also if we consider the situation in Swaziland - it is an approach that is still under development, and there are still many practical kinks to be worked out (Riddell, 1999; Samoff, 1999).

8.4 Reflection on design

The following basic principles have been featured most prominently in the inservice course that has been described and evaluated in this thesis:

- the application of a skill acquisition model in which change concerns of teachers are also addressed;
- the integration of curriculum materials in the inservice course.

These principles are briefly discussed below in relation to the findings of this study and in relation to other research findings.

8.4.1 Addressing change concerns through a skill acquisition model

Successes and failures of the inservice course

SMART had adopted the following training elements of a skill acquisition model (Showers, Joyce & Bennett, 1987) to develop teaching skills: information, demonstration, practice, follow up and feedback. Furthermore, following the CBAM model (Hall & Loucks, 1978), informational, personal and management concerns that teachers might have towards the change were addressed, integrated with the training elements of the skill acquisition model. No further common design principles had been defined for the development of these training elements in the SMART design principles. Chapter 4 presents how these training elements have been worked out for the '97 inservice course.

Teachers were adequately informed on what the change was all about in the initial workshop, according to the participants and the designer of the course (chapter 4). It therefore is assumed that informational concerns were adequately addressed. Although teachers were given the opportunity to discuss their personal concerns with the change, it was not possible to address individual concerns of all teachers in an adequate way. Furthermore, the practice in the 'try out' phase appeared to have limited functionality for most cases, in the sense that teachers have only used a limited number of exemplary lessons (from the teacher's guide) as intended by the designer. This means that most of these teachers have only been confronted by the pursued change in the 'try out' phase in a limited way, so that management concerns have not been optimally addressed with most teachers. Teachers mostly used the student materials adapted to their own way of teaching. The follow-up workshop therefore mainly dealt with problems that teachers had experienced in the 'try out' phase when they used student materials in their own way, and hardly with management concerns related to the change that the designer pursued.

However, some teachers changed in a more student-centred direction as intended, mainly through use of the student materials, and primarily because they wanted to change themselves. Addressing personal and management concerns appeared less an issue for these teachers.

The SMART intervention did not provide any further support to teachers to integrate the change more widely in their teaching. It was implicitly assumed that this was not required for the improvements that were pursued. This assumption appears to be false for most teachers when it comes to changes in note giving, textbook use and student involvement. The assumption seems valid when teachers already see a need for improvement themselves.
Whether or not teachers actually improved their teaching skills was not really assessed. Yet, the fact that some changed their behaviour as intended indicates that they managed to master the required skills adequately.

Comparison with similar interventions
Van den Berg (1996, 2001) found that a short inservice course that aimed at enhancing the implementation of a constructivist approach by primary education teachers in The Netherlands, with similar training elements as the SMART inservice courses (also integrated with exemplary materials), provided teachers with a clearer view of what to expect, the motivation to start, and curriculum materials as tools. This indicates that also this intervention did not go much beyond addressing informational and personal concerns of most participants, as was the case with the SMART inservice course.

Thijs (1999) observed that two-day inservice courses in Botswana - with a comparable design as has been adopted for the SMART inservice courses and with a similar target group - can be a useful means to introduce innovative teaching methods and create teachers' initial awareness of the change that is pursued. This observation is in line with the findings of Van den Berg (1996) and the findings of this study. She concludes that this type of course does not suffice when it comes to integration of more student-centred teaching on the longer term, even if the design of the courses is extended with the element of peer coaching. She proposes ongoing school-based support in conjunction with the formation of 'professional development interest groups' to gradually effect change over time, in which a constant link is made with teachers' actual classroom practice. The study presented in this book indicates that this probably holds true for the majority of teachers, but that minor successes can be achieved with motivated teachers simply by providing adequate resources.

Also the design of the Primary Science Programme (PSP) of South Africa (Harvey, 1999b) shows resemblance to the design of the SMART inservice intervention. In this project, the elements of science kits provision, centre-based workshops, provision of learning materials, school-based support and the development of subject-interest committees were integrated in a programme lasting three years, for which the Science Education Project (SEP) model[2] (Rogan & Macdonald, 1985) was adopted. Over the three year period there were seven one-day workshops per year and eight day-long 'classroom support' visits per year for ten schools. PSP staff pursued a vision of quality education in primary schools (only for science) that was activity-based.
The impact of the PSP programme was assessed via extensive classroom observation in terms of the extent to which participants had integrated certain student-centred teaching methods in their teaching. Contrary to the SMART biology inservice courses, the PSP inservice intervention seems to have realised substantial changes as intended by the PSP designers. Harvey (1999b) concludes that his findings confirm the effectiveness of the model in promoting activity-based teaching. The results indicated that especially intensive coaching in schools appeared to be crucial to address teachers' concerns adequately at all levels for obtaining effect. Teachers who received only workshop training did not differ much from teachers who had not received any inservice education at all. However, Harvey finds the conclusion that intensive coaching may be a prerequisite for change alarming, because it is simply not a realistic option for the less developed countries, as it is expensive and labour-intensive, and also requiring considerable skills (author's note: this probably also holds for most

[2] The SEP model consisted of the following phases:
i. Security Phase: focusing on subject knowledge and technical skill with apparatus.
ii. Methods Phase: focusing on internalising new generalisable teaching methods.
iii. Aims phase: teachers assume greater control over the aims of the project.

Western countries). Harvey suggests that in the absence of adequate support, it might be wise to limit educational reform to developing the quality of existing teacher-centred methods rather than attempting a radical shift in underpinning pedagogy. The findings of this study point in a similar direction, but indicate that a modest shift towards more student-centredness is feasible, even with the less expensive and less labour-intensive SMART type of intervention.
The experiences of the SEP project, aiming at improving science education at secondary level in Black schools, formed an important basis for the design of the PSP project. Also for the SEP project considerable effects are documented, in terms of change in instruction of teachers (Macdonald & Rogan, 1988), and in terms of improved student learning outcomes (Rogan & Macdonald, 1985). However, it appears to be doubtful whether the SEP efforts have achieved much in terms of the change it pursued towards more student-centred teaching (Rogan & Gray, 1999). Moreover, it is difficult to determine to what extent certain design principles have contributed to specific successes of the project (Macdonald, 1993).

The suggestion has been made before that an extension of the SMART intervention with more in-school support could be a means to address management and implementation concerns of teachers more adequately. This argument is supported by some of the studies that have been discussed in this section. Yet, research from Western countries (Campo 1993; Hargreaves, 1992; Zahorik, 1987), indicates that a culture of individualism appears to be alive in most schools, constraining initiatives to promote collaboration. Also in Swaziland, collaboration in and between schools is not very strong (Prenen, 1997). Dissatisfaction of teachers with the status of their profession plays an important role in this because it reduces motivation for collaborative initiatives in the context of inservice activities. Thijs (1999) proposes to start building on existing collaboration activities in schools, in which teachers perceive a clear practical benefit in terms of saved time or work (e.g. common schemes and tests). This seems a valuable extension of the more pragmatic (i.e. needs-based, clear benefits, realistic costs) approach towards inservice education, launched earlier.

8.4.2 Integration of clear and validated materials in inservice courses

Successes and failures of the materials

Exemplary materials (lessons in teacher's guide) were to be developed and integrated with the training elements of the skill acquisition model that had been

adopted for the design of the inservice courses. The main purposes of these materials were to exemplify specific teaching skills in behavioural terms in lessons, and to address especially management concerns of teachers. The SMART design principles are quite detailed as far as the design of curriculum materials is concerned. Chapter 4 describes the development and characteristics of the materials of the '97 course.
The findings of this study indicate that the student materials have been especially instrumental in promoting student involvement in lessons as intended. The exemplary lessons have been much less successful because of limited functional use in the 'try out' phase.

Comparison with materials from other interventions
Alberding (1996) found that none of the chemistry teachers who had participated in a SMART inservice course and who were visited in their school unannounced, had used the exemplary lessons as intended. This is in line with the findings of this study. Comparable findings have been reported by Voogt (1993) in a study in The Netherlands focussing on courseware (teacher's guide and student material) to support the implementation of an inquiry-based curriculum. Three of the five case teachers in her study ignored the teacher's guide and adapted the use of the student materials to their usual way of teaching. The introduction of the courseware was not integrated in an inservice course in this study. Voogt expected that integration of courseware with inservice courses would have accomplished more, as far as effectiveness of the exemplary material is concerned. The integration of curriculum materials in inservice courses seemed to be a promising approach at the time that the deliberations on the SMART design took place in 1993/'94, and still is seen as a promising approach by many (Ball & Cohen, 1996; Moonen, 2001; Ottevanger, 2001; Spillane, 1999; van den Akker, 1998; Roes, 1997; van den Berg, 1996). Exemplary materials can boost the effectiveness of inservice programmes, especially in their demonstration and practice components (Roes, 1997; Loucks-Horsley et al., 1998). Yet, Harvey (1999b) found that considerable effects can be achieved with inservice interventions that only provide 'learning materials' for students, and no further guidance in terms of (exemplary) materials for teachers, but that add considerable school-based support through coaching instead.

The findings of this study indicate that some, albeit modest, effects can be achieved through the provision of good quality student materials (that fulfil a specific need of teachers) in workshops, without further support in school through exemplary materials and/or coaching. However, it is expected that exemplary material can be a useful and even an essential instrument, especially for beginning teachers (who require specific support to survive and develop basic skills) and for experienced teachers (who want to embark on more complex changes and need examples of how to do it). The results of this study also indicate that the real potential of these materials can only manifest itself when adequate support or supervision is provided in the schools.

8.4.3 Positioning the SMART approach

In the SMART project, teacher education experts were charged with the main task of organising workshops to improve the teaching of science teachers. It is therefore not strange that the inservice approach adopted by the SMART team (a combination of elements of the skill acquisition model and CBAM model), had a lot in common with the 'expert model' as described by Sprinthall et al. (1996). Inservice based on the 'expert model' aims at shaping skills through behaviour modifications after which the teachers are expected to incorporate such individual behaviours in their teaching (a process) to promote student learning (a product). Basic assumptions for this approach are that: i) there is a core of information and skills that experts and professional teacher educators have developed; this knowledge base forms the framework for inservice programmes; ii) all teachers (from beginners to experienced/professional teachers) need advice to improve teaching; iii) providing information, demonstrating and practising of the skill as effectively as possible will lead to teachers using the method.
Although Sprinthall et al. (1996) acknowledge that improvements have been achieved through the 'expert model', they are convinced that more collaborative (interactive) models, taking into account cognitive development processes, are more effective on the long run. Clear proponents of more collaborative approaches based on more constructivist principles are e.g. Bell (1998), Lieberman (1992), and Marx, Freeman, Krajcik and Blumenfeld (1998). Also Joyce and Showers (1995) have revised their current focus, and have embedded their skill acquisition model (classified as an 'expert model' by Sprinthall et al. (1996), and an important pillar of the SMART inservice design) within a framework of teacher growth.
In hindsight, the 'expert model' was probably a plausible 'choice' for SMART under the given circumstances (see section 8.3). It also has been adopted because it seemed to be a successful model at the time that the deliberations on the

SMART design took place in 1993/'94. Joyce and Showers (1980) even indicated that when inservice was geared to fine-tuning of knowledge and skills, the elements of instruction with demonstration probably would suffice. They did, however, emphasise that when complex models of teaching were being introduced, that instruction, demonstration, practice with feedback and coaching were all crucial elements of inservice programmes. Because SMART staff decided to limit the change to improvement of basic teaching skills, the skill acquisition model seemed to be an appropriate model, and probably still is. However, it seems fair to say that SMART has gone some steps beyond the fine-tuning of basic teaching skills in the '97 inservice course. And, although the reduction of note giving in combination with promotion of use of textbooks by students might have seemed fine-tuning in the eyes of the designers at that time, it appeared to be a major leap in the eyes of most teachers. This study makes clear that for these kinds of behavioural changes - which appear to be major - the 'expert model' does not suffice for most teachers in the way it has been designed. More tailor-made, collaborative approaches embedded in a conducive school climate are probably required to facilitate such changes for most teachers.
Yet, currently the skill acquisition/CBAM model still forms an important basis for design of inservice courses all over the world (Loucks-Horsley, 1998; Sprinthal et al., 1996; Guskey, 2000), albeit that integration with more collaborative elements is recommended, especially when considerable changes in teaching behaviour are pursued - see also Ross, Rollheiser & Hogaboam-Gray (1998) and Olson, et al. (1999) for examples.
Based on the successes of the PSP project in South Africa, Harvey (1999b) proposes to adopt the model used as a basis for design in this project (with strong similarities with the skill/CBAM model) as a general model for improving the quality of science education in developing countries. This seems surprising considering his doubts on the sustainability of the observed effects after the three year course had ended, and his doubts on the feasibility of such intensive and expensive programmes for these contexts. A more flexible approach, in which an inservice model is chosen that fits the inservice goal and the educational context, seems more appropriate and will be elaborated upon in the next section.

8.5 Enhancing the potential of inservice education

The potential of inservice education to improve science education should ultimately manifest itself in improved learning outcomes of students. In this study it has been assumed that the intended improvements in teaching would lead to 'better' learning.

The potential of the SMART inservice intervention to improve basic teaching skills and promote student involvement in Swaziland has been elaborated in section 8.2. In section 8.3 it has been discussed how the potential of the intervention could be improved through addressing specific factors at the micro-, meso- and macro levels of education. Subsequently, section 8.4 reflected on the main design principles of the course and to what extent they have contributed to the obtained effects. It also discussed possible improvements that could be made in these design principles to enhance the effect of the intervention.

This study shows that a SMART type of intervention has the potential to improve science education for specific target groups in specific situations for which adaptations in the design will sometimes be required. However, many other designs could be considered and might be more suitable for specific purposes, target groups and contextual situations.

Subsection 8.5.1 discusses issues of feasibility that should be considered before decisions on design are made. Subsequently, some guidelines are provided in 8.5.2 for a more flexible approach towards inservice design.

8.5.1 Contemplating feasibility

In considering the feasibility of an inservice approach for a specific situation, it is important to know what status the teaching profession has. Two extreme views exist which focus on the relation between government and education in a society (Naeve, 1992; OECD, 1990), which are known as: i) the 'minimum competency model'[3] and ii) the 'open professionalism model'[4]. In most societies, the prevailing view will probably be somewhere in the middle between these two extremes.

At the time that SMART was operational, the ruling view in Swaziland was more inclined towards the 'minimum competency model'. The profession of teaching had a low status; teachers were seen as mere technicians, and change initiatives were scarce and generally not embraced by the system. SMART was in fact an expert skill centre that focussed on

3 Minimum competency model: The teacher is regarded primarily as a technician who is able to implement the curriculum that has been defined by external bodies. The inservice is mostly framed and measured in terms of (basic) skills; inservice institutes are in fact skills centres.

4 Open professionalism model: Regards teachers with their knowledge and expertise as key-persons in the process of educational change. Coincides with the tendency to decentralise governance in education. Cannot be realised by short-term interventions but only by supporting the developmental processes of teachers in the context of their schools.

improving teaching skills, which seemed to fit the situation.
The earlier mentioned PSP and SEP projects clearly had adopted the 'open professionalism' model as a vantage point for their inservice efforts, which can be understood from an ideological and political point of view, considering the circumstances at that time (cf. Rogan & Gray, 1999; Gray, 1999). Educational change was not the only thing that motivated teachers to participate zealously in these projects during the 'Apartheid era'; social and political factors also playing an important role (Rogan & Gray, 1999). The consequences of radically changing from systems with a 'minimum competency' reality to a system of 'open professionalism' are often not considered in much depth in countries that radically want to erase all elements of suppression and inequality that were linked to the previous regime (cf. Rowell, 1995).
In some western countries, teacher associations have recently come to a consensus on teaching standards. Advocates of such standards argue that major limitations in traditional systems of inservice education could be overcome this way, such as: i) the lack of clarity about what aspects teachers need to improve, ii) the lack of incentives, and iii) the low level of personal ownership (Ingvarson, 1998). Others fear that this will degrade the teachers to (or maintain them at) the technician status of the 'minimum competency model'.
It probably makes sense to adapt the design of inservice support to teachers to the status that has been designated to the teaching profession in a society. Yet, it can happen that teachers resent it when they are merely seen as technicians, as Hungwe (1994) reports from Zimbabwe.

Next to whether a certain approach is feasible for a specific contextual situation, it is also important to consider whether the inservice approach is feasible in terms of staffing, expertise and resources. These 'down to earth' factors probably clarify to a great extent the considerable gap that exists between what is perceived to be good design based on traditional models and methodology originating from research, and how professional designers of education products actually design (Loucks-Horsley et al., 1998; Visscher-Voerman, 1999). Harvey (1999b) notes that planning of INSET in practice still remains largely a matter of ideological commitment, intuition and rule of thumb. Guskey (2000) adds that evaluations of inservice interventions in practice often have limited value because inservice educators are often vague about the intended outcomes of their courses.
Most authors maintain that it does not need to be difficult, expensive and time-consuming to design and evaluate courses using 'state of the art' theory, but that it is important to start from the existing practical situation.

Finally, it will be individuals who will decide on the specifics of design of an inservice intervention. To come to a consensus on design, of which the persons responsible for the programme have an internally consistent perspective, is probably the hardest nut to crack. Anderson and Mitchener (1994) note that a plurality of orientations and approaches exist amongst educators because people hold different expectations for schools and teachers, and because in any complex human endeavour there are always more goals to strive for than one can achieve at the same time. To facilitate analysis and deliberation and to reach an internally consistent perspective, they suggest accepting any such orientations as viable, and try to make them explicit in order to highlight the issues that should be considered. This study illustrated that the SMART team has made a commendable effort to reach consensus on inservice design. Yet, in the end it appeared that some orientations and issues have not been adequately clarified and considered during the SMART staff deliberations. This might have led to some inconsistency in implementation between the different science subjects: for some the SMART approach appeared less feasible and desirable than for others.

8.5.2 Towards a flexible approach for inservice design

Several authors (Beeby, 1966; de Feiter et al., 1995; Verspoor & Leno, 1986) have attempted to get an overall picture of how educational systems work and advance in developing countries, and how inservice education should tie in with these insights to remedy shortcomings or facilitate improvement. The danger for oversimplification of such attempts has been pointed out before (Harvey, 1999b).
The findings of this study indicate that a more flexible approach - one which combines realistic end-points for specific target groups in specific situations with appropriate design principles - has greater potential on the short- and long-term.
Based on the lessons learnt in this study, an attempt has been made to propose what steps should be considered to design an inservice programme that is appropriate for a specific goal and target group, and feasible in a specific educational context. This has been done by answering the following questions: i) how to get started? ii) how to approach curriculum design for inservice courses? iii) how to approach instructional design for inservice courses? iv) how to approach evaluation design for inservice courses? The specific steps for this 'smart approach' towards inservice design are elaborated in box 8.1 below.

Box 8.1: Enhancing the potential of inservice education: steps to consider in the design process

1. Getting started

i) *The 'expert model' or the 'collaborative model'*

If possible, make a preliminary decision about which model for inservice design would suit the contextual situation best. If the view of 'minimum competency' prevails in the system, a more 'expert-based' model probably is the most realistic choice. Of course, combinations of elements from both models are possible.

ii) *Identification of the designers*

When an 'expert model' is adopted, the experts will be the designers. With collaborative models, teachers most likely play a more important role. In both cases, it is important to identify important stakeholders in the design (e.g. preservice teacher educators, inspectorate, school administrators), and determine what influence they will have in design decisions.

iii) *Identification of a professional development problem or need*

When a 'expert model' is adopted for design, it is mostly the experts who will decide what problem or perceived need will be tackled. With more 'collaborative-based' models teachers obtain a more important role in this. However, it is very likely that policy makers have determined the problem or need already. Nevertheless, this aspect needs a lot of consideration as has been illustrated in this study, because it has enormous consequences for staffing, resources and design. A general lesson that has been learnt from experiences with inservice education is that the pursuit of revolutionary changes (e.g. changing from 'teacher centred' to 'student centred' teaching) mostly has very limited results in general. Furthermore, this study indicates that it is important to identify a specific target group of teachers (e.g. depending on professional stage of development of teachers) and identify their professional development needs, rather than for all (science) teachers in general.

iv) *Choosing a planning strategy*

It is important to clarify the following at the start, as far as possible:

- what the main events in the design process will be, related to curriculum, instructional, and evaluation design;
- what time frame will be used;
- how decisions will be made related to design and its improvement;
- what external expertise will be required;
- how design products will be checked on consistency with agreed principles.

v) *Acquiring design skills*

Ensure that all who are going to be involved in the design have an acceptable understanding of, and skills in the essential processes of curriculum, instructional, and evaluation design. This is essential for equal participation in the deliberations on design, and for the consistency of subsequent products. Design skills could be developed through training on the job with more experienced inservice educators involved.

Box 8.1: Enhancing the potential of inservice education: steps to consider in the design process *(CONTINUED)*

2. Curriculum design

The term *curriculum* is defined here as a document that clarifies the following for an inservice program in general: i) what is to be learnt, ii) why it is to be learnt, and iii) how to facilitate this learning. This is the plan for learning of the teachers who participate in the inservice course (on a higher level of abstraction), as jointly agreed upon by the designers and laid down in formal documents. This formal inservice curriculum should contain at least the following:

i) a clearly defined goal and intended outcomes of the planned inservice education, related to the identified problem/need of the specified target group;
ii) clearly formulated design principles that have been adopted for the design of the inservice courses that have to achieve the intended outcomes related to:
  - the inservice model that has been adopted; the choice of inservice model (or elements thereof) will depend on the of goal of the programme (e.g. fine tuning or major change in pedagogy) in relation to the stage of development of the target group (survival phase, adjustment phase, or mature conventional/experimenting phase); the most recent overview for design of professional development courses for science teachers is provided by Loucks-Horsley et al. (1998);
  - curriculum materials to be developed;
iii) a rationale for the inservice model that has been adopted as a basis for design, taking into account the perceived problem/need, the target group and the contextual situation;
iv) a protocol that clarifies how instructional plans will be checked on alignment with the curriculum agreed upon.

3. Instructional design

An instructional plan is defined here as a document that clarifies the following for a concrete inservice course: i) what is to be learnt, ii) why it is to be learnt, and iii) how it has to be learnt. These are the documents in which concrete objectives and instructions (e.g. instruction sheets for group work in workshops, exemplary lessons for practice in schools) are laid down for specific training elements of inservice courses based on the curriculum agreed upon. Quite often instructional plans will be developed by individual designers, or a smaller group of designers than the group that decided on the curriculum. The instructional plans should at least have been:

i) checked on alignment with the curriculum;
ii) validated by experts and tested in classrooms in case of (exemplary) curriculum materials.

4. Evaluation design

An evaluation plan is defined here as a document that clarifies for an inservice programme: i) when formative and/or summative evaluations will take place to establish to what degree intended outcomes of the programme/courses have been achieved, and which factors have played a role in this, ii) on which levels (participants' reactions, participants' learning, organisation support and change, participants' use of new knowledge and skills, and/or student learning outcomes) the evaluation(s) will take place, and iii) who will carry out these evaluations.

An evaluation of an inservice programme/course should at least:

i) result in empirical evidence on the extent in which intended outcomes have been achieved (its worth);
ii) recommendations for improvement or termination.

It will be clear that no time and money should be wasted on evaluation of inservice activities of dubious design (e.g. one-shot inservice activities, and inservice courses for which the outcomes have not been clarified).

The most recent overview for evaluation of professional development courses is provided by Guskey (2000).

8.6 In conclusion

This study has contributed to knowledge growth on the following areas:

I. the potentials and limitations of skill acquisition models - also addressing change concerns - in improving science education in a developing world context;
II. the potentials and limitations of the integration of curriculum materials in inservice education to improve science education in a developing world context;
III. specific professional development needs of teachers in a developing world context, in relation to their stage of professional development;
IV. the potential to achieve change or improvement of education through inservice education in a developing world context;
V. how inservice educators could design professional development programmes more effectively in an attainable way in a developing world context;
VI. how to approach evaluation of inservice courses in a developing world context.

A considerable body of knowledge is available at the moment to design inservice education, which has potential for a specific target group taking account of the specific contextual situation. Further research will have to monitor new design efforts so that further improvements can be made towards better professional development -and ultimately better learning outcomes of students. Evidence that the latter also is a definite result of inservice education remains scarce. Although not easy, it is important to provide more tangible indications of success in this regard to maintain the credibility of inservice education and its role in improving education in developing countries: an important task for future research.

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Samenvatting
Het verbeteren van het onderwijs in de exacte vakken in Swaziland: de rol van nascholing

Inleiding

Verbetering van het onderwijs in ontwikkelingslanden krijgt op het ogenblik weer veel aandacht, met name in het kader van armoedebestrijdingprogramma's. De afgelopen decennia hebben de meeste ontwikkelingslanden na het bereiken van onafhankelijkheid een groot gedeelte van hun, veelal beperkte, nationaal budget besteed om iedere burger de mogelijkheid te verschaffen funderend onderwijs te kunnen volgen. Wat betreft het primair onderwijs zijn goede vorderingen gemaakt, maar de toegankelijkheid van het middelbaar onderwijs ziet er over het algemeen nog heel wat minder rooskleurig uit. Verder waren de middelen over het algemeen te beperkt om voldoende aandacht te besteden aan kwaliteitsverbetering van het onderwijs.
Het SMART-project *(Science & Mathematics Advice and Regional Training)* aan de Universiteit van Swaziland was erop gericht om met name het onderwijs in de exacte vakken (biologie, natuurkunde, scheikunde en wiskunde) in het voortgezet onderwijs in Swaziland te verbeteren. Dit nascholingsproject, ondersteund door de Vrije Universiteit van Amsterdam, heeft dit op drie manieren aangepakt: i) het opzetten van nationale en regionale inservice centra met geschoolde lokale inservice docenten, ii) het ontwikkelen en uitvoeren van nascholingscursussen, en iii) het verbeteren van de faciliteiten van scholen voor het onderwijs in de exacte vakken.
Het in dit proefschrift beschreven onderzoek richt zich op een nascholingscursus die in het kader van het SMART-project in Swaziland ontwikkeld en uitgevoerd is. Het doel van de studie is het inzicht te vergroten in de rol die nascholingscursussen kunnen hebben bij het verbeteren van onderwijs in dergelijke contexten. Hiertoe zijn de effecten van de cursus geëvalueerd en geïnterpreteerd

in relatie tot de gehanteerde ontwerpprincipes voor de cursus en in relatie tot factoren in de onderwijscontext van Swaziland. De volgende vragen hebben richting gegeven aan het onderzoek:

Hoe zijn de SMART-ontwerpprincipes totstandgekomen en hoe zijn deze principes geconcretiseerd in de nascholingscursus?

Welk effect heeft de cursus gehad op het lesgedrag van de leraren die aan de cursus deelnamen? Hoe kunnen de vastgestelde effecten geïnterpreteerd worden?

Ter beantwoording van deze onderzoeksvragen zijn de volgende studies uitgevoerd: i) een *reconstructiestudie* naar ontwerp en ontwikkeling van de nascholingscursus, ii) een *evaluatiestudie* om het effect van de cursus vast te stellen, en iii) een *interpretatieve studie* om de effecten te duiden.

Ontwerp en ontwikkeling

Een grote uitdaging waar het SMART-team al snel mee geconfronteerd werd, was overeenstemming te krijgen over basis ontwerpprincipes voor de ontwikkeling van nascholingscursussen in alle exacte vakken. In het overleg over ontwerpprincipes hebben de volgende elementen en factoren een belangrijke rol gespeeld:

- uitgangspunten, richtlijnen en budget in het SMART-projectdocument;
- resultaten van een evaluatiestudie van één van de eerste SMART-inservice cursussen;
- een literatuurstudie naar effectieve vormen van nascholing;
- advies van deskundigen van de Universiteit Twente en de Vrije Universiteit van Amsterdam.

In het SMART-projectdocument was al bepaald dat workshops en curriculummaterialen belangrijke ingrediënten in de SMART-benadering moesten gaan vormen. De eerste nascholingscursussen die door SMART georganiseerd werden bouwden voort op de aanpak die gehanteerd werd in een voorafgaand gelijksoortig nascholingsproject. In eendaagse workshops ontvingen leraren een bundel leerlingmateriaal die actief leren moesten bevorderen. In de workshops werd leraren de gelegenheid gegeven de leerlingactiviteiten zelf uit te proberen, met de verwachting dat ze deze activiteiten dan succesvol in hun lessen zouden integreren. Een evaluatie van zo'n cursus leidde tot twijfel over de effectiviteit van deze aanpak, hetgeen aanleiding was tot heroverwegingen over het ontwerp van de nascholingscursussen.

In de SMART-ontwerpprincipes, waarover overeenstemming werd bereikt, valt veel te herkennen van wat er door de literatuurstudie was aangereikt en door externe adviseurs werd benadrukt. Met deze principes wilde het team duidelijkheid en uniformiteit bewerkstelligen voor het ontwerp van de SMART-cursussen. Inhoudelijk werd het volgende overeengekomen: i) het belangrijkste doel van de cursussen is het verbeteren van (elementaire) didactische vaardigheden, ii) de belangrijkste doelgroep betreft onervaren leraren waarvan verondersteld wordt dat ze behoefte hebben aan deze ondersteuning, en iii) de inservice inspanningen moeten afgestemd worden op de onderwijsrealiteit in de scholen. Ook werd besloten dat de elementen informatie, demonstratie, praktische oefening en feedback (van het 'skill acquistion' model van Joyce en Showers, 1988) de procedurele basis voor het ontwerp van de SMART- inservice cursussen zouden moeten vormen. Deze trainingselementen dienden te worden opgenomen in een sandwich-aanpak bestaande uit een tweedaagse workshop, gevolgd door een (onbegeleide) praktijkperiode in school van drie maanden, waarna de cursus werd afgesloten met een workshop van een halve dag. Verder werd overeengekomen dat curriculummaterialen een belangrijke exemplarische functie in al de scholingselementen moesten gaan vervullen, maar vooral gedurende de praktijkperiode.
Alhoewel er een belangrijke stap naar verduidelijking en uniformiteit was gezet, bleven er nog wel onduidelijkheden over in het ontwerp. Zo was bijvoorbeeld niet duidelijk geformuleerd wat er met (elementaire) didactische vaardigheden werd bedoeld. Ook bestond onvoldoende duidelijkheid over hoe er rekening gehouden moest worden met de realiteit in de klas. Concentratie op de doelgroep werd ook bemoeilijkt omdat het ministerie eiste dat alle leraren moesten kunnen deelnemen aan de cursussen. Tenslotte, waren de ontwerprichtlijnen voor de te ontwikkelen curriculummaterialen zeer uitgebreid, maar was er weinig steun voor het uitwerken van de trainingselementen van het 'Joyce en Showers model' in concrete instructie.

Deze studie richt zich op één specifieke nascholingscursus - die ontwikkeld is op basis van de SMART-ontwerpprincipes - voor biologieleraren. De trainingsonderdelen van deze cursus zijn georganiseerd in de periode van mei tot augustus 1997. In hoofdstuk 4 wordt beschreven hoe de SMART-ontwerpprincipes vertaald zijn in concrete instructie in de trainingselementen en in de exemplarische lessen van het curriculummateriaal. Naast het verbeteren van didactische basisvaardigheden (voorbereiding van en reflectie op lessen, het geven van aantekeningen, het gebruik van het leerboek, en het geven en nakijken van huiswerk) werd er in de cursus ook aandacht besteed aan het bevorderen van leerlinggericht onderwijs.

Effecten van de nascholingscursus in perspectief: evaluatie en interpretatie

Voor de evaluatieve en interpretatieve studies zijn negen leraren geselecteerd uit de deelnemers van de nascholingscursus voor diepgaand onderzoek. De uitgebreide en gevarieerde dataverzameling richtte zich met name op veranderingen in onderwijsgedrag op de korte en lange termijn, en de interpretatie hiervan. Met name lesobservaties door de onderzoekers, percepties van de individuele leraren, percepties van leerlingen, en documenten van leraren en leerlingen verschaften de gegevens over onderwijsgedrag en eventuele veranderingen hierin. Bij het duiden van de effecten is in eerste instantie uitgegaan van het perspectief van de individuele leraren. Dit perspectief is in interviews gaandeweg verscherpt waarbij ook de (soms tegenstrijdige) gegevens, die van verschillende bronnen over twee jaren verzameld waren, werden ingebracht. Bij de uiteindelijke duiding van de effecten heeft ook het referentiekader van de onderzoeker een rol gespeeld. Bij de presentatie van de resultaten worden de duiding van de effecten vanuit respectievelijk het perspectief van de leraar en de onderzoeker zo veel mogelijk gescheiden behandeld.

Wat betreft het verbeteren van *didactische basisvaardigheden* liepen de effecten van de cursus nogal uiteen. Zo heeft de cursus nauwelijks effect gehad op de lesvoorbereiding van de leraren. Voor de zeer onervaren leraren was lesvoorbereiding een zaak van overleven die door allen serieus werd aangepakt. De lesvoorbereiding was echter met name gericht op het vullen van lessen met leerstof en nauwelijks op leerhandelingen en uitkomsten zoals werd nagestreefd door de cursus. Het bestuderen van de lesstof en het maken van aantekeningen voor leerlingen waren en bleven de belangrijkste lesvoorbereidende activiteiten van deze leraren. Geen van de meer ervaren leraren besteedde serieuze aandacht aan lesvoorbereiding en dit veranderde niet na participatie in de cursus. Lesvoorbereiding werd over het algemeen als een symptoom van onervarenheid gezien. De echte 'doceerders' onder deze leraren baseerden hun lessen jaar in jaar uit op de aantekeningen die ze in hun eerste jaren gemaakt hadden. De meer leerlinggerichte leraren gebruikten daar ook het leerlingmateriaal voor dat ze verzameld hadden. Ook bij de ervaren leraren waren de lessen nauwelijks gericht op leeruitkomsten zoals werd nagestreefd door de cursus. De meer leerlinggerichte leraren zagen het materiaal als een middel om leerlingen meer actief bij de les te betrekken met een minimum aan lesvoorbereiding. Het reflecteren op lessen dat eveneens in de cursus werd bevorderd is door geen van de leraren echt in praktijk gebracht.

Ook werd er in de nascholingscursus gestreefd naar een vermindering van de leerboekvervangende aantekeningen die de meeste leraren gaven, gecombineerd met een actiever gebruik van het leerboek door de leerlingen. Dit bleek voor de zeer onervaren leraren geen realistisch streven te zijn. Het eerste wat deze leraren deden als ze begonnen met lesgeven was het aanleggen van een rijk arsenaal van notities. Deze nieuwelingen in het vak kozen voor de methode die reeds lang door hun collega's beproefd was en door leerlingen als normaal werd ervaren. Verder is het geven van aantekeningen een middel om rust in de klas te handhaven of te herstellen, zeker voor onervaren leraren. Ook het merendeel van de ervaren leraren maakte niet de stap naar minder aantekeningen en beter leerboekgebruik. Ondanks dat sommigen de voordelen hiervan zagen, bleek het een te grote stap en het eindpunt te onzeker voor de meeste leraren. Slechts één leraar slaagde erin het roer volledig om te gooien. Hij had duidelijk gekozen voor een meer leerlinggerichte manier van lesgeven - nadat hij in meerdere biologie cursussen had geparticipeerd - en vond dat leerboekvervangende notities daar niet in thuis hoorden.

De cursus had het effect dat - vooral onervaren - leerkrachten meer aandacht besteedden aan huiswerk. Huiswerk werd vooral gegeven en gecontroleerd om meer invloed te hebben op het leergedrag van leerlingen, maar nauwelijks voor formatieve evaluatie van vorderingen van individuele leerlingen. Daarentegen gaven sommige ervaren leerkrachten nooit huiswerk, ook niet na de cursus. Zij waren van mening dat huiswerk alleen diende om leerlingen aan te sporen tot

leren en vonden dat dit veel beter gerealiseerd werd door het geven van overhoringen en proefwerken.
De conclusie luidt dat het bij de didactische basisvaardigheden niet altijd om simpele gedragsveranderingen ging. Met name de veranderingen in het geven van aantekeningen en het leerboekgebruik betekende een (te) grote kentering in onderwijsgedrag. Meer succesvol was de interventie als het om relatief kleine aanpassingen in onderwijsgedrag ging (bijvoorbeeld bij huiswerk, het introduceren van een goed leerboek, verbeteringen in het behandelen van lesinhoud) die tegemoet kwamen aan reële behoeftes voor professionele ondersteuning bij de leraren.

Ook bij het bevorderen van *leerlinggericht onderwijs* liepen de resultaten van de interventie uiteen. Succes werd er vooral geboekt bij sommige van de meer ervaren leraren. Deze leraren waren al gemotiveerd om leerlingen actiever bij hun lessen te betrekken, hetgeen zeker bevorderd is door hun frequente participatie in eerdere nascholingscursussen. Vooral het verschaffen van leerlinggerichte onderwijsactiviteiten ('hands-on/minds-on' leerlingmateriaal) was effectief. Geen van deze leraren slaagde er echter in de meer complexe leerlinggerichte activiteiten van het materiaal (zoals rollenspel, experimenten, veldwerk en projecten) succesvol toe te passen. Echter, bij de 'doceerders', die het merendeel van de ervaren biologieleraren in Swaziland uitmaken, heeft de interventie weinig bereikt wat dit betreft. De stap was voor deze leraren duidelijk te groot.
Voor de zeer onervaren leraren bleek leerlinggericht onderwijs ook geen realistisch streven te zijn. Deze leraren hadden het over het algemeen veel te druk met zich staande te houden in een voor hun nieuwe situatie; ze waren dan ook niet snel geneigd eveneens te gaan experimenteren met voor hun nieuwe vormen van onderwijs.
Al met al blijkt docentgericht onderwijs de normaalste zaak van de wereld als biologieleraren in Swaziland de school binnenstappen. Dit proberen te veranderen blijkt moeilijk, maar niet onmogelijk.

Uiteraard waren *factoren in de onderwijscontext* ook van invloed op de effectiviteit van de interventie. Op het niveau van het onderwijsleerproces bevestigen de resultaten de bevindingen van eerdere studies dat het effect van de interventie veel meer bepaald wordt door het persoonlijk referentiekader van gevoelens, kennis en waarden van de leraren dan door specifieke beperkende factoren in de onderwijsleeromgeving. Ook bevestigt deze studie dat het belangrijk is om bij het ontwerpen van nascholingscursussen rekening te houden met de specifieke 'concerns' die leraren in bepaalde stadia van hun professionele ontwikkeling hebben omtrent hun taak van lesgeven. Het feit dat alle biologieleraren tot de cursus moesten worden toegelaten heeft dan ook beperkend gewerkt voor de effectiviteit van de cursus. Wat betreft het bevorderen van leerlinggericht onderwijs heeft de interventie het meeste effect gehad bij meer ervaren, gemotiveerde leraren die al een behoorlijk stuk zelfvertrouwen in het lesgeven hadden ontwikkeld.

Ook factoren op het meso- en macroniveau waren van invloed op de effectiviteit van de cursus. Het zijn vooral de beperkingen op deze niveaus (met name het gebrekkige onderwijsbeleid ten tijde van SMART, het feit dat de verbeteringen alleen het science- onderwijs betroffen, de beperkte wederzijdse afstemming van nascholingscursussen en preservice lerarenopleidingen, de onvoldoende betrokkenheid van belanghebbenden bij het ontwerpen en implementeren van de nascholingsinterventies, beperkingen in de examens en professionele beperkingen) die de invloed van nascholing sterk gelimiteerd hebben.

Ook onvolkomenheden in *het ontwerp van de cursus* kunnen het effect beperkt hebben. Reeds eerder werd gesteld dat de '97 nascholingscursus over het algemeen conform de SMART-ontwerpprincipes ontwikkeld was. De resultaten van de evaluatiestudie wijzen erop dat de cursus, door middel van het verschaffen van informatie over en demonstraties van de didactisch vaardigheden, de leraren voldoende geïnformeerd heeft over het 'wat, waarom en hoe' van de veranderingen. En, ofschoon in de twee workshops de gelegenheid werd gegeven om problemen te bespreken die leraren hadden met de voorgestelde veranderingen, was het onmogelijk dit voor elke individuele leraar adequaat te doen. Verder bleek dat het praktiseren van de vaardigheden in de scholen middels de exemplarisch lessen voor de meeste leraren gering was. De meeste leraren hebben daarom slechts een beperkt beeld gekregen van wat de veranderingen in de schoolpraktijk voor hen zouden betekenen. Ook de leraren die gemotiveerd waren om leerlingen actiever bij hun les te betrekken maakten veelal weinig gebruik van de exemplarisch lessen. Het zijn vooral de 'hands-on/minds-on' activiteiten van het leerlingmateriaal die deze leraren op hun eigen manier gebruikten en waarmee sommigen meer leerlinggericht onderwijs in hun lessen realiseerden. De potentie van exemplarisch materiaal zal waarschijnlijk verhoogd kunnen worden als dit gericht is op de behoefte aan professionele

ontwikkeling van specifieke doelgroepen (bijv. beginnende leraren) en gepaard gaat met adequate begeleiding in de scholen.
Aan het ontwerp lag de aanname ten grondslag dat als het in nascholing om beperkte veranderingen (bijv. het verbeteren van elementaire didactische vaardigheden) gaat, leraren na actieve participatie in de volledige cursus geen verdere ondersteuning nodig hebben om de veranderingen in hun dagelijks lespatroon te integreren. Deze aanname is waarschijnlijk nog steeds juist indien het werkelijk om elementaire didactische vaardigheden gaat (hetgeen in de '97 cursus niet altijd het geval bleek). Echter, als het gaat om leerlinggericht onderwijs in de scholen te introduceren, kan dit waarschijnlijk voor de meeste leraren alleen bereikt worden met intensieve ondersteuningsprogramma's in de scholen, met name in de 'implementatie' en 'impact' fasen. Ook resultaten van andere studies in zuidelijk Afrika wijzen in deze richting.

Naar een optimale rol voor nascholing

Deze studie toont aan dat het SMART-type nascholingsinterventie een effectieve rol kan spelen in initiatieven ter verbetering van het middelbaar onderwijs in Swaziland als de interventie zich richt op specifieke doelgroepen en hun specifieke situatie. Hiertoe zullen soms aanpassingen, zoals eerder aangegeven, in het ontwerp gemaakt moeten worden. Enkele overwegingen worden hieronder kort samengevat.

Het is van belang naar *haalbaarheidsfactoren* te kijken. Zo is het de moeite waard vast te stellen welke status de leraarprofessie heeft in een bepaald land. Wordt bijvoorbeeld in een land de leraar primair beschouwd als een 'technisch uitvoerder', waarvan verwacht wordt dat deze het curriculum implementeert zoals wordt voorgeschreven, dan ligt het voor de hand in de nascholing de nadruk te leggen op het verbeteren van didactische vaardigheden ter bevordering van een getrouwe curriculumimplementatie. In waarschijnlijk wat zeldzamer situaties kan het voorkomen dat leraren als de sleutelfiguren gezien worden in de verbetering van het onderwijs. In deze visie kan een onderwijsverandering alleen een succes worden als deze door de leraren en de scholen gedragen worden. In de onderwijscontext van Swaziland heeft de leraar vooral de status van 'technician' en SMART richtte zich voornamelijk op het verbeteren van de vaardigheden van de leraren. Verder zal ook rekening gehouden moeten worden met haalbaarheidsfactoren op instellingsniveau alwaar het nascholingprogramma ontworpen en uitgevoerd moet worden.

Het lijkt niet verstandig één bepaalde aanpak voor nascholing in ontwikkelingslanden te propageren. Hiervoor is de realiteit te divers en te weerbarstig. Gebaseerd op de ervaringen in deze studie wordt aanbevolen een meer *flexibele aanpak voor het ontwerpen en ontwikkelen van nascholingscursussen* te volgen, die gericht is op een specifiek doel en een specifieke doelgroep en haalbaar is in een specifieke context. In hoofdstuk 8 worden hiertoe vier ontwerpstappen in detail beschreven waarbij antwoord gegeven wordt op de volgende vragen: i) hoe te beginnen? ii) welke stappen moeten genomen worden in het ontwerpen van een nascholingsprogramma? iii) welke stappen moeten genomen worden in het ontwikkelen van instructie (voor trainingselementen en lesmaterialen) van een specifieke nascholingscursus? iv) waar moet aan gedacht worden bij evaluatie van nascholingscursussen?

Opbrengst van de studie

Samenvattend kan gesteld worden dat deze studie op de volgende terreinen bijgedragen heeft aan kennisvermeerdering:

1. De mogelijkheden en beperkingen van 'skill acquistion' modellen - waarbij ook rekening gehouden wordt met de 'concerns' van leraren - als basis van ontwerp van nascholingscursussen die gericht zijn op het verbeteren van science-onderwijs in ontwikkelingslanden.
2. De mogelijkheden en beperkingen van de integratie van curriculummaterialen in het ontwerp van nascholingscursussen die gericht zijn op het verbeteren van science onderwijs in ontwikkelingslanden.
3. De specifieke behoeften van leraren in een ontwikkelingsland voor ondersteuning in hun professionele ontwikkeling in relatie tot de ervaring die ze opgedaan hebben in het lesgeven.
4. De potentiële rol die nascholingsinterventies kunnen spelen in het verbeteren van het onderwijs in ontwikkelingslanden.
5. Het efficiënt ontwerpen en ontwikkelen van potentieel effectieve nascholingscursussen in een ontwikkelingslandcontext.
6. Evaluatie van nascholingscursussen in een ontwikkelingslandcontext.

De kennis die op het ogenblik geaccumuleerd is op het gebied van het ontwerpen van nascholingscursussen, waarbij rekening gehouden wordt met een specifieke doelgroep en contextuele situatie, is aanzienlijk. Desalniettemin is het belangrijk nieuwe en betere ontwerpen te blijven ontwikkelen en evalueren ter verdere optimalisering van toekomstige INSET (INService Education and Training) initiatieven die uiteindelijk een substantiële bijdrage leveren aan het beter leren (en een betere toekomst) van de jonge generaties van ontwikkelingslanden. Dat dit laatste ook een gevolg is van nascholingsinterventies wordt nog te weinig door onderzoeksresultaten aangetoond. Hoewel dergelijk onderzoek gecompliceerd is, lijkt het voor de geloofwaardigheid van nascholing, en haar rol in het verbeteren van onderwijs in ontwikkelingslanden, van belang in de toekomst meer in dit soort onderzoek te investeren.

Appendix A
Country status indicators for wealth, illiteracy and education

(From: UNESCO World Education Report 1998)

COUNTRY STATUS INDICATORS

DATA PER COUNTRY

	Parameters	*Swaziland*	*South Africa*	*Botswana*	*Mozambique*	*Lesotho*	*Nether-lands*
I. Wealth	1. GNP per capita in US$ '92 1995	1080 1170	2670 3160	2790 3020	60 80	590 770	20590 24000
	2. Average annual growth rate (%) of GNP 1980-92 1985-95	1.6 0.6	0.1 –1.0	6.1 6.0	–3.6 3.6	–0.5 1.5	1.7 1.8
II. Illiteracy	3. Estimated adult illiteracy rate in 1995 (%)	23.3	18.2	30.2	59.9	28.7	–
	4. Expected number of years of formal schooling 85/95	–/11.2	–/13.1	8.5/10.6	–/3.4	9.1/8.3	15.0/15.5
III. Education structure & efficiency	5. Duration primary and secondary education (in years)	7+5	7+5	7+5	5+7	7+5	6+6
	6. Net enrolment ratio (%) primary education 1985 1995	79 95	– 96	89 96	51 40	71 65	82 99
	7. Net enrolment ratio (%) secondary education 1985 1995	– 43?	–- 52	23 45	– 6	13 16	89 –
	8. Pupil/teacher ratio primary education 1985 1995	34 33	– 37	32 26	64 58	55 49	17 19
	9. Pupil/teacher ratio secondary education 1985 1995	19 18	– 28	25 18	40 38	21 24	15 12
	10. Number of students per 100,000 inhabit. enrolling in third level education in 1985 1995	421 543	– 1524	180 403	11 41	113 221	2794 3485

COUNTRY STATUS INDICATORS (continued)		DATA PER COUNTRY					
	Parameters	*Swaziland*	*South Africa*	*Botswana*	*Mozambique*	*Lesotho*	*Netherlands*
IV. Education Expenditure & equity	11. Percentage distribution of current expenditure by level (1st, 2nd, 3rd) 1995	36.6 26.4 27.5	81.8 – 15.4	– – –	– – –	50.8 30.9 17.0	30.1 39.0 31.0
	12. Current expenditure per pupil as % of GNP per capita (1st, 2nd, 3rd) in 1985	9 30 296	15 – 132	9 65 515	– – –	6 44 766	13 19 55
	13. Current expenditure per pupil as % of GNP per capita (1st, 2nd, 3rd) in 1995	10 29 302	18 – 59	– – –	– – –	14 51 399	15 20 44
	14. Current expenditure per pupil in US$ by level (1st, 2nd, 3rd) in 1995	117 339 3533	569 – 1864	– – –	– – –	107 393 3072	3600 4800 10560

Appendix B
Design principles for the SMART inservice courses

In its meeting of 25/11/93 SMART made the following **decisions in relation to the development** of teaching material:

- to make a start with the development of exemplary materials for all subjects, that cover only a few lessons for a certain topic and that should primarily be seen as vehicles for learning of the teachers;
- to make available support material such as student material and scheme for the whole topic which eventually should enable the teachers to organise similar lessons for other parts of the topic;
- to validate the new exemplary material, involving mentors, before use on large scale;

A teaching pack will be produced for all science subjects that will consist of exemplary material and support material which will be given free of charge (single copies only) to participants of the national workshops.

A need was felt to agree on a more detailed base line for all subjects from which these teaching materials were to be developed and for an inservice approach integrated with it. SMART has adopted in its meetings of 14/3/94 and 29/3/94 the first design principles for the development of its courses. These principles have been updated after meetings in November 1994 and March 1995, and are presented below.

STARTING POINTS

1. Since our main objective is professional development of teachers the materials should primarily be seen as vehicles for learning of the teachers. They are therefore called exemplary material mainly **aimed at developing/improving instructional skills of teachers**, eventually expecting that these developed skills will also be used in other lessons without help of the exemplary material.
2. SMART will not stop to function as a catalyst in the reduction of the main environmental uncertainty factors (in schools, in REO's, in MoE, in Preservice Teacher Training), and adjust the degree of innovation when improvement occurs.
3. Since the environmental uncertainty surrounding the teaching profession in Swaziland can be called high and the capacity of the system to handle educational innovations relatively low, SMART will for a start limit the degree of innovation of the change in order to achieve at least a discrete change.
4. Inservice/professional development activities should be properly matched to the stage of development the teachers are in. From research, classroom observations and experiences in workshops there is a clear impression that many science teachers in Swaziland have a rather limited repertoire of basic skills of instruction and often use them in a limited way in a rather limited classroom situation. Therefore there seems to be the most need for assistance in the group of science teachers who are in the stage of "Becoming competent in the basic skills of instruction". So our material will be geared to further developing these skills, which are a prerequisite for facilitating learning of students, which is SMART's ultimate aim. The skills that will be considered are: promote textbook use, design of a lesson, explaining theory using less notes, practical lessons, demonstrations, exercises, homework. group discussion, and questioning. Ultimately this should lead to increased professionality of participants of the inservice programme, showing in routine of handling basic skills, ability to reflect on action and professionality outside the classroom.
5. In principle SMART will focus on **one basic skill** for all science subjects at the same time. Initially SMART will focus on basic skills required during the lessons.

DIRECTIVES FOR DEVELOPING AND VALIDATING EXEMPLARY MATERIAL

1. The material will consist of a teacher's guide with exemplary lessons, and student materials.
2. The exemplary lessons will **contain a lot of procedural specifications**, focusing on essential but apparently vulnerable elements of teaching related skills.
   In the material SMART will **focus on one basic teaching skill** and provide sufficient specifications for this skill in the material. The specifications related to the basic skill should be so detailed that they can serve as a learning instrument for teachers to learn the skill. Also for other areas specifications might have to be given in order to make the lessons a success. These specifications can be kept brief. In the material also attention will be paid to explaining why certain unfamiliar activities are important to do.
3. In the exemplary material **different 'teaching methods'** will feature such as expository method, discussion, example method, group work, 'student practical', demonstration, field work, etc., taking into account that we want to further develop basic skills of instruction only.
4. The exemplary material will only cover a sub-topic in **4 to 6 lessons**.
   Ideally this sub-topic should be the first part to be dealt with in the topic.
5. The exemplary material will only **require equipment** that the majority of the schools (> 80 %) can be expected to have.
6. The material will be **based on used curriculum** (syllabuses, textbooks, schemes, etc.) **and examinations**. Ideally the exemplary lessons should be useful for all commonly used syllabuses for that subject in Swaziland. If certain sections are not meant for all syllabuses this will be explicitly described.
7. As far as **promotion of recommended textbooks** is concerned the following was decided:
   Chemistry will not recommend the book 'Science for today and tomorrow' from now on but refer teachers to other books (like: Chemistry in Balance) and special teacher reference books for the chemistry content. Chemistry will provide complete student material for the topic under discussion.
   Biology will write materials close to a textbook: for Combined Science reference will be made to 'Science for today and tomorrow' and for Biology and Human and Social Biology reference will be made to books normally used for these syllabi.
8. The language of the material should be as **simple and clear** as possible.
9. **Format** of the teacher's guide.
   The teacher's guide will always of the following parts:
   Part 1: explanation for the teacher
   This part contains the following sections:
   <u>Target group and characteristics of the material</u>
   With information on:
   - syllabuses and topic for which the material has been written
   - a time planning scheme for the specific topic
   - prerequisite knowledge and skills expected from students at the start of the lessons
   - the teacher's guide, student material, and recommended textbooks

   (The designed lessons will in principle be single lessons of 40 minutes with a general advice how to adapt these to lessons of different duration)
   User's comments. teachers' and students' comments.
   - Aims and objectives of the lessons

   <u>The basic teaching skill</u>
   This section contains information on the 'what, why and how' of the basic teaching skill that focussed on in the inservice course and in the exemplary lessons. The benefits of the improvement/change for both teacher as well as students should be also be spelled out here.
   <u>Lesson overview</u>
   This overview of the exemplary lessons will be the last page of part 1 or the first page of part 2.

DIRECTIVES FOR DEVELOPING AND VALIDATING EXEMPLARY MATERIAL (cont.)

9. **Format** of the teacher's guide (cont.)
   Part 2: the lessons
   This part consists of 4 to 6 lessons exemplary material lessons of 40 minutes duration, each consisting of the following sections:
   - the objectives of the lesson
   - a lesson plan: giving an overview of teacher and student activities, including time allocation
   - further guidance on lesson preparation and equipment/material required
   - hints on learning problems that student might encounter and how to assist them .
   - lesson progress of the exemplary lesson with instructional specifications for:
     - the introduction
     - middle phase of the lesson including presentation of new theory, demonstrations, student activities, etc.)
     - end of lesson
   - Answers to questions or exercises

   Part 3: will contain any support material in a recognisable way.
   Part 4: topic test (optional; to be included when support material is covering the whole topic).
10. The **student material**, used in the exemplary lessons, should be available as support material in separate booklets of which multiple copies can be bought from SMART at a reduced prize. Student material will be printed opposite to teacher material unless the student material is very limited. A clear visible distinction between student and teacher material has to be made.
11. For the **development and dissemination** of the exemplary material SMART will adopt the following procedure:
    i. Development of material based on directives and framework for selected basic teaching skill
    ii. Appraisal by experts and SMART staff
    iii. First revision of material
    iv. Testing of revised material in class
    v. Second revision of material
    vi. Use of material integrated with training

In this development and dissemination process SMART will constantly pursue **value congruency between designers and teachers**. It should not be too difficult, be clearly useful/beneficial and not be too far from the practice in the classroom in the eyes of the teachers.
The dissemination of validated exemplary material supported by in-service training will start in 1995. Two sets of exemplary material (+ support material) will be developed for each subject per year.

DIRECTIVES FOR DEVELOPING SUPPORT MATERIAL

1. SMART will produce support material for all science subjects, which can be assumed not yet to be available in most schools and which is essential for applying more broadly what has been learnt in the inservice training.
2. The support material may contain:
   - such **elements** (featuring in the exemplary material) **for the whole topic** concerned, which are not readily available as resources in most schools and which are not adequately available in the textbooks in use, such as can be:
   - pupil centred activities
   - questions, problems, exercises, assignments
   - information required by the syllabus
   - an overview of the whole topic which may contain references to the syllabuses, a concept map and a lesson scheme for the topic
   - reference to availability of teaching resources such as mentioned in the SMART information booklet
3. The support material will be Part 3 of the teaching pack. The format of the support material should be in line with that of the exemplary material as much as possible. SMART will ensure that participants can buy multiple copies of this material at a reduced prize.

DIRECTIVES FOR THE WORKSHOPS IN WHICH THE MATERIAL IS INTRODUCED

SMART will adopt the model proposed by Joyce and Showers for the workshops. This means that the following elements will form the backbone of the workshops:

- information on the theory of the focal skill
- demonstration of the skill
- practice of the skill by participants
- feedback on own practice

Information on the 'what, why, and how' of the teaching skill that is focussed on in a particular course will be incorporated in part 1 of the teacher's guide. This information will feature in the 'information' training element of the workshop.

Appendix C
Curriculum materials of the '97 biology inservice course

Topic scheme

Topic: Organisms & their Environment	**TIME ALLOCATION (per syllabus; in periods of 40 min.)**				**LEARNING ACTIVITIES**
TOPIC OBJECTIVES	*Biology*	*Human & social biology*	*Combined science*	*Add. Comb. science*	*(according to numbering in stud. mater.)*
INTRODUCTION TO THEME/TOPIC					
• Introduction to topic/general plan	1	1	1	1	1, 2
FOOD PRODUCTION					
• objectives related to photosynthesis	-	4	-	-	
FOOD CHAINS & FOOD WEBS					
• objectives related to structure of food chains and food webs	3	1	2	2	3, 4, 5, 6, 7
• objectives related to trophic levels and pyramids of biomass and energy	3	-	-	-	8
ENERGY FLOW					
• objectives related to energy flow	3		2	2	10, 11
• objectives related to energy loss in food chains	2	-	1	1	12, 13
NUTRIENT & WATER CYCLES					
• objectives related to carbon cycle	3	2	1	1	9, 15
• objectives related to nitrogen cycle	3	3	-	-	17
• objectives related to water cycle	2	-	-	1	16
RELATIONS BETWEEN ORGANISMS					
• objectives related to parasitism	1	-	-	-	18, 19
EXERCISES IN HANDLING INFORMATION	1	-	-	-	6, 7, 12, 13, 16, 17
TOPIC TEST	2	1	1	1	
RECOMMENDED TIME ALLOCATION	24	12	8	9	

Examples of procedural specifications in exemplary lessons

Procedural specifications related to the skill of *'using hands-on/mind-on activities'*; this refers to a 'reader' to which questions have been added to practise reading and study skills.	
Pupil activity (15 min)	1. Hand out the worksheet 'Introduction to Air Pollution' to each pupil. 2. Tell pupils to start reading the first piece of information individually, underlining words they don't understand. 3. Tell them that when they are through with this to sit 3-4 together and help each other in finding the meaning of these words. 4. Tell them, if at the end they still don't know the meaning of certain words, to call you. 5. Let them answer the questions after this. 6. Stress that their own opinion is only asked for in question 5, but that the other answers should be based on the information they have read. 7. Go around and check on progress. 8. Stop after 15 minutes.
Procedural specifications related to the *'checking and giving of homework'*.	
The end of the lesson (1 min)	1. Write the following homework on the blackboard: ▪ finish the worksheet 'introduction to air pollution'; ▪ study pp ….. of the textbook (related to air pollution); ▪ complete worksheet 'living indicators of air pollution' (learning activity 18) at home. 2. Tell pupils to copy this homework in their notebook. 3. Tell pupils what will be done in the next lesson.

A lesson plan of an exemplary lesson

Time	Lesson phase	Teacher activity	Pupil activity
10	INTRODUCTION	- discusses homework	- respond - ask questions - make corrections
		- tells what will be done in this lesson	- listen
	NEW CONTENT		
15	Presentation/Explanation	- presents and explains - asks questions	- listen - respond and ask questions
7	Notes	- gives notes	- copy notes
7	Pupil activity	- gives instructions - monitors/guides activity	- listen - do activity
1	END OF THE LESSON	- gives homework - reveals the focus of next lesson	- write down homework - listen

Appendix D

Objectives and instructions for specific training elements of the workshops

OBJECTIVES AND PROGRAM OUTLINE OF THE INITIAL WORKSHOP

MAY-'97 INITIAL WORKSHOP

OBJECTIVES:

- to provide insight in the 'what, why and how' of selecting, and using 'hands-on/minds-on' activities
- to demonstrate and discuss some exemplary lessons in which strategies and methods for selecting and using 'hands-on/minds-on' activities are applied
- to practise selection and adaptation of 'hands-on/minds-on' activities for use in class
- to practise designing a lesson around a learning activity based on an effective format
- to improve the teaching of the environmental/ecology related topics by offering a wide range of student material, and other resources
- to introduce teachers to peer coaching and related skills
- to make arrangements for the coaching

PROGRAM

Tuesday

0900 - 0915	Introduction
0915 - 0945	The 'what, why and how' of using 'hands-on/minds-on' activities
0945 - 1015	Introducing the material and the exemplary lessons
1015 - 1030	Preparation for the demonstration of an exemplary lesson
1030 - 1100	Tea
1100 - 1200	Demonstration of an exemplary lesson
1200 - 1230	Practising the selection & adaptation of 'hands-on/minds-on' activities
1230 - 1330	Lunch
1330 - 1430	Practising the selection & adaptation of 'hands-on/minds-on' activities (continued)
1430 - 1500	Water quality testing: a demonstration

Wednesday

0900 - 1030	Practising designing of a lesson around a learning activity
1030 - 1100	Tea
1100 - 1200	Peer teaching of a self-designed lesson
1200 - 1215	Evaluation of workshop
1215 - 1230	Arrangements for the try out & coaching phase

OBJECTIVES AND PROGRAM OUTLINE OF THE FOLLOW-UP WORKSHOP

AUGUST-'97 FOLLOW-UP WORKSHOP

OBJECTIVES:

- to share experiences on what has been put into practice in exemplary lessons and in other lessons and how this has been done;
- to establish what teachers want to adopt and will apply in the teaching of other topics, and whether any further support is needed in this;
- to establish to which extent the teachers and trainers have a common vision on what has been important in the training and the material;
- to evaluate the in-service course and material;
- to agree on a strategy for the next in-service cycle and to make further arrangements for this.

PROGRAM

0830 - 0900	Registration
0900 - 0930	Introduction
0930 - 1030	Sharing experiences: good & bad (group session)
1030 - 1100	Tea
1100 - 1130	Sharing experiences (plenary session)
1130 - 1230	Sharing experiences & supporting each other (observation and discussion of a lesson)
1230 - 1245	Towards a shared strategy
1245 - 1300	Evaluation of workshop
1300 onwards	Lunch & Reimbursements

INSTRUCTIONS FOR: SELECTING AND ADAPTING 'HANDS-ON/MINDS-ON' ACTIVITIES

This exercise is meant to practise in the selection and adaptation of 'hands-on/minds-on' activities for the topics 'Organisms & their Environment' and 'Effects of Man on the Ecosystem' based on:

- strategic steps discussed (see also Teacher's Guide part 1, page vii-xi);
- the syllabus you are teaching (Teacher's Guide, appendix 1);
- the recommended schemes from the MoE/SMART(copies are available);
- using the topic schemes for the topics(Teacher's Guide part 1, pages ii-iii).

ASSIGNMENTS

Teachers, teaching the same syllabus subject, to form groups of 3-4 teachers. Each group will be allocated a topic.

1. Time allocation

i) Decide on how much time you want to allocate to the teaching of the complete topic, based on:
- the recommended time mentioned in the MoE/SMART schemes
- the time you think that will/should be available for the topic

Write this time allocation under 'Total time allocation' at the bottom of the 2nd column of the attached table.

ii) Decide on how much time you want to allocate to the teaching of each objective of the topic *(as mentioned in the first column of the attached table)*, based on:
- the recommended time mentioned in the topic scheme (see part 1 of the teacher's guide)
- the time you think that will/should be available for the objectives

Write this time allocation in the second column of the attached table.

2. Selection

Select/choose 'hands-on/minds-on' activities for the specific objectives by:

i) Finding out from the topic scheme which activities are available for a specific objective

ii) Comparing the activities available (in the student material) for a specific objective

iii) Deciding which activity (-ies) to use for the teaching of the objective based on:
- available time
- suitability for achieving the syllabus objective(s)
- suitability for your pupils
- suitability for yourself
- materials/equipment required

(Mind ! You are expected to choose the activities used in the exemplary lessons in any case.)

iv) Go through all the objectives of the topic like this. But don't forget that you might want to allocate some time to other activities as well (e.g. theory lesson, test, etc.).

Don't take too long for this! This should only be based on your first impressions by skimming through the material.

Write down the number(s) of the activities you have chosen in the third column of the attached table. The 'hands-on/minds-on' activities of the exemplary lessons have been filled in for you already.

3. Adaptation

Now focus on one of the activities you have chosen for a specific objective.

Before using an activity in a lesson you will have to check whether it is really suitable. So do this first by:

i) trying out/doing the activity yourself (if possible) and answering any questions

ii) by answering the following questions related to the activity
- what are the objectives of the activity ?
- are the objectives of the activity in line with what is required for the syllabus ?
- is the information clear ?
- are questions/assignments/exercises incorporated and if so are these relevant/useful for learning ?
- are instructions incorporated and if so are these clear and complete ?
- is anything else missing/incorrect/redundant ?

iii) make changes/adjustments to the activity if required.

INSTRUCTIONS FOR: DESIGN OF A LESSON AROUND A SELECTED/ ADAPTED 'HANDS-ON/MINDS-ON' ACTIVITY

This exercise is meant to practise in the design of a lesson based on :

- a 'hands-on/minds-on' activity you have chosen and adapted in the previous exercise
- objective(s) selected from the syllabus you are teaching (app 1 of TG)
- the topic scheme you have constructed in the previous exercise
- application of strategic design steps discussed (see Teacher's guide part 1, page ix and x)
- the effective lesson format presented (see appendix)

ASSIGNMENT

- In this exercise we would like you to design a 1 period lesson, using the attached effective lesson format.
- You will do this together with another colleague, for the syllabus you are teaching.
- The lesson should focus on objective(s) of your syllabus related to the 'hands-on/minds-on' activity you selected.
- Look at the exemplary lessons in the teacher's guide to help you on your way.
- In designing your lesson follow the steps for design described below.

STEPS REQUIRED FOR DESIGN OF A LESSON

Design step 1 : particulars of 'hands-on/minds-on' activity

- Write the main focus of the 'hands-on/minds-on' activity you selected under 1a of your design form.
- Based on your experience estimate how much time the activity will take to complete and fill this in under 1b of the same form.
- Using your topic scheme decide how much lesson time you can spend on the activity you have selected. Fill this in under 1c of the same form.

<u>Design step 2 :</u> formulation of objectives

- Write down the objectives of the 'hands-on/minds-on' activity under 2a of your design form.
- Tick the objectives which are required/relevant for the syllabus you teach.
- If you have any additional objectives for the lesson in which you want to use the 'hands-on/minds-on' activity, write them down under 2b.

<u>Design step 3:</u> lesson plan

- Write the name of the 'hands-on/minds-on' activity you are going to use above the lesson plan on your design form.
- Fill in the lesson plan, incorporating the 'hands-on/minds-on' activity you selected.
- Mention which teacher and pupil activities you want to do during the following lesson parts :
  1. the introduction
  2. New content
  3. The end of the lesson

To help you on your way, look at the attached format of a lesson and the examples of lessons worked out for you in the teacher's guide.

- Allocate time to the main activities, depending on the duration of a period in your school.

<u>Design step 4 :</u> lesson progress

The elements mentioned in the lesson plan under design step 3 need to be worked out in more detail in this phase of the design.

In gaining experience/routine this probably will not always be documented in great depth for e.g. the introduction and most tasks of the end of the lesson. You will at a certain stage include these tasks automatically in your lessons. However the following elements/tasks need to be documented for each lesson :

1. main points for the 'New content' part of the lesson, such as:
   - main points of theory to be presented
   - instructions to be given for the 'hands-on/minds-on' activity
2. summarising notes to be given, if any
3. additional questions/assignments/worksheets, if any
4. homework to be given

Work these out in more detail for this lesson on the design form under 4a-d.

Textbooks are available if required.

Note : 2 and 3 could be put in a separate file to which pages could be added, enabling you to constantly improve/update these, for later use.

The other parts of the lesson progress could be written in a day to day preparation book.

<u>Design step 5 :</u> required teaching aids and/or equipment

- This concerns the teaching aids and equipment/material you are going to use in the lesson and which needs to be ready/available before the start of the lesson. Write this on your design form under 5.

Note : You might consider adding this information to the file mentioned under step 4.

Appendix E
Questionnaire Teachers' perceptions

EVALUATION FOLLOW-UP WORKSHOP 8 AUGUST 1997

Teacher Background

1a. In how many form 5's do you teach biology? ....

1b. For which syllabuses do you teach biology in form 5? ....

2a. Did you attend the Biology workshop in May 1997? yes/no

2b. Did you try out the material on 'Environment/ecology related topics'? yes/no

3. What were the main reasons for you to participate in today's workshop?
....

.

The questions below refer to the training/material of the May workshop.

---

4. What did the training and material try to improve as far as you are concerned?
....

5. Was any improvement needed as far as you are concerned? yes/no
If so, what was wrong with your way of teaching?
....

6. Do you think any improvement has taken place due to the training and material?
Please explain. yes/no
....

The follow-up workshop

Please indicate for the following statements to what degree you agree with them or not.

7a. The workshop was worthwhile visiting.
totally disagree 1 2 3 4 5 totally agree

7b. I don't see the need for sharing my experiences in the try out of the material with my colleagues.
totally disagree 1 2 3 4 5 totally agree

7c. I really benefited from the groups discussions in which teachers shared their experiences.
totally disagree 1 2 3 4 5 totally agree

7d. The plenary session on sharing experiences really showed me which factors are important for successful teaching
totally disagree 1 2 3 4 5 totally agree

7e. The observation/discussion of the video lesson was a very relevant part of this workshop.
totally disagree 1 2 3 4 5 totally agree

7f. It was difficult to give an honest opinion on what I will change in future in my way of teaching.
totally disagree 1 2 3 4 5 totally agree

7g. After this workshop I am convinced that peer coaching can help me a lot in improving my teaching.
totally disagree 1 2 3 4 5 totally agree

7h. The discussion on the next in-service cycle convinced me that I have to participate.
totally disagree 1 2 3 4 5 totally agree

7i. The time for this follow-up workshop was too short.
totally disagree 1 2 3 4 5 totally agree

7j. The input from the trainer during the workshop was minimal.
totally disagree 1 2 3 4 5 totally agree

After this workshop

8. Do you think you are going to participate in the next in-service cycle on the teaching skill 'selecting and using teaching aids' related to the topics: 'The Chemicals of Living Cells' & 'Animal Nutrition'?
   o yes
   o no

   If not, can you please explain why not?
   …………………………………………………………………………………………

9. Are you going to participate in peer coaching then?
   o yes
   o no

   If not, can you please explain why not?
   …………………………………………………………………………………………

10. Do you have any additional comments to improve the Biology workshops and/or materials?
   …………………………………………………………………………………………
   …………………………………………………………………………………………
   …………………………………………………………………………………………

Appendix F

Teachers' perceptions on their teaching before the '97 biology inservice course

Perceptions of teachers related to their teaching before the '97 biology course intervention

Before the initial workshop started a questionnaire (app. 4.12) was administered to find out more about the usual way of teaching of the participants. Of the 47 teachers who attended the complete initial workshop, 41 completed the questionnaire (87%). Of the respondents 33 teachers (81%) teach the biology syllabus, 6 teachers teach biology for the combined science syllabus (15%) and 2 teachers teach integrated science (5%).

<u>Teaching methods and evaluation activities</u>
Two-third of all the teachers say that they use the teaching methods lecturing, demonstration and discussion often. Half of the teachers give notes often and 17% of the teachers give notes almost always. Homework giving and checking occurs often according to most teachers, and 17% of the teachers indicate they give and check homework almost always. See also table 1 for more information.

Table 1: F*requency of occurrence of teaching methods and evaluation activities in lessons of teachers who participated in the '97 biology initial workshop*

Teaching method/ evaluation activity	Almost never (1)	Some-times (2)	Often (3)	Almost always (4)	**Mean**	**S.d.**	**N**
Lecturing	3 (7%)	9 (22%)	24 (59%)	2 (5%)	2.7	0.7	38
Note giving/taking	1 (2%)	10 (24%)	20 (49%)	7 (17%)	2.9	0.7	38
Demonstration	1 (2%)	10 (24%)	27 (66%)	1 (2%)	2.7	0.6	39
Discussion method	0 (0%)	8 (20%)	27 (66%)	5 (12%)	3.0	0.6	40
Homework giving	0 (0%)	3 (7%)	30 (73%)	7 (17%)	3.1	0.5	40
Homework checking	0 (0%)	5 (12%)	28 (68%)	7 (17%)	3.1	0.6	40

'Hands-on/minds-on' activities
41% of the teachers say that they use the questions from the textbook sometimes or almost never in their lessons, and 53% use them frequently. Worksheets are used more often: 58% indicates they use this activity often or almost always, while 32% use it sometimes or less.
Practising of 'handling of information' exercises and practical work occur often in class, and group work is done sometimes to often. The less conventional activities like role-play and games are hardly used and fieldwork is done sometimes. Most teachers hardly use projects, one-third of the teachers indicate that they use these sometimes. See also table 2.
There are two teachers who indicate that they hardly (almost never or sometimes) use 'hands-on/minds-on' activities in class.
Most teachers obtain the 'hands-on/minds-on' activities from SMART-materials and/or from textbooks: 80% of the respondents (N=32) use the SMART materials and 89% textbooks. Some teachers also obtain them from past exams and two teachers indicate that they also make their own 'hands-on/minds-on' activities. See table 3.

Table 2: *Frequency of use of specific 'hands-on/minds-on' activities in lessons of teachers who participated in the '97 biology initial workshop*

Activity	Almost never (1)	Some-times (2)	Often (3)	Almost always (4)	**Mean**	**S.d.**	**N**
Answering questions from textbook	5 (12%)	12 (29%)	19 (46%)	3 (7%)	2.5	0.8	39
Use of worksheets	5 (12%)	8 (20%)	23 (56%)	1 (2%)	2.5	0.8	37
Practice handling information exercises	1 (2%)	9 (22%)	26 (63%)	1 (2%)	2.7	0.6	37
Group work	1 (2%)	14 (34%)	21 (51%)	2 (5%)	2.6	0.6	38
Role play	17 (42%)	14 (34%)	3 (7%)	0 (0%)	1.6	0.7	34
Games	29 (71%)	9 (22%)	0 (0%)	0 (0%)	1.2	0.4	38
Practical work	1 (2%)	7 (17%)	28 (68%)	4 (10%)	2.9	0.6	40
Fieldwork	15 (37%)	17 (42%)	6 (15%)	0 (0%)	1.8	0.7	38
Projects	24 (59%)	12 (29%)	2 (5%)	0 0%)	1.4	0.6	38

Table 3: *Sources for selecting 'hands-on/minds-on' activities*

Source	**Use by teachers**
SMART materials and textbooks	22 (55%)
SMART materials, textbooks, and other sources	7 (17%)
Textbooks only	7 (17%)
SMART-materials only	3 (8%)
Other sources only	1 (3%)

What teachers and students do during a lesson

44% of the respondents indicate that they spend 30% or less of their lesson time on individual work or group work. 12 teachers (29%) spend 31 to 50% of their lesson time on this and 9 teachers (22%) say that they spend more than 50% of the lesson time on individual work or group work.

36% of the respondents indicate that the students are speaking 30% or less of the time of an average lesson, 39% indicates that the students are speaking 31 to 50% of a lesson and 20% indicate that students are speaking 51% or more of a lesson (not clear whether this refers to task related talking).

19 teachers indicate that they themselves speak 51% or more of the lesson time, and 8 of them speak more than 70% of the lesson time. 20 teachers say they speak 31% to 50% or less of an average lesson.

Preparation and scheming

39% of the respondents say that they spend on average between 16 and 30 minutes on preparation for a lesson, 46% spend more than 30 minutes on preparation for one lesson. All teachers make a scheme of work, which is compulsory in all schools in Swaziland.

School factors

The average number of students in a form 5 class varies from less than 10 to 84, with an average of 35 students. 37% of the respondents indicate an average number of 20-29, and 27% a average number of 30-39.

12 teachers (29%) indicate that all students have a textbook and 11 say that 75 to 99% of the students

have a textbook. 4 teachers indicate that 50 to 75% have a textbook, whilst 12 say that less than 50% have a textbook.
20 teachers (49%) did not know how much their department has approximately spent on the purchase of science equipment in 1996, and it seemed that many of the other teachers just made a guess.
31 teachers (84%) indicate that there are copy facilities present in the school, which they are allowed to use, 6 do not have these facilities and 4 teachers did not answer this question.

Usual way of teaching of the environmental topics

27 teachers (66%) completed this part of the questionnaire. Some teachers who have not completed this part probably have not taught these topics before.
On average 9,5 periods are spent on the topic 'Organisms and their environment' and 6,5 periods on the topic 'Effects of man on the ecosystem'. So in total 16 periods are spent on these topics, which is about 40% of the recommended time allocation.
Normally, most teachers teach these topics in term 2 or term 3. 18 teachers indicate that they find the two environmental topics important. 2 teachers don't find the topics important.
The way of teaching of these topics is pretty similar to the usual way of teaching described before. A difference seems that demonstration, note giving, practical work, group work, practising in 'handling of information' exercises are done somewhat less. On the other hand discussion, homework, fieldwork and answering questions from textbooks is done slightly more frequent.
11 teachers indicate that they encountered problems in the teaching of these topics: i) do not know what to teach in combination with limited adequate teaching resources (6x), ii) lack of time at the end of the year when examinations start (6x), iii) too many students in class to do this properly (2x).

Conclusions on teachers' perceptions of their own teaching

- Much lesson time is used for lecturing, demonstration, note giving and discussion. At least half of the teachers spend some time on the conventional 'hands-on/minds-on' activities frequently (questions, practical work and group work). 12% of the teacher almost never uses questions (from textbooks or worksheets). The handling information exercises are practised often. Projects, role-plays and games are hardly used and fieldwork is done sometimes. Homework giving and checking is part of the daily routine for 60% of the teachers.
- The activities are obtained mostly from SMART materials and textbooks.
- On average 30% of the lesson time is spent on group work or individual work. The teacher speaks 60% of the lesson time and the students speak 40% of the lesson time on average.
- Teachers spend on average about 30 minutes on preparation of a lesson.
- All teachers do the compulsory scheming; specific scheming for topics is probably hardly done.
- In most classes the number of students in form 5 classes ranged from 20 to 40.
- In more than half of the schools (of the respondents) more than 75% of the students have a textbook. In 30% of the schools less than half of the students have a textbook.
- Most schools have copy facilities that the teachers can use.
- The two topics 'organisms and their environment' and 'effects of man on the ecosystem' are normally taught in term 2 or 3. Most teachers find these topics quite important. Teachers spent about 40% of the recommended time on these topics in previous years. Teachers indicate no major differences between the teaching of these topics and the teaching of other topics. Teachers indicate that they often do not know what to teach for these topics because limited adequate teaching resources are available for these topics. Furthermore, lack of time at the end of the year when examinations start often makes that these topics do not get the attention they deserve.

Appendix G

Intended behavioural outcomes of the '97 biology inservice course

Training elements related to the focal teaching skill	Intended behavioural outcomes
I. Promotion of student involvement & active learning	1. SMART 'hands-on/minds-on' activities are used in the teaching of all topics, when available. 2. The 'hands-on/minds-on' activities are used in a student centred way. 3. Teacher involves students in the lesson by applying the 'question and answer method'.

Training elements that are promoted in all SMART biology inservice courses	Intended behavioural outcomes
II. Note giving	1. Notes given are summarising, structured, and concentrating on difficult concepts. 2. Limited lesson time is spent on note giving/copying. 3. Teacher instructs students to copy the notes and students copy notes in notebook; teacher gives support in how and where to write notes and how and where to write answers to questions.
III. Textbook use	1. All students have the same textbook 2. Students take their textbook to class 3. The textbook is used (together with the materials): - use is made of the textbook in class - homework is given from textbook - students (have to) study from the textbook
IV. Homework	1. Adequate attention is paid to homework at the start of the lesson (checking, discussing and/or marking). 2. Students are assigned to do homework, which is clear and relevant; teacher writes the homework on the blackboard and tells students to copy the homework; students copy the homework
V. Lesson preparation & evaluation	1. A topic scheme is used for the selection of the 'hands-on/minds-on' activities resulting in rational use. 2. The selected activities are suitable/relevant for pupils & teacher; adaptations are made, when necessary/required. 3. The teacher can show a lesson plan containing: - planned objectives; - planned instructions for activity; - answers to questions of activity. 4. The lesson design form is used. 5. Self-evaluation is done; the self-evaluation form is used.

Appendix H
Data collection instruments

LESSON OBSERVATION FORM 'SELF-PREPARED LESSONS'

Name school: Class: Official lesson time:
Name teacher: Date:

Introduction

Start: End: Time required:

- ❑ Homework
- ❑ - Homework is checked
- ❑ - Homework is discussed
- ❑ - Homework is/was marked
- ❑ - Homework/evaluation discipline geared to evaluation of individual students
- ❑ - The homework consisted of a learning activity
- ❑ The teacher introduces the lesson
- ❑ Tries to find out what ideas/knowledge students have
- ❑ The teacher stimulates asking questions

New content

- ❑ Presentation/explanation

Start: End: Time required:

- ❑ - Teacher involves students in the lesson by using the question and answer method in class.
- ❑ - Presentation does not last longer than 15 min
- ❑ - Appropriate use of communication media
- ❑ - All students have the same textbook
- ❑ - Students take their textbook to class
- ❑ - Textbook is used/referred to
- ❑ - The teacher stimulates asking questions

- ❑ Notes & notebook use

Start: End: Time required:

- ❑ - Notes given are structured.
- ❑ - Notes given are summarizing and/or concentrating on difficult concepts.
- ❑ - Support is given to pupils through notes (relevance, necessary).
- ❑ - Limited lesson time is spent on note giving/copying.
- ❑ - Teacher tells students to copy notes.
- ❑ - Students copy notes in notebook.
- ❑ - Students write answers in notebook.

- ❑ - Teacher gives support in how and where to write notes and answers to questions.
- ❑ The teacher stimulates asking questions

- ❑ Student activity

Start: End: Time required:

- ❑ - The teacher provides the students enough materials
- ❑ - Teacher introduces the activity by using the question and answer method in class.
- ❑ - Clear instructions are given
- ❑ - Student centered activities are used in a student centered way.
- ❑ - Teacher is promoting active learning/ Students are actively working on the activities.
- ❑ - Appropriate support is given by the teacher to facilitate active learning
- ❑ - Textbook is used together with the materials/reference is made to the textbook in class
- ❑ - Students write answers in notebook.
- ❑ - Teacher gives support in how and where to write answers to questions.
- ❑ The teacher discusses the student activity
- ❑ The teacher stimulates asking questions

End of lesson

Start: End: Time required:

- ❑ The teacher summarises what has been done/learned
- ❑ The teacher checks for understanding
- ❑ Homework:
- ❑ - Students are assigned to do homework, unless valid reasons not to do so.
- ❑ - Homework is given from:
- ❑ textbook
- ❑ learning activities
- ❑ notes
- ❑ - Homework given is clear.
- ❑ - Homework given is relevant.
- ❑ - Teacher tells students to copy the homework.
- ❑ -Teacher writes the homework on the blackboard.
- ❑ - Students copy homework/take homework serious.
- ❑ - Students have to study from the textbook
- ❑ - Active learning is promoted through homework.
- ❑ The teacher tells what will be done next lesson

Preparation

I. Scheming of the topic
- ❑ -The recommended scheme is used
- ❑ -A topic scheme is used/made
- ❑ -Adequate/realistic time has been allocated to the topic
- ❑ -A sensible sequence of (sub-)topics is followed.

II. Selection of Learning Activities
- ❑ Student activities have been selected from:
  - ❑ SMART material
  - ❑ Textbook
  - ❑ other, namely ....
- ❑ The activities are relevant for the syllabus
- ❑ The activities are relevant for the syllabus objectives.
- ❑ A realistic number of activities has been selected
- ❑ The activities are suitable/relevant for pupils & teacher

III. Adaptation of Learning Activities
- ❑ Adaptations are made, when necessary/required.
- ❑ Adaptations made are relevant and adequate.

IV. Preparation of the Lesson & Learning Activities

The teacher can show that the following is prepared:
- ❑ try out / adaptation of activity
- ❑ use of exemplary lessons in planning
- ❑ lesson plan
- ❑ planned objectives
- ❑ planned main points of theory presented
- ❑ planned instructions for activity
- ❑ answers to questions prepared
- ❑ planned notes
- ❑ planned homework
- ❑ the design form is used

Other remarks

- ❑ Self evaluation
  - ❑ the evaluation form was used
  - ❑ other, namely ....
- ❑ Organisational problems
- ❑ other namely, ...

QUESTIONNAIRE STUDENTS '98 **TEACHING AFTER THE INTERVENTION**

1. Indicate how often the following events (numbered 1-8 in the table below) take place on average in your biology lessons.

Tick: 1 - if it takes place once a month or less (also when it never takes place)
2 - if it takes place once in two weeks
3 - if it takes place once or two times a week
4 - if it takes place in almost every lesson

1. The teacher demonstrates experiments in class	1	2	3	4
2. We do exercises from the biology textbook in class	1	2	3	4
3. We do group work in class	1	2	3	4
4. We do individual assignments in class	1	2	3	4
5. The teacher gives us a worksheet or booklet with questions to answer in class (not a test!)	1	2	3	4
6. the teacher asks us to read/study some text in class	1	2	3	4
7. We carry out practical work ourselves in class	1	2	3	4
8. The teacher gives homework at the end of the lesson	1	2	3	4

2. How many times in form 4 and form 5 did you go outside the school for biology excursions or biology field trips ? .... times.

3. Which of the following activities do you like most in your biology lessons ? Please rank the activities by putting numbers in front of the activities, ranging from 1 (the activity you like most) to 6 (the activity you like least). When an activity never occurs in your biology lessons, you can leave that activity open.
   .... copying notes
   .... doing practical work
   .... doing assignments
   .... doing group work
   .... reading a text
   .... listening to the teacher

4. The next statements are about homework. Indicate how often the following events take place.

Tick: 1 - if it takes place almost never
2 - if it takes place sometimes
3 - if it takes place often
4 - if it takes place almost always

		1 almost never	2 sometimes	3 often	4 almost always
1.	For homework, the teacher tells us to answer the questions	1	2	3	4
2.	For homework, the teacher tells us to study certain paragraphs of the textbook	1	2	3	4
3.	For homework, the teacher tells us to study our notes	1	2	3	4
4.	The teacher writes homework on the blackboard, which we copy	1	2	3	4
5.	We have to hand in homework, so that the teacher can mark it	1	2	3	4
6.	At the start of the lesson the teacher discusses the homework	1	2	3	4

5. Indicate for the following events how often they take place in an average biology lesson.

Tick: 1 - if it takes place almost never during a lesson
2 - if it takes place sometimes during a lesson
3 - if it takes place often during a lesson
4 - if it takes place almost always during a lesson

		1 almost never	2 sometimes	3 often	4 almost always
1.	Students ask the teacher questions	1	2	3	4
2.	The teacher asks questions to the students	1	2	3	4
3.	students copy notes	1	2	3	4
4.	the students are allowed to talk to each other when doing assignments	1	2	3	4
5.	the teacher gives notes	1	2	3	4
6.	The teacher asks you a question in class	1	2	3	4
7.	The teacher helps you in class when you have a problem with understanding	1	2	3	4
8.	You ask the teacher a question in class	1	2	3	4

6. The following questions are about biology textbooks.
   a. Do you have a biology textbook? ....
   b. What do you use it for? ....
   ……..

7. The following questions are about booklets for students doing biology at high school level, produced by the University of Swaziland.
   a. For which of the following biology topics did you receive/buy such a booklet? Tick the topics for which you received/bought it.
      - ❑ reproduction in man
      - ❑ transport in man (blood circulatory system)
      - ❑ energy production & respiration
      - ❑ the building blocks of organisms (cells & tissues)
      - ❑ organisms & their environment
      - ❑ effects of man on the ecosystem
      - ❑ chemical of living cells
      - ❑ animal nutrition (digestive system)
   b. Did you have to pay for these booklets? ....
   c. How often did you use the booklets (you received/bought) in class? Tick or encircle the appropriate answer.
      almost never/sometimes/often/almost always
   d. How often did you use the booklets (you received/bought) to study from at home or in study time? Tick or encircle the appropriate answer.
      almost never/sometimes/often/almost always
   e. Which of the following sources do you study the most from at home or in study time ?
      Please rank the sources by putting numbers in front of them, ranging from 1 (the source you use most) to 4 (the source you use least). When you have never used a particular source, you can leave it open.
      .... notes in your notebook
      .... booklets form UNISWA
      .... other books (e.g. from library)
      .... your textbook

Appendix I
Data analysis methods

NOTEBOOK ANALYSIS

Subtopic	Syllabus objective reference	No of concepts mentioned in syllabus	No of syll. concepts occurring in notes	No of words	No of diagrams	Remarks
Sexual reproduction	b.2.1	8	8	126	1	diagram puzzle
in Man	b.2.2	7	7	79	1	diagram puzzle
	b.2.3	5	5	39	0	
	b.2.4	7	4	156	1	
	b.2.5	3	3	26	0	
	b.2.6	3	3	82	0	
	b.2.7	2	2	20	0	
	b.2.8	5	5	119	0	
	b.2.9	2	0	0	0	
	b.2.10	3	0	0	0	
	b2.11	7	1	3	0	hand out/ material?
	b.3.1	6	4	99	0	
	b.3.2	3	3	68		
TOTAL	**13**	**61**	**45**	**817**	**3**	
Non-syllabus notes	-	-	4	46	0	
			% of objectives covered: 85% % of concepts covered: 74% word/concept ratio: 18 word/diagram: 288 no of references to textbook: 0 no of references to material: 2?			
Notes are almost identical for different students						

FORMULAS OF INDICES

$$\text{Notes coverage - index} = \frac{\dfrac{\textit{\% of objectives covered}}{10} + \dfrac{\textit{\% of concepts covered}}{10}}{2}$$

$$\text{Notes detail - index} = \frac{\dfrac{\textit{Number of words}}{\textit{concept}}}{10} \times 2$$

$$\text{Students' preference-index} = \frac{\textit{Mean of preference for listening to teacher} + \textit{Mean of preference for copying notes}}{\textit{Mean of preference for practical work} + \textit{Mean of preference for doing group work}}$$

Appendix J
Case report

CASE REPORT: TEACHER A

1. Data collected

Data have been collected during the try out of the materials in schools in 1997, and one year after the intervention in 1998 and included:

- Questionnaire data: collecting teacher A's perception of his teaching before, during and after the intervention in 1997 (appendices 5.4 and 5.5); collecting his students' perceptions of the material and the teaching during the intervention in 1997 and of the teaching one year after the intervention in 1998; collecting teacher A's perception on the value of the biology inservice courses for him personally.
- classroom observation data: the teaching of one exemplary lesson and two lessons in which the teacher had incorporated 'hands-on/minds-on' activities himself, were observed during the 'try out' phase in 1997. In 1998 a lesson of a form 4 and a form 5 class have been observed;
- logbook data, in which the teacher gave his perception of the observed lessons in 1997;
- document data of the teacher's scheme of work, lesson preparation book, and notebooks of three of his students in 1997 and 1998;
- data from interviews with the teacher held after the lesson observations in 1997 and 1998, based on the data collected through questionnaires, observations, logbook and documents.

2. Teacher and school characteristics

Teacher A is a Swazi male and 28 years old. He is fully qualified and has seven years of teaching experience. He therefore is assumed to be in the 'mature phase' of professional development and does not belong to the target group as defined in the SMART design directives (see chapter 3). He has majored in biology and chemistry, but has only taught biology thus far. He considers the environmental related topics important. Teacher A indicated that he had a more teacher centred style in general before the intervention. Lecturing, note giving and demonstrations were dominant in his lessons before the intervention. However, he also claims that there were already some efforts to promote more student involvement in his lessons before the intervention. During the observations he appeared to enjoy teaching and was popular with his students. He seemed open for change, showing through trying out new ways of teaching. Teacher A has participated in many SMART inservice courses in the past.

Teacher A is teaching in a rather small rural mission school for girls, with limited lab facilities, but reasonable copying facilities. There are 17 teachers employed at the school and Teacher A is the only biology teacher. There were 55 students in his form 5 class in 1997 and 33 in 1998[1]. The head teacher is mainly concentrating on his administrative task, and does not put much priority on improving the lab facilities, according to the teacher. However the head teacher always allows teacher A to participate in the SMART workshops and to sell the student materials to the students.

Teacher A indicates that he never talks about teaching with colleagues of his school. His form 5 students were quite active and responsive on average.

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1 His form 4 biology class only counted 10 students in 1998. The teacher and the administration of the school had followed the advice of SMART to introduce a soft science option for the 'not science inclined' students. The biology exam results for this school had been very poor in the previous year, mainly due the fact that all students were allowed to do biology.

3. Participation and perceptions

Teacher A has participated in all units of the May '97 biology inservice course, and was involved in coaching. Teacher A also bought class sets of the student material, which students had to pay for. Teacher A claims to have used at least two exemplary lessons in the 'try out' phase of the '97 biology inservice course, and that he encountered no problems in this, and neither made any changes in the lessons. The teaching of one exemplary lesson (a role play) was observed. The lesson was not used in a functional way. The teacher skipped a lot of the instructions given in the lesson and he also skipped some lesson parts. It appeared that he mainly had used the learning activity to prepare for this lesson. Students were active in the lesson, but the learning outcomes were probably limited.

When asked immediately after the intervention in 1997, the teacher says that the training and the materials improved his teaching of these topics, his teaching in general, and his skill in 'selecting and using learning activities'. He also thinks that the teacher's guide enabled him to use the 'hands-on/minds-on' activities better, and that the students learned a lot of the environmental topics because of the activities. The students themselves indicate that they enjoyed the teaching of these topics, and on average they found the teaching of these topics some better compared to previous topics. The students found the lessons interesting and easy to understand and most students hope that next topics will be taught in a similar way. The majority of the students indicate that the booklets assisted them in better understanding of the topics. Visited one year later, the teacher still thought that the training and the materials improved his skill in 'selecting and using learning activities'. Furthermore he still thinks that the students learn a lot of the (environmental) topics because of the activities. When asked to summarise in a few sentences what (overall) effect the biology inservice has had on his teaching, he responded as follows: *"it made my teaching easier" and "some of the teacher's guides had clear guidelines to be followed."*

<u>In short:</u> Teacher A has participated in all units of the course, but functional use of the exemplary material in the 'try out' phase has been limited. The teacher thinks that the inservice course has had a considerable positive impact on his teaching skills (in general and for the focal skills in specific), and that it made his teaching easier. He also thinks that the students have gained a lot through the student materials. The students are positive about the materials and the teaching in the 'try out' phase.

4. Behavioural changes related to the focal teaching skill and topic

In this section results will be presented on data collection that has taken place on teaching behaviour of this teacher related to inservice elements of the May-August 1997 inservice cycle, i.e. i) lesson preparation, ii) use of 'hands-on/minds-on' activities in relation to the promotion of student involvement, iii) coaching and self-evaluation, and iv) teaching of the environmental topics. For each element the behaviour of the teacher will be described before, during and after the intervention of 1997. This behaviour has been reconstructed based on perceptions of teacher and students, observations in class and document analysis. The results of the data collection, related to behaviour before and during the intervention, has been used to make a prediction of what could be expected to this respect one year after the intervention. This has been verified through a study in 1998.

Lesson preparation
The behaviour of teacher A related to lesson preparation before, during and after the intervention is summarised in Box 1 on the next page.

The findings of 1997 indicated that teacher A did hardly change his way of preparing for lessons. He just continued with the usual scheming of topics and planning of lessons, which is compulsory for all teachers in all schools. The topic schemes and lesson design form, introduced in the inservice course were never used. He selected so many activities that he could not finish the syllabus before the examinations started. The sequence he used in the teaching of the subtopics was rather erratic and sometimes confusing. The selected activities were relevant for the syllabus and manageable for him and the students, in general. He claimed that he made adaptations in some activities, and that he spent more time on the preparation of his lessons than usual. The exemplary lessons were not used as an example for preparation.

Based on the '97 results the following was predicted for 1998:
'teacher A will not change his preparation discipline; he will only do what is minimally required for all teachers'

The results of the 1998 study indicated that the proposition was correct (see Box 1). Teacher A admits that he just does the minimal required preparation for his lessons. The student materials make it easy for him to make lessons attractive for students and himself, without too much effort. Although Teacher A thinks that his teaching would improve with better preparation, he will not engage in this as long as the educational climate in his school and in the country does not improve The following frustrations are mentioned to this respect:
"the head teacher does not give priority to the building of a laboratory; the government does not take the teachers serious"

It can be concluded that teacher A has not changed his preparation discipline in the direction intended by the designer of the inservice course.

Use of 'hands-on/minds-on' activities and promotion of student involvement
The behaviour of teacher A related to the use of 'hands-on/minds-on' activities and promotion of student involvement before, during and after the intervention is summarised in Box 2 on page 313.

In the 'try out' phase of the '97 biology inservice course teacher A used an impressive number of 'hands-on/minds-on' activities in his lessons. The teacher managed to use the more simple 'hands-on/minds-on' activities in a student centred way and promote active learning, in his own lessons. However the more complex activities gave disappointing results to this respect. The exemplary lessons have hardly been used as an example for using 'hands-on/minds-on' activities in his self-prepared lessons.

Box 1: Preparation discipline of Teacher A before, during and after the '97 biology inservice course

Preparation discipline before the intervention

- The compulsory scheming of topics and planning of lessons is always done;
- time spent on preparation of a lesson is 15 to 30 minutes on average according to the teacher.

Preparation discipline during the intervention

- advance planning of the environmental topics as practised in the workshop not done; suggested planning and sequence in topic scheme of the teacher's guide not looked at; he does not finish the complete syllabus at the end of the year; the sequence in which the subtopics were taught was not really appropriate;
- learning activities selected for the observed lessons were relevant for the objectives and manageable for teacher and students; selection seemed to be based on the relevance for the syllabus objectives and on the interest of the teacher and the students, and not on the advice that is given in the topic scheme of the teacher's guide; no other sources were used for selecting learning activities;
- no adaptations were made in the learning activities he used in the observed lessons and none were necessary; he claimed that he made adaptations in the other activities when necessary;
- the most essential planning for lessons (i.e. objectives and some basic information on lesson progress) was written down in a prep book (standard and compulsory in most schools); for the observed lessons the teacher had read the activities and prepared the answers to the questions;
- systematic preparation of lessons as practised in the initial workshop and demonstrated in the exemplary lessons was never done; the design form was never used
- more time was spent on preparation than usual, according to the teacher.

Preparation discipline after the intervention

- he only does the compulsory scheming and preparation; he admits that his written lesson preparation mostly boils down to reporting afterwards, because he mostly repeats what he has done the year before;
- he says that the material make his lessons more attractive, without requiring too much preparation efforts; he rarely adapts the learning activities, he says now;
- he thinks that better preparations will lead to better teaching, but does not want to make the effort required for this; he feels that the environment is not conducive for making such efforts; he feels that his department is neglected by the school administration and there is nothing he can do about it; he is also not happy with the way teachers are treated and the way education is organised in Swaziland.

Box 2: Use of learning activities and promotion of student involvement by Teacher A before, during and after the '97 biology inservice course

The use of learning activities & promotion of student involvement before the intervention

- Perceptions of teacher and students on frequency of use of more student centred activities:
  - teacher and students indicate that practicals and worksheets are used frequently;
  - the practising of 'handling information exercises' is often done according to the teacher
  - reading a text in class occurs almost never according to the students.
  - role play, games, fieldwork and projects hardly take place, according to the teacher and students;
- students indicate that individual work is done almost always, but group work only sometimes to almost never; the teacher indicates the opposite;
- the questioning & answer method is used sometimes according to the teacher, while the students say that the teacher asks them questions almost always.

The use of learning activities & promotion of student involvement during the intervention

- 37 learning activities have been used; the exemplary lessons have been hardly used as an example;
- relatively simple learning activities are used in a student centred way and active learning is promoted through this; more complicated activities lead to disappointing results;
- student involvement was also promoted through using the question and answer method;
- the students were active and responsive in the observed lessons; the students were positive about the material and the teaching; the majority of the students indicate a preference for more student centred teaching (T/S Index = 0.85)*;
- there was more active learning and more student involvement compared to other topics, according to the teacher.

The use of learning activities & promotion of student involvement one year after the intervention

- he makes active use of almost all SMART student materials that have been produced in the past (in class and for studying at home by both form 4 and 5); the use of learning activities is limited to great extent to availability of SMART materials; practicals are often a problem because of limited facilities;
- the quality of the application of learning activities was good in the observed lessons, but the selected activities were not very complicated;
- clear evidences of promoting student involvement and active learning in the observed lessons through the use of learning activities and regular use of the question and answer method;
- his reasons for selecting & using learning activities/promotion of student involvement:
  i) it helps pupils/they grasp things faster; students are more involved then and they really do things; the materials are simple to use for students;
  ii) the materials help him to evaluate progress through the questions and worksheets; the questions can be discussed in class;
  iii) it promotes better learning; things are better imprinted like this; with only listening they quickly forget;
  iv) it makes his job easier, because he does not need to develop/prepare for his lessons this way.

* T/S Index= preference of students for teacher centred teaching/ preference of students for student centred teaching; > 1 indicates a more teacher centred preference on average and < 1 indicates a more student centred preference on average.

The findings of 1997 indicated that the teacher is motivated to promote student involvement and intended to use more 'hands-on/minds-on' activities in his lessons in future, when available. Based on these results the following was predicted for 1998:
"hands-on/minds-on' activities of SMART are used in the teaching of all topics, when available; increasing attempts to promote student involvement and active learning, because he is motivated to do this, although the availability of 'hands-on/minds-on' activities are expected to be conditional for this; for the less complex activities he is expected to be reasonably successful"

The results of the 1998 study indicate that the propositions were basically correct (see Box 2). It seems likely that the SMART inservice courses in general, and the '97 biology course in particular, have contributed to realising more student involvement and active learning in teacher A's lessons. However, it seems that the training and exemplary material have only played a limited role in this. It is especially the student material that seems to have contributed to a change in behaviour to this respect. It is expected that he will require support when he wants to embark on more complex activities. However, it appeared that he preferred to experiment on his own (see also under coaching below).

Coaching and self-evaluation
The teacher says that he never evaluates his own teaching and that the self-evaluation forms provided by SMART have never been used. Teacher A indicated that he did not intend to make use of lesson evaluation forms in future. The teacher initially agreed to participate in coaching but was never very motivated. After he had been observed two times (with SMART staff involved), he made clear that he did not see any benefit in coaching for himself and was not keen in observing his partner as well. No further coaching took place. In the two lessons coaching rules were adhered to, as far as possible. The teacher only wanted to discuss the lesson immediately after he had taught it, for which little time was available. In the discussions it became clear that he did not really want to be involved in coaching.
Therefore no behavioural change was anticipated in 1998 in the intended direction, and none has been observed. However it is expected that for further skill development related to promotion/ facilitation of active learning, further support will be imperative. However, teacher A is not really keen on getting advice from 'outsiders'. Previous experiences in his preservice training seem to block further development through coaching. Furthermore he does not find the school environment conducive for embarking on this.

Teaching of the environmental topics
Teacher A was expected to spend more time on these topics through use of the SMART student material, because almost all teachers had indicated that there was a real need for this kind of material. Furthermore in 1997 teacher A had indicated that he intended to use the 'environment related materials' again in 1998. He spent 4-5 weeks on both topics in 1998, which is less than what he did in 1997 (8 weeks), but still considerably more as he has been doing before the introduction of the material (2.5 weeks). Many activities were used during the intervention in 1997 and after the intervention in 1998, whilst before the intervention hardly any 'hands-on/minds-on' activities were used for these topics.
It can be concluded that the intended change in teaching of the environmental topics has been achieved with this teacher mainly through making available the student material.

5. Behavioural changes related to note giving, textbook use, and homework

Since the teacher had been involved in many SMART inservice activities in the past, a potential impact on behaviour could be expected as far as teaching behaviour is concerned that has been promoted by SMART throughout the years (through discussion with teachers and through exemplary material). Before 1996/97, he must have been in the 'adjustment phase' of professional development, and therefore a typical target group teacher for whom improvement of basic teaching skills (e.g. related to note giving, textbook use, and homework) was assumed to be an important development need. Below, the teacher's behaviour related to these elements will be approximated for the period before and after the intervention. Furthermore an attempt will be made to establish the influence of the SMART program on any detected changes in behaviour related to this, in the direction this was intended.

Note giving

The behaviour of teacher A related to note giving before, during and after the intervention is summarised in Box 3 below.

Box 3: Note giving of Teacher A before, during and after the '97 biology inservice course

Note giving before the intervention

- notes were given frequently in lessons, according to the teacher and the students;
- analysis of notebooks indicated that note giving was practised comprehensively, albeit not that extensively (Notes index=8/4)*.

Note giving during the intervention

- less notes were given according to the teacher, but students indicate otherwise;
- from the observations and analysis of the notebooks it became clear that no notes were given at all during the teaching of the environmental topics;
- the teacher says that he prefers doing activities instead of giving notes; because most of the content was incorporated in the student material, it was not necessary to give notes;
- the teacher wants the students to write the answers to questions in the learning activities in their notebooks; he does not tell them this every time and he does not consider it a problem that they sometimes write notes or answers in the materials.

Note giving one year after the intervention

- all sources of data collection indicate that notes are structured and summarising, and that not much lesson time is consumed by this; also not much of lecturing takes place in his lessons; the teacher indicated that this is a general pattern he has adopted, already for some years;
- notes for the environmental topics were given now, albeit very brief/cryptic;
- the teacher wants to continue with giving summarising notes because:
  - i) the students expect it;
  - ii) it is the tradition in school;
  - iii) it is a good strategy to assist them in this way; he thinks that it is not useful to give detailed notes when students have a good textbook.

* Notes Index = % coverage of syllabus objectives and concepts/ number of words per concept; e.g. 10/10 stands for complete and very detailed notes, and 8/4 indicates quite complete, but not very detailed notes

It can be noted that during the intervention no note giving took place, whilst he used to give notes frequently in his previous teaching. This made that a lot of lesson time could be used for the learning activities, but that completely no support was given anymore to students through notes.
Based on these results the following was predicted for 1998:
'when 'hands-on/minds-on' activities are used in class this will lead (not on purpose) to less notes (but not necessarily more concise/better) and less lecturing'

The results of the 1998 study indicate that the proposition is not correct. The findings of 1998 somehow contradict those of 1997 (see Box 3). From the results of the '98 study it appeared that his note giving in 1998 came very close to what the inservice providers would like to see (see appendix 5.1). The teacher claims that he started already with more summarising notes from the start of his career, which would mean that the findings of 1997 were not representative for his behaviour. If it is true that the teacher has pursued this kind of note giving already for a long time, he must have felt encouraged by the discussions in the SMART workshops he visited many times, and the examples in the SMART material he says he still uses frequently. More evidence for a SMART influence in this could not be established.

Textbook use
The behaviour of teacher A related to 'textbook use' before, during and after the intervention is summarised in Box 4 below.

It can be noted that all students had already a textbook before and during the intervention, but that it was rather outdated and probably not often used. Based on the insights gained in 1997 the following was predicted for 1998:
'more active use of textbook in class is expected, if it contains relevant learning activities, because he is motivated to do this'.

The results of the 1998 study indicate that the proposition is partially correct (see Box 4).
It can be concluded that in 1998 all students have the same good textbook and all take it to class. However 'hands-on/minds-on' activities are still hardly used from it, but the teacher wants to improve on this. This behaviour is very much in line with what the inservice providers would like to see (see appendix 5.1). Although the SMART inservice has not been the only facilitator in this process, the teacher must have felt encouraged by the discussions in the SMART workshops he visited many times, and the examples in the SMART material he says he still uses frequently. More evidence for a SMART influence could not be established.

Box 4: Use of the textbook by Teacher A before, during and after the '97 biology inservice course

Textbook use before the intervention
- all students have the same textbook; this appears to be the school policy for all subjects;
- the textbook is rather outdated, and not recommended by SMART.

Textbook use during the intervention
- all students have the same textbook;
- the textbook is rather outdated, and not recommended by SMART;
- the textbook has not been used during the try out phase (in class, for homework or for own reference), because the student material was more than enough; also students confirmed limited use of textbook in class during this period but indicate that they used the textbook frequently to study from at home;
- the use of text and questions from the textbook (demonstrated in the material) is new to him.

Textbook use one year after the intervention
- all students have the same textbook;
- another textbook is used which is appropriate although not recommended by SMART; he prefers this book above the textbooks recommended by SMART;
- all students take their textbook to class;
- textbook mainly used to refer to diagrams in class and to give homework from; the textbook is not used in another more active way in class (e.g. using learning activities);
- he wants to improve the use of the textbook by students because it is their main information source and more important than their notes.

Homework discipline

The behaviour of teacher A related to 'homework discipline' before, during and after the intervention is summarised in Box 5 below.

It can be noted that teacher A was taking homework already serious before the 1997 intervention. Based on the insights gained in 1997 the following was predicted for 1998:
'homework will continue to be integrated in his teaching behaviour and could even come quite close to how SMART would like to see it, probably because he sees this as instrumental/ beneficial in his teaching/ for learning'

The results of the 1998 study indicate that the proposition is correct (see Box 5).
It can be concluded that the teacher has a homework discipline, which comes quite close to what the inservice providers would like to see (see appendix 5.1). Although it was not possible to establish the influence of the SMART inservice on this, the teacher must have felt encouraged by the discussions in the SMART workshops to this respect.

Box 5: Homework discipline of Teacher A before, during and after the ' 97 biology inservice course

Homework discipline before the intervention

- homework is assigned almost every lesson according to teacher and students;
- homework consists almost always of answering questions and/or doing assignments and sometimes/often of reading a text according to teacher and students;
- attention is paid to homework (by marking or discussing it) almost always according to teacher and students;
- the students are not clear on whether they are assigned to study notes for homework and how often homework is written on the blackboard.

Homework discipline during the intervention

- homework (exercises, texts and notes) is given more frequently than usual;
- the homework consists of answering questions, reading texts and studying notes;
- adequate attention is paid to homework by marking it or discussing it in class;
- the homework given in the observed lessons was clear and relevant.

Homework discipline one year after the intervention

- homework giving and checking is a common routine;
- main reasons for giving and checking of homework:
  - 'to make sure that they do the work';
  - 'it is a good time investment'.

6. Within-case analysis

The main results of the case study of Teacher A are presented in Box 6.

Box 6: Case summary Teacher A

Teacher and school characteristics

- Fully qualified and experienced; 'mature phase' of professional development;
- Some promotion of student involvement before intervention; reasonably open for change;
- Limited collaboration with colleagues in school; frequent SMART inservice participant;
- Small rural school with limited science facilities; head teacher more administration orientated.

Participation and perceptions in/of '97 inservice course

- participated in all units of the '97 biology inservice course and in coaching;
- limited functional use of the exemplary material; excessive use of student materials;
- perceptions of teacher on course (incl. Material) and its effect: positive;
- perceptions of students on teaching and student materials: positive.

Behaviour related to focal teaching skill and topic & effect of '97 inservice course

- lesson preparation: only does what is minimally required; no effect;
- use of learning activities and promotion of student involvement: as intended; positive effect;
- lesson evaluation: no functional participation in coaching/self-evaluation forms not used; no or negative effect;
- teaching of the environmental topics: as intended; positive effect.

Behaviour related to note giving, textbook use and homework & effect of '97 inservice course

- note giving: as intended; possible effect;
- textbook use: as intended; possible effect;
- homework: as intended; possible effect.

The SMART '97 biology inservice course has affected the teaching behaviour of teacher A. Especially the use of learning activities, the promotion of student involvement, and the teaching of the environmental topics have changed in the intended direction.
Teacher A's behaviour related to note giving, textbook use and homework was also quite close to what was intended by SMART. Although it is expected that SMART inservice has had a positive influence here, this could not be supported by substantial evidence.
Teacher A's preparation and evaluation of lessons was rather far away from what was found intended by SMART, and the inservice courses have had no influence on his behaviour to this respect.

Teacher A has probably made only limited functional use of the exemplary lessons, although he claims otherwise. If indeed only limited use has been made of these lessons, they cannot have been very instrumental in the changes in behaviour described above. These changes then seem to have been mainly caused by the provision of SMART student materials, which appealed to the teacher

and his students. This means that he has been quite successful in producing lessons, using simple 'hands-on/minds-on' activities from the student materials, in which active learning was promoted without much support from the exemplary material.
Teacher A appeared to be negatively influenced in his attitude towards the teaching profession because of the limitations he perceived in the educational environment in his school, and in the status of his profession in Swaziland. However, this has not kept him from experimenting with more student centred teaching approaches, as long as this did not take too much effort. He probably embarks on this because he finds teaching more enjoyable and rewarding in that way. A more student centred focus can be expected for 'mature phase' teachers according to the professional development model, presented in chapter 3. On the other hand his preparation of lessons seems to have been negatively influenced by the perceived negative factors. These factors probably also have contributed to his negative attitude towards coaching and self-evaluation. However, it seems that negative experiences during his preservice training have played a bigger role here.

Based on teacher and school characteristics and on results of the '97 research, predictions have been made regarding his teaching behaviour to be expected one year after the intervention. Except for note giving these predictions were correct to a great extent. For the future it is expected that teacher A will require more inservice training with more intensive support (and a conducive environment) if he would like to embark on more complex skills related to the facilitation of active learning. However, it is not expected that he will put much energy in further professional development when the conditions in his school and in Swaziland remain the same. The bad experiences in his preservice training make it unlikely that he will engage in any form of intensive support. He probably will continue experimenting on his own for some time, participating in (not too demanding) inservice courses so now and then.

Appendix K
Short & long term effects

Evaluation sheet: teacher A

Training elements	Evaluation criteria	Short-term effect	Long-term effect
I. Promotion of student involvement & active learning	1. SMART 'hands-on/minds-on' activities are used in the teaching of all topics, when available.	-	2
	2. The 'hands-on/minds-on' activities are used in a student centred way.	2	2
	3. Teacher involves students in the lesson by applying the 'question and answer method'.	0	0
II. Teaching of environmental topics	1. More time is spent on the teaching of the environmental topics on average, after the intervention	2	1
	2. The environment related student materials of SMART are used in the teaching of these topics.	2	2
III. Lesson preparation & evaluation	1. A topic scheme is used for the selection of the 'hands-on/minds-on' activities resulting in rational use.	0	0
	2. The selected activities are suitable/relevant for pupils & teacher; adaptations are made, when necessary/required.	0	0
	3. The teacher can show a lesson plan containing: - planned objectives; - planned instructions for activity; - answers to questions of activity.	0	0
	4. The lesson design form is used.	0	0
	5. Self-evaluation is done; the self-evaluation form is used.	0	0

Evaluation sheet: teacher A (continued)

Training elements	Evaluation criteria	Short-term effect	Long-term effect
IV. Note giving	1. Notes given are summarising, structured, and concentrating on difficult concepts.	-1	1
	2. Limited lesson time is spent on note giving/copying.	2	2
	3. Teacher instructs students to copy the notes and students copy notes in notebook; teacher gives support in how and where to write notes and how and where to write answers to questions.	0	1
V. Textbook use	1. All students have the same textbook	1	1
	2. Students take their textbook to class	0	0
	3. The textbook is used (together with the materials): - use is made of the textbook in class - homework is given from textbook - students (have to) study from the textbook	0	0
VI. Homework discipline	1. Adequate attention is paid to homework at the start of the lesson (checking, discussing and/or marking).	1	1
	2. Students are assigned to do homework, which is clear and relevant; teacher writes the homework on the blackboard and tells students to copy the homework; students copy the homework	1	1

KEY TO EVALUATION SCORE

Effect value	Effect description
2	a considerable effect
1	some effect
0	no effect
-1	a negative effect
-	effect not established

Appendix L
Lesson planning

From: A guide to school regulations and procedures.
Swaziland Ministry of Education, 1997

Scheming refers to the more long term planning in teaching, in which teachers write down what they are going to cover of a certain syllabus over a certain period of time (e.g. for one term or for a whole year). SMART had already made available the so-called 'Recommended Schemes' for the teachers, recommending a sequence in which the topics could be taught as well as giving time allocations (in terms of periods of 40 minutes) to specific topics, for complete COSC syllabuses. Many, especially inexperienced, teachers used these as a guideline for their scheming. The Ministry of Education prescribed to schools that teachers had to complete so-called 'Schemes of Work' (Ministry of Education, 1988a), in which a similar kind of information was requested as provided in the 'Recommended Schemes' (see Box 6.12). Most schools used these schemes of work, and the school administration was expected to check these regularly.
The Ministry of Education also prescribed to schools that teachers had to record their daily lesson preparation in a book, called 'prep-book' by teachers, specifying minimum requirements for such preparations (Ministry of Education, 1979). Also these prep-books had to be checked regularly by the school administration (see Box 6.12).

Extract from school regulations of the Ministry of Education of Swaziland related to schemes of work and lesson preparation

Schemes of work

1. The scheme is the teacher's plan of operation and must always be available on the school premises for inspection by the Head of the School or Ministry official.
2. schemes for the first term must be submitted for approval by the end of the first fortnight of the term……… the signature of the Head of the School signifies that the scheme has been approved.
3. An effective scheme should include:
   - The topics or activities to be covered
   - The amount of time allocated to each topic or activity
   - A brief account of the teaching methods
   - Details of the books, materials and visual aids

Daily preparation book

1. Daily preparation is to be recorded in a book or file provided by the school.
2. The Head of the School must check preparation frequently and sign and date the preparation book to show that the content is approved.
3. The preparation book of probationary teachers must be checked and signed at least once every week.
4. The preparation book must always be up-to-date and available on the school premises for inspection by the Head of the School or Ministry official.
5. The following minimum information should be recorded in the prep book in a neat and systematic way:
   - Date of the lessons, the period, and name of class
   - Topic or activity do be dealt with
   - Books and materials to be used
   - Work to be done by teacher and pupils.

Glossary

BSc	Bachelor of Science
CBAM	Concerns Based Adoption Model
COSC	Cambridge Overseas School Certificate
GCE	General Certificate in Education
G/K	Guskey/Kirkpatrick (effect level)
IMSTIP	Inservice Mathemathics and Science Teaching Improvement Program
INSET	Inservice Education and Training
PGCE	Post Graduate Certificate of Education
SMART	Science and Mathematics Advice and Regional Training
SPEC	Science Pre-Entry Course
STC/STD	Secondary Teaching Certificate/Diploma
UNISWA	University of Swaziland
UT	Universiteit Twente
VUA	Vrije Universiteit Amsterdam