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Assisting teachers through curriculum change: teachers' use of support materials for teaching about smoking-related matters

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CHAPTER 1

CONTEXT OF THE STUDY, AND THE RESEARCH PROBLEM

1.1 OVERVIEW OF THE STUDY

This study involved research relating to the development and investigation of teaching and learning materials to support biology teachers to make the changes required by the revised South African school curriculum, whilst teaching about smoking and related matters.

The study was done in two phases. The first phase, the diagnostic phase, aimed at obtaining research-based information about what would be appropriate content to put in the package in order to assist teachers make the changes required by the new curriculum. This phase of the study was meant to establish the current situation regarding the teaching of smoking and related matters (including the nature and extent of smoking by learners in schools, as well as how the topic of smoking was being taught), and the needs of teachers having to teach the topic using the new approach to teaching and learning. This was done by directly asking the teachers what they believed was needed in the package and by conducting a situational analysis to identify strengths and weaknesses in the way smoking was currently being taught. Ideas found to be effective (strengths) were incorporated in the package, whilst short-comings (weaknesses) were addressed in the package. The topic on smoking and smoking-related matters was chosen because of the serious social and health-related problems resulting from smoking (see Chapter 2), and its link to the biology curriculum. The involvement of the stakeholders during the development of curriculum materials means that the materials are more likely to be responsive to their needs, and thus more likely to be used (Zammit, 1992; Draper, 1998). Two techniques were used to gather information in the diagnostic phase: activity-based questionnaires and semi-structured interviews. The questionnaires were administered to 29 teachers from 14 schools, and the interviews were conducted with 10 teachers from 7 schools.

The second phase of the study, the therapeutic phase, involved the development and investigation of a teaching and learning package which dealt with smoking-related matters in a way which promoted the approaches required by the new curriculum. The aim of this phase of the study was to better understand factors that affect teachers' use of support materials so that curriculum developers can design materials that are more likely to support teachers involved in curriculum innovation. The same research instruments were used in this phase of the research. The activity-based questionnaires were administered to 27 teachers from 20 schools, and 12 teachers were interviewed after they had used the package. Four of the 12 teachers interviewed had also been interviewed in the diagnostic phase.

This chapter describes the context of the study (the introduction of the new curriculum in South African schools, and the new requirements) and examines the implementation problems which motivated this study.

1.2 THE NEW CURRICULUM FOR SOUTH AFRICAN SCHOOLS

The purpose of this section is to put the reader in the picture about what the curriculum changes involve and why they happened. Firstly, it is important to realise that these changes were not solely for educational reasons, but had political, social, and economic agendas. These factors impact on the success of the implementation, and therefore need to be understood by the reader. Secondly, since it was difficult to establish from the jargon-laden policy documents what classroom practices the new curriculum required (Chisholm, 2000) this section attempts to spell out clearly what changes teachers need to make in order to successfully implement the new curriculum. The policy documents, which were supposed to guide teachers on how to implement the new curriculum, were laden with ideological rhetoric (Chisholm, 2000) which focused on explanations of reasons for change and principles underpinning the new curriculum, but provided only scant and fragmented information on classroom practices (Parker, 2006). Because this study investigated teachers' classroom practices, it was important to spell out what the requirements and practices of the new curriculum are before their implementation could be researched. Section 1.2.3, starting on page 6, explains each requirement in more depth, based on an extensive literature review, as stated in Chapter 4, pages 62-64.

1.2.1 Introduction of the new curriculum and the reasons behind the changes

After the election of the new South African government in 1994, a new school curriculum was planned. It was announced in 1996 and implementation started in 1998. A number of factors prompted the curriculum reform, but essentially the reform was politically motivated. The national politics had a huge influence on the South African curriculum-making (Chisholm, 2005; Chisholm and Leyendecker, 2008). The African National Congress was concerned that the curriculum of the past was discriminatory, as explained in the following quote:
The existing curriculum was

- "*fragmented along racial and ethnic lines, and has been saturated with the racial ideology and educational doctrines of apartheid*, [and]
- [provided] *unequal access to education and training at all levels of the system*".

(African National Congress, 1995: 3)

The new government wanted to be seen to make a difference, particularly with the 1999 elections approaching. This involved changing the laws governing the country, including the constitution and all racially entrenched legislation (African National Congress, 1995), and by changing the education system (Department of Education, undated a; Department of Education, 2002). The government used two sets of arguments to motivate for the need to change the education system — one set based on social reasons, and the second on economic factors.

Social reasons

The new government, through its education system, wanted to remove all traces of discrimination and to promote participation by previously disadvantaged groups. The social arguments (of the new government) seemed to target South Africans at two levels:

- **At the level of individuals**: The government intended to make things better for each individual by "*equipping all learners with knowledge, competencies and orientations needed to be successful after completion of their studies*" (Department of Education, 2002: 7), ensuring "*an improved quality of life for all*" (Department of Arts, Culture, Science and Technology, 1996: 10).
- **At a national level**: These arguments focussed on nation-building. The new government wanted to change the mind-set of the people of South Africa by encouraging them to interact and work together in order to develop "*a new sense of national identity, based on dignity and respect for all people, rather than on racial, gender and class division*" (Department of Education, Undated a: 4). The government wanted to address the issue of the imbalances between historically advantaged and disadvantaged institutions and groups, as well as to encourage participation of more girls and women in science, engineering and technology (Department of Arts, Culture, Science and Technology, 1996). They hoped to achieve this by "*encompassing a culture of human rights, multilingualism, multiculturalism and nation-building, and being responsible citizens*" in order to build a stronger nation (Department of Education, 2002: 7). In so-doing, they hoped to produce "*a well-educated population capable of participating fully in the new South Africa*" (Department of Arts, Culture, Science and Technology, 1996: 10).

Economic reasons

The economic arguments underpinning the changes to the education system are based on the belief that education contributes towards economic growth in a country. Consequently many countries strive to improve their education system in order to boost their economy (Walberg, 1991; Drori, 2000; The Centre for Development and Enterprise, 2004). The South African government recognised that countries with well-developed education systems had grown faster, economically, in the twentieth century than those which had delayed educational development (African National Congress, 1995). The government realised, therefore, that a strategy that emphasised the "*acquisition of good quality basic education and training by all South Africans*" was needed in order to revive the economy of the country (African National Congress, 1995: 36). Most developed countries focus, in particular, on developing a skilled scientific and technological workforce, in order to improve the country's economy, and hence the standard of living of individuals in the country. The South African government acknowledged that education, particularly in science, engineering and technology, was essential for economic growth (Department of Arts, Science, and Technology, 1996), and would be needed to achieve an "*improved international competitiveness for South African economic activities*" (Department of Arts, Culture, Science and Technology, 1996: 10).

In its 1995 Green Paper[1] on science and technology, in which proposals were made to prepare South Africa for the 21st century, the new government expressed its desire to ensure that there was an improvement in the country's economy so that it would be able to compete in the world market (Department of Arts, Culture, Science and Technology, 1996). For South Africa to be economically viable and compete in international markets it was crucial that it developed a workforce which "*is able to think creatively, critically and to solve problems independently*" (Nourse, 1999: 36). The desire to improve the

[1] A Green Paper is not a statement of government policy, but outlines issues and options to which readers are invited to respond.

economy of the country was therefore the second factor which prompted South Africa to look critically into reforming its educational curriculum.

1.2.2 A brief history of the introduction of the new school curriculum

The new government first unveiled its plans for the new curriculum in 1996. At the time, and up until 2006, this curriculum was referred to as *Curriculum 2005*. A small booklet on *Curriculum 2005* (Department of Education, 1997a) was used as one communication tool for helping people (particularly teachers) to understand the proposed changes. This booklet explains why there was a need for curriculum reform; the differences between the "old" and "new" curriculum; the key principles of the new curriculum; the proposed new structure of the education system; and the roles to be played by various stakeholders (for example, learners, parents and teachers).

In the new curriculum many familiar terms were replaced by unfamiliar terms. For example, "teachers" became "educators"; "pupils" became "learners"; what were formerly called "standards" now became "grades", "subjects" became "learning areas", and what used to be the "syllabus" for each subject was replaced by a "National Curriculum Statement". New concepts and terms were introduced including "phase organisers", "learning programmes", "assessment criteria", "range statements", and "performance indicators".

The proposed new structure of the education system

The revisions to the structure of the schooling system are summarised in Table 1 on the next page. The 12 years of schooling were divided into two "bands", the *General Education and Training* band (GET) incorporating Grades R to 9, and the *Further Education and Training* band (FET) incorporating Grades 10 to 12. The *General Education and Training* band was further divided into "phases" (as shown in Table 1).

What had been called "subjects" were reduced in number for the *General Education and Training* phase, and regrouped into eight "learning areas" One of these was the *Natural Sciences* (the learning area involved in this study).

1.2.3 The requirements of the new curriculum

If the intention of curriculum planners is to use the curriculum documents as a vehicle for change in the education system, the jargon used and what is required of the teachers must be explained explicitly to avoid confusion. Sanders and Nduna (2007: 13) point out that no matter how willing the teachers are, "*if they do not understand what it is they are required to do they will struggle to make the changes intended by the curriculum developers.*" In addition to providing clear explanations, policy documents also need to inform teachers of the difference between the traditional teaching approaches they were using and those required by the new curriculum. Pinto (2005: 2) asserts that teachers need realistic guidance — particularly from the curriculum developers and those directing the curriculum change — and "*practical suggestions for their classes.*" The reality is that if teachers do not understand what they are supposed

to do, they end up constructing their own meaning for the curriculum requirements (Ogborn, 2002) and might not do what is required of them .

Table 1: The structure of the education system, including grades, bands and phases

Band	Grade	Phases
General Education and Training band	R	Pre-school
	1 2 3	Foundation phase
	4 5 6	Intermediate phase
	7 8 9	Senior Phase
Further Education and Training band	10 11 12	

Source: Department of Education (1997a)

The new South African school curriculum requires teachers to change their ways of teaching. However, research in South Africa has revealed that the policy documents on the new requirements have not thoroughly explained what teachers are supposed to do in class (Khulisa Management Services, 2002; Pabale and Dekkers, 2003; Sanders and Kasalu, 2004; Parker, 2006). The South African policy documents provide neither a list of the requirements nor clear explanations. Parker (2006) analysed the National Curriculum Statement for Mathematics and found that the Department of Education made assumptions about teachers' understanding, and that terms were used without clear explanation of what they meant. For example, the document announces that the curriculum should be "learner-centred" and "activity-based", but uses each term only once, and does not clearly explain the meanings of the terms (Parker, 2006).

In order to be able to proceed with their research, Sanders and Kasalu (2004) developed and validated a list of the changes which science teachers implementing the new curriculum are required to make to their classroom practice, later updated by Sanders and Nduna (2007). The development and validation of the list was done in five steps. In the first step the authors identified the requirements of the new curriculum by analysing the National Curriculum Statement and other policy documents, and also using the inside information of the first author, who was a member of the original Natural Sciences Learning Area Committee. Eight requirements were identified. The second step involved face-validating the requirements using a focus group interview with teacher educators who were involved in pre-service training of teachers who had to implement the new Natural Sciences curriculum (one physics, one chemistry and one biology). At that time teacher educators at reputable institutions were amongst the most knowledgeable authorities on the new curriculum, because they were having to train teachers to implement it. Each teacher educator completed a mindmap showing what they thought the requirements were. This was followed by a brain-storming and discussion session with the group, in an effort to find

consensus on what the requirements were. During this exercise a ninth requirement was identified (integration). The third step was to identify the distinguishing characteristics of each requirement (what each term actually meant). This was initiated during the focus group interview, and followed by revisiting the policy documents and reviewing the relevant literature. In the fourth step, Sanders and Kasalu validated the list of distinguishing characteristics they had drawn up for each requirement by means of checklists which were completed by the original three teacher educators and a further science education researcher, to check the "extent of agreement about the characteristics" (Sanders and Kasalu, 2004). This resulted in the production of a list which identified nine requirements for the new curriculum, and spelled out what teachers need to know to fully understand each requirement (what Sanders and Kasalu referred to as the "distinguishing features" of each requirement) [See Appendix A for an updated list of requirements and their distinguishing features]. The fifth and final step in the validation process was to present the list to the education and research communities for their input and suggestions. This was done at two conferences. The first was the 2004 conference of the *Southern African Association for Research and Development in Mathematics, Science, and Technology Education*, where about 40 science education researchers provided input, and enthusiastically endorsed the work as extremely useful. The second conference was the 2006 *South African Association of Science and Technology Educators* conference. It was presented at the conference plenary to about 300 teachers and Department of Education officials. Again it was strongly lauded as providing valuable insights. Several Department officials said that for the first time they actually realised what teachers were meant to be doing.

For each requirement the list of distinguishing features starts with a "statement of the obvious", which simply explains the requirement at a very self-evident level, using the relevant key term. For example, "activity-based learning" is explained as "*learners need to be actively involved in the learning process*" (Sanders and Kasalu, 2004: 920). If teachers only understand the requirement at the "obvious level", then they do not fully understand the requirement. They need to be aware of the other distinguishing features.

Since my study involved finding out whether *Natural Science* teachers understand and use the requirements of the new curriculum in their classrooms, it was necessary for me to understand what the requirements are so that I could check teachers' understanding and the extent to which they implemented the requirements in a classroom situation. In the following discussion the requirements of the new curriculum are spelled out in more depth. The discussion includes the research-based or theoretical underpinnings of each requirement to show why it is important in improving teaching and learning.

Requirement 1*: Education should be outcomes-based*

The new South African curriculum requires that teachers focus on the outcomes of the learning process (Department of Education, 2003). Teachers are expected to identify the outcomes they wish to target in their lessons and then design their lessons around them (Department of Education, 1997b). According to Spady (1994: 2) "*outcomes are clear learning results that we want students to demonstrate at the end of significant learning experiences*". van der Horst and McDonald (1997) suggest that outcomes-based education requires teachers to focus their attention on two things: (1) the desired end results of each learning process, and (2) the teaching strategies to guide learners in achieving the desired outcomes. There is a third aspect that teachers need to be aware of — that assessment should be used to determine whether the outcomes have been achieved.

Outcomes are crucial in the teaching and learning process in that they give teachers a target to aim for. They also assist teachers in determining criteria against which to measure achievement of the aims. It is therefore important that teachers understand outcomes fully. Sanders and Kasalu (2004) suggested a numbers of things that teachers need to know if they are to fully understand outcomes. Sanders and Nduna (2007) have updated the list for the revised curriculum.

- *Lessons must be planned to achieve pre-stated outcomes, and this should be the starting point of all lesson planning.*
- *Outcomes state what learners should be able to do AFTER a learning experience, and are not just a list of activities done during the lesson.*
- *Outcomes must include not only knowledge but also the skills and attitudes to be developed.*
- *Outcomes must be stated in measurable terms, so they can be observed and assessed.*
- *Learning should address the different types of learning outcomes:* ***critical*** *and* ***developmental outcomes*** *across all learning areas, and* ***learning outcomes*** *which are specific to a particular learning area or subject.*
- *Teachers should formulate their own more detailed outcomes to direct their lessons. We call these* ***lesson outcomes****.* (Sanders and Nduna, 2007: 20)

In the new South African curriculum the "critical outcomes" and "developmental outcomes" [spelled out in Appendix B] apply across all grades irrespective of the learning area or subject. In addition, each learning area has subject-focused outcomes originally called "specific outcomes", but renamed "learning outcomes " when the curriculum was revised in 2002. Originally there were nine specific outcomes in the *Natural Sciences*, but these were reduced to three learning outcomes after the revision of the curriculum [see Appendix C]. Teachers are also expected to write more focused outcomes for individual lessons. The curriculum statement does not name this level of outcome, but Sanders and Kasalu (2004) call them "lesson outcomes".

If outcomes are the results of learning that learners need to demonstrate at the end of a learning process, then the behaviours need to be observable. Spady (1994: 2) argues that outcomes "*are not values, beliefs, attitudes, or psychological states of mind*" but are what learners can actually do with what they know after a learning experience. Since outcomes involve the actual doing rather than knowing it is appropriate, as Spady points out, that they be defined according to the actions learners are expected to do after a learning episode. He suggests that educators should use observable action verbs like, "describe", "explain", "design", or "produce" (to define and develop outcomes) rather than vague or non-demonstrable verbs, for example, "understand", "believe", and "think".

One could argue that outcomes (as Spady defines them) do not differ from the behavioural objectives that teachers used in the "old" system. van der Horst and McDonald (1997: 8) point out that outcomes-based education is not new in the education sphere, but "*has its roots firmly embedded in earlier work on educational objectives, competency-based education, mastery learning and criterion-referenced assessment*". In the 1950's Bloom and his co-authors devised a taxonomy of behavioural objectives for educators (Bloom *et al.*, 1956). For decades South African teachers were taught to write behavioural objectives. For example, the prescribed textbook (Falk, 1971) used by biology student teachers who were trained at the University of the Witwatersrand in the early 1970's shows how behavioural objectives

should be written to describe behaviours using action verbs. The practice of using behavioural objectives for specific lessons continued until the introduction of *Curriculum 2005* in 1998. The similarities between the goals of the "old" and the "new" systems can be seen if one compares the aims and objectives in the old *General Science* syllabus with the outcomes in the new *Natural Sciences* curriculum statement [see Appendix C for objectives of the old *General Science* syllabus and outcomes of the new *Natural Sciences* curriculum statement].

A second way in which the outcomes in the new curriculum are similar to the objectives in the old syllabus document relates to the way the outcomes are used. Bloom and his co-authors asserted that their taxonomy of objectives was useful to plan learning experiences and prepare evaluation devices (Bloom *et al.*, 1956), which is the same claim made by proponents of outcomes in the new curriculum (Department of Education, undated b).

A third similarity between the outcomes of the old and the new systems has to do with the three areas targeted by the outcomes. In Bloom's taxonomy they focussed on three domains,

- *the cognitive domain.* This is the domain that deals with objectives to do with knowledge, understanding, and intellectual skills.
- *the affective domain.* This includes objectives that "*describe changes in attitudes, and values*" (Bloom *et al.*, 1956: 7).
- *the psychomotor domain.* This is the domain that deals with manipulative or motor-skills (Bloom *et al.*, 1956).

These areas are the same as those emphasised by the outcomes in the new South African school curriculum, so the focus on skills and attitudes in the new curriculum is actually not new.

Although there are a lot of similarities between objectives in the old system and outcomes in the new systems there are also some differences. Firstly, in the new system there is an increased emphasis on outcomes at the broad level. The broad goals of the Education Department (which Spady calls "exit outcomes" and which in *Curriculum 2005* are called "critical and developmental outcomes") are heavily emphasised, appearing in the National Curriculum Statement of every subject even though they are not subject-specific. Therefore teachers should be very aware of these broad goals. In the old system the broad goals of the whole curriculum were not spelled out in the syllabus documents of each subject. If such goals did exist, teachers did not seem to be aware of them. Secondly, although teachers in the old and the new systems used outcomes / objectives in the same way, i.e. to direct and plan their lessons, pupils in the old system were not aware of these objectives. In the new system, however, learners are meant to be made aware of the outcomes. Learners should be given the outcomes prior to learning experiences, and made aware that assessment will be used to evaluate their success in achieving the outcomes.

Requirement 2: Teachers should be facilitators of learning

The new South African school curriculum requires teachers to be facilitators of learning rather than transmitters of knowledge (Department of Education, 1997b; Department of Education, 2002). The term 'facilitate' originates from a Latin word *facilis* which means 'to make easy' (Bentley, 1994). In terms of teaching, facilitation refers to teachers making learning easier for the learners. Bentley defines facilitation (in the context of facilitating groupwork) as

> *"the provision of opportunities, resources, encouragement and support for the group to succeed in achieving its objectives, and to do this through enabling the group to take control and responsibility for the way they proceed".* (Bentley, 1994: 31)

Nourse (1999) claims that facilitating lessons promises valuable outcomes in as far as learning is concerned, provided it is done properly. However, facilitation is not as simple as it may seem to be. Sanders and Kasalu (2004) found that several (number not given) of the 10 teachers interviewed did not understand the complexities of facilitating. It is crucial that teachers fully understand what facilitation is in order to deal properly with the demands of the new curriculum. Sanders and Kasalu (2004) suggest a numbers of things that South African teachers need to know if they are to fully understand what facilitation means, and avoid misconceptions about what it involves. They need to understand that

- *teachers should not simply be transmitters of knowledge, but should "make easier" or "assist the progress" of learning.*
- *facilitating involves a balance between explaining concepts and allowing learners to construct their own understanding.*
- *in order to facilitate, teachers need to*
  - *specifically plan lessons to achieve the outcomes.*
  - *be well prepared in terms of their content knowledge and suitable pedagogical approaches to achieve the outcomes.*
  - *provide the necessary resources for meaningful learning to take place (not just leave the learners to discover things for themselves).*
  - *create a favourable environment which allows for meaningful learning to happen.*
  - *monitor and deal with learners, as individuals or groups, as learning is happening.*
- *teachers need to consolidate lessons to ensure all learners have covered everything, and that concepts developed are those currently accepted by scientists.*

(Sanders and Kasalu, 2004: 919)

In cases where resources are lacking it is up to the teacher, as a facilitator, to provide learners with the necessary resources for learners to use for learning activities, so that learning can happen. Teachers should not be the sole source of information. Providing learners with resources is important (Bentley, 1994; Sanders and Kasalu, 2004), particularly in South African schools, where many schools, especially in the rural areas, lack resources such as school libraries, the internet (because there are no computers or they are not connected to the internet), textbooks, science equipment, posters, and pamphlets.

Facilitation cannot be implemented in isolation, as the nine requirements of the new South African school curriculum are linked to one another. Facilitation, for example, is linked to:

- **Outcomes:** Having outcomes clearly spelt out for a lesson does not guarantee achievement of the outcomes. Good facilitation from teachers is essential in order to effectively achieve the outcomes.

- **Learner-centred learning:** Each learner is unique and teachers have to address their needs (McCombs and Whisler, 1997). For teachers to address the needs of individual learners involves facilitation.
- **Activity-based learning:** In activity-based learning, where learners are supposed to be involved in meaningful activities that engage their minds, they may need the teacher to facilitate the learning process.
- **Groupwork:** Facilitation plays an important role in groupwork, which can be problematic in as far as learning is concerned if it is not facilitated properly. It is important that learners, in their individual groups, are closely monitored by the facilitator (Nourse, 1999; Sanders and Kasalu, 2004). Teachers need to ensure that work is being done, and guidance is given when necessary. While learners work in their groups the facilitator should check to see to it that meaningful learning is taking place (Sanders and Kasalu, 2004). If learners in different groups are given different tasks which contribute to construction of knowledge, it is important that at the end of those tasks teachers ascertain that all learners have covered everything (for example, by presentations by each group to the whole class) and that they (teachers) give clarification where necessary. Gaps in scientific knowledge will arise if teachers do not consolidate their lessons, particularly if individual groups have engaged in different tasks. Group A, for example will not know what scientific concepts Group B was dealing with. All of this requires extensive facilitation.

Bentley (1994) argues that facilitation empowers learners, making them believe in themselves. It also promotes active participation by learners in creating their knowledge (Nourse, 1999).

Requirement 3: ***Learning needs to be learner-centred***

The new South African school curriculum emphasises the need for a "learner-centred" approach, as mentioned in the Revised National Curriculum Statement for *Natural Sciences*, which states that "*the outcomes encourage a learner-centred and activity-based approach to education*" (Department of Education, 2002: 1). However, the definition of "learner-centred" is not given in the policy document. I therefore perused the education literature on the topic. McCombs and Whisler define learner-centered learning as "*an empirically informed perspective that begins with a focus on knowing and understanding each learner*" (McCombs and Whisler, 1997: xii). They point out that learner-centred learning puts emphasis on learners and their individual needs and interests, cultural backgrounds and beliefs (McCombs and Whisler, 1997). Sanders and Kasalu (2004) suggest a numbers of things that teachers need to know if they are to fully understand learner-centredness.

- *Teachers must be aware that there is variation in the class in terms of different*
  - *cultural backgrounds, beliefs and practices,*
  - *home language,*
  - *pace of learning,*
  - *styles of learning,*
  - *methods of demonstrating achievements.*
- *[T]eachers should plan lessons to take into account these differences.*
- *[T]eachers must actively accommodate differences (in practice).*
- *[A]lthough it is true that learners should be at the heart of learning (actively engaged in*

the learning process) "learner-centred" is not the same as "activity-based".

- *[L]earners should be able to make some choices about what and how they learn.*

Sanders and Kasalu (2004: 919)

Not all the points suggested by Sanders and Kasalu (2004) will be further discussed here as they are explicitly stated. This section will look at cultural backgrounds, beliefs and practices, and the learning styles of individual learners. The literature on learner-centred learning reveals two features central to learner-centredness: recognising and accommodating learners' differences, and allowing learners a degree of choice.

Recognising and accommodating learners' differences

The first characteristic of learner-centredness focusses on the recognition and accommodation of learners' differences. Teachers need to be aware that learners are unique, and that learners come to class with different needs, cultural backgrounds, beliefs and practices, and learning styles. McKenzie (2007) points out that some learners may differ in other ways such as their sexual orientations or if they suffer from physical or mental disorders. Teachers should accommodate individual learners when they plan their lessons and when they teach (McCombs and Whisler, 1997; Sanders and Kasalu, 2004).

- **Differences in cultural background, and beliefs and practices:** Learners come from different cultural backgrounds which might influence their learning (Dimmock, 2004). Hofstede (1991) (cited by Dimmock, 2004: 46) asserts that culture entails a "*pattern of thinking, feeling and acting underpinning the collective programming of the mind which distinguishes the members of one group or category of people from another.*"

  Cultural background, beliefs and practices may impact on the learning of science in two ways. Firstly, learners may have cultural beliefs that contradict the science they are being taught, and these beliefs may interfere with the learning of new scientific concepts. For example, a number of South African cultures believe that the lightning is controlled by the power of witches. The Venda people specifically believe that lightning will strike anyone wearing red clothes (Kibirige and van Rooyen, 2007). Sebego (1995), in her study involving Grade 11 Batswana children from four different tribes, found that the cultural beliefs of children from different tribes about what determines the gender of a baby differed.

  Cultural practices can affect learning in a second way if cultural practices regarding how learning happens are in conflict with the way teachers want the children to learn. In some societies children are expected to be respectful and obedient to older people "*whose authority is rarely questioned*" (Dimmock, 2004: 47). For instance, Tabulawa (1997) points out that in Botswana children are dominated and subordinated by the elders. Tabulawa claims that since dominance and subordination have been "*internalised, students and teachers carry them to the classroom as their cultural baggage, which in turn informs their actions and respective classroom roles*" (Tabulawa, 1997: 195). Such learners, because of their cultural background, may find it difficult to express curiosity, and feel more comfortable listening to, and being instructed by, teachers (Jegede, 1994). However, the new South African curriculum emphasises activity-based approaches, and learners are expected to be responsible for their learning. Such approaches require learners to express curiosity, ask questions, actively participate in classroom activities, and construct their own knowledge (Nunan,

1988; McCombs and Whisler, 1997), and children from many South African cultures may find this difficult.

- **Recognition of different learning styles:** According to McCombs and Whisler (1997) individual learners have different learning styles. Pritchard (2005: 53) defines 'learning styles' as "*habits, strategies, or regular mental behaviours concerning learning, particularly deliberate educational learning, that an individual displays.*" Different styles have been identified, for example, *visual learning,* which involves learners who prefer to learn by seeing, because they have a good visual memory. They prefer information that is presented to them in the form of diagrams, graphs, pictures and posters. There are learners who prefer to learn by listening and are referred to as *auditory learners.* These learners have good listening skills, which is an advantage when engaged in "*discussion, lectures, interviewing, hearing stories and audio tapes, for example*" (Pritchard, 2005: 58). There are also those learners who prefer to learn by doing and are called *kinaesthetic learners.* These learners "*enjoy physical activity, field trips, manipulating objects and other practical, first-hand experiences*" (Pritchard, 2005: 58). If only one learning style is encouraged by teachers the chances are that learners who are not comfortable with the style will work and learn less effectively than other learners. Pritchard asserts that teachers' awareness of learning styles should have an impact on the way they choose to teach — and should help them to a better understanding of the needs of learners, "*as well as to an awareness of the need to differentiate materials, not only by level of difficulty but also by learning style*" (Pritchard, 2005: 54).

  Teachers need to know about, understand, and accommodate learners' learning styles (Nunan, 1988; McCombs and Whisler, 1997; Sanders and Kasalu, 2004). In order to accommodate learners' different learning styles teachers have to be flexible in their teaching approach, that is, possess a variety of teaching strategies that they can use over a period of time (Dimmock, 2004).

Involvement of learners in decisions about their learning

The second feature of learner-centredness advocates that learners be allowed to choose what they would like to learn about. Nunan (1988) suggests that learner-centeredness is a kind of pedagogy which encourages the collaboration of both teachers and learners in the learning process. A number of authors writing about learner-centredness believe that learners should be allowed to exercise their responsibility in the choice of what and how to learn in class (Nunan, 1988; McCombs and Whisler, 1997). McCombs and Whisler (1997: 90) emphasise that learners should be given choice "*whenever and wherever possible*". According to Nunan (1988), allowing learners to choose what they want to learn in class accommodates their needs and interests.

This seems to be idealistic, and may be difficult for some teachers to implement in the "real" classroom situation. Firstly, science is a hierarchical subject, meaning that learning should start with basic concepts before moving on to the more complex ones. Choosing concepts in a logical sequence may not be easy for learners, because they lack an understanding of "the big picture". Secondly, for teachers to be able to teach in a learner-centred way they need to be extremely skilled. Changing from a teacher-centred to a learner-centred approach requires a paradigm shift for both teachers and learners (Tabulawa, 1997; Ottevanger, 2001; Nykiel-Herbert, 2004). However, a number of teachers in developing countries are under-qualified (Guthrie, 1990; Tabulawa, 1997). According to South African statistics only 42% of

science teachers in South Africa were adequately qualified in 1995 (Edusource, 1997). This implies that a number of South African teachers may find it difficult to teach in a learner-centred way.

Some teachers confuse "learner-centredness" with "activity-based" learning, as shown in the study by Sanders and Kasalu (2004) where eight of the ten South African biology teachers interviewed regarded these two approaches as one and the same thing. However, the Revised National Curriculum Statement For Grades R-9 (Schools) for Natural Sciences states that the outcomes of the new curriculum "*encourage a learner-centred and activity-based approach to education*" (Department of Education, 2002: 1). The quote from the policy document suggests that "learner-centred" and "activity-based" are two different things (activity-based learning will be discussed in the next section).

Requirement 4: *Learning should be activity-based*

The new South African school curriculum emphasises the need for an "activity-based" approach (Department of Education, 2002). However, not much is said about activity-based learning in the policy documents. I had to look into the education literature to find more information on activity-based approaches.

Activity-based learning is an approach which emphasises the engagement and participation of learners in various meaningful activities which allow them to construct knowledge (Sanders and Kasalu, 2004). Meaningful activities are those activities that involve more than just physical engagement in tasks (Carin and Sund, 1980; Sanders and Kasalu, 2004). Carin and Sund (1980: 77) point out that learners can be "*actively involved by listening, speaking, reading, seeing, and thinking, providing their minds are acting on what is being learned*". Sanders and Nduna (2007) suggest five things that South African teachers need to know if they are to fully understand what activity-based learning means in the context of the new curriculum, and if they are to avoid confusing it with a learner-centred approach. Teachers need to understand that

- *learners should be actively involved in learning process.*
- *the activities should serve as the starting point for learners to construct knowledge.*
- *activities must be meaningful (have a purpose, usually to achieve some stated outcome)*
- *meaningful learning activities must also engage the learners in mental activities, which allow the learners to construct knowledge and develop understanding.*
- *a variety of methods or strategies should be used to engage learners actively in the learning process (to achieve a broad range of outcomes relating to knowledge, skills and attitudes).* (Sanders and Nduna, 2007: 27)

Activity-based learning is underpinned by different learning theories, implied in the quote above. These include:

- **Meaningful learning:** Ausubel (1963) defines meaningful learning as a specific way of learning in which learners actively incorporate new knowledge into their cognitive structures. According to Ausubel (1963) if this does not happen then rote-learning results. According to Ausubel (1963: 22) a meaningful approach to learning requires that "*the learning material itself is potentially meaningful*"as discussed under Requirement 5 in the next page. Ausubel also points out two other

important criteria for meaningful learning, that the learner must know how to learn meaningfully, and must intend to do so. Teachers may have to guide learners to learn in a meaningful way, and encourage them to have the intentions to do so (Ausubel, 1963; Shuell, 1987), and *"provide links to the real-world knowledge of students"* (Shuell, 1987: 245). Ausubel points out that meaningful learning is essential because it yields superior learning outcomes when compared with rote-learning (Ausubel, 1963).

- **Constructivism:** Constructivism focuses on learners mentally constructing their own knowledge (Vygotsky, 1978; von Glasersfeld, 1984), and in order to do this they must *"acquire knowledge by participating in authentic tasks ....."* (Marsh and Ketterer, 2005: 1). The constructivist theory of learning acknowledges that learners are active individuals who engage in their own knowledge construction by integrating new information with what they already have, and by representing it into a meaningful way (Anderson *et al.*, 1996). The implication for teachers is that teaching should not be simply a transmission of knowledge from the teacher to the learners — rather learners should be involved in the process of learning (Anderson *et al.*, 1996; Boaler, 1998).

Activity-based learning, as mentioned earlier, encourages active involvement of learners in the learning process, which is what both meaningful learning and constructivism advocate.

Requirement 5: *The curriculum should be relevant*

The new South African school curriculum emphasises *".... learning* [that is] *relevant and connected to real-life situations"* (Department of Education, 1997b: 7). According to Sanders and Nduna (2007: 27) South African teachers experience problems when they try to *"achieve relevance in science lessons"* because the range of different backgrounds of learners makes classes very heterogeneous. Thus finding examples that are relevant to each learner is not easy. Sethole (2004: 24), in his study documenting the learners' experiences of well-taught mathematics lessons, verified that *"the task of making mathematics relevant is a challenging one"*. Research reveals that a number of teachers do not really understand what "relevance" means (Sanders and Kasalu, 2004). The understanding of most teachers in their study was found to be at what the authors referred to as "the obvious level" (Sanders and Kasalu, 2004: 920). If teachers only understand relevance at *"the obvious level"*, then they do not fully understand the requirement, and Nyabanyaba (1999) points out that the way teachers understand relevance impacts on their classroom practices.

There are several ways in which lessons can be made relevant:

- What is taught in class can be applied to everyday life experiences and prior knowledge of the learners (Nyabanyaba, 1999; Sanders and Kasalu, 2004).
- Relevance can involve using examples from the country or local area (Sanders and Kasalu, 2004).
- Relevance need not only involve what learners knew before — it can also include new information that will be useful or relevant in the future (Sanders and Kasalu, 2004).

Requirement 6: *Skills development should be a focal part of the curriculum*

Skills can be defined as "*acquired proficiencies, which can be taught, learned, and perfected with practice.*" (Sanders, 2000: 151). The new South African school curriculum encourages the achievement of skills by learners, as mentioned in the Revised National Curriculum Statement for Grades R-9 for Natural Sciences which states that "*.... the Learning Areas stipulate the concepts, skills and values to be achieved on a grade by grade basis ....*" (Department of Education, 2002: 2). The same document states that the curriculum envisages a learner who is multi-skilled (Department of Education, 2002).

The new curriculum strives to assist learners acquire skills in order to face problems inside and outside the classroom environment. Skills that are supposed to be taught, as recommended by the new curriculum, include critical thinking, communication, problem-solving, collecting and analysing data, organising and critically evaluating information (Department of Education, 1997b; Department of Education, 2002). Developing the skill of critical thinking is a goal firmly embedded as one of the critical outcomes (Department of Education, 2002). Having critical thinking skills can help learners to reason in a more logical way, and analyse facts and problems in a methodical way in order to make informed decisions on what to do (Tyser and Cerbin, 1991; Chiras, 1992).

Sanders and Kasalu (2004) suggest several things that teachers need to know if they are to promote the development of skills in their classrooms:

- *skills are competencies which can be learned, developed and improved.*
- *skills must be actively taught. Developing skills is more than just getting learners to use the skill.*
- *the skills to be developed should be stated as outcomes in teachers' lesson preparations and thus targeted in their lessons.*
- *the purpose of lessons / activities intended to develop skills should be publically announced to the learners.*
- *on-going practice is needed in order to perfect a skill.*
- *skills should, at some stage, be well integrated with content and not taught in a vacuum.*

(Sanders and Kasalu, 2004: 920)

The teaching of skills is not as easy as it seems. Chiras (1992) warns those who plan to teach critical thinking skills (which is one of the recommendations of the new curriculum) that it is an active process which requires learner participation. However, teaching a skill involves more than just making learners use the skill (Beyer and Charlton, 1986), which they found most teachers who thought they were **teaching** skills were just doing. A chapter in one South African book (Sanders, 2007) gives teachers guidelines on what skills are, why skills should be taught, what skills to teach in science, and how one goes about teaching a skill.

Requirement 7: *Groupwork must be promoted*

The new South African school curriculum encourages the promotion of groupwork. This is reflected in one of the critical outcomes, which states that learners should be able to "*work effectively with others as*

members of a team, group, organisation and community" (Department of Education, 2002: 1). Cohen (1994) cited by Brodie and Pournara (2005:36) defines groupwork as "*students working together in a group small enough so that everyone can participate on a task that has been clearly assigned.*" In the early years of implementing the new curriculum a number of South African studies found learners sitting in groups but not doing groupwork (Davis, 2001; Rogan, 2004; Brodie and Pournara, 2005).

Sanders and Kasalu (2004) suggest a numbers of things that South African teachers need to know if they are to fully understand what groupwork means in the context of the new curriculum and avoid misconceptions about what it involves. They need to understand that

- *groupwork should "feature prominently" in classroom practice, but not all teaching and learning necessarily has to use this approach.*
- *groupwork must involve purposeful, meaningful activities to achieve outcomes (not just be done for the sake of working in groups).*
- *groupwork is desirable because it emulates real-life situations where activities, decision-making and problem-solving at work and home often involve groups rather than individuals.*
- *all learners must participate actively in the shared task.*
- *groupwork can be used to develop social skills.*
- *the communication involved in groupwork helps learners to "construct knowledge" meaningfully.*
- *successful groupwork will probably require some extent of monitoring and guidance (facilitation) by the teacher.* (Sanders and Kasalu, 2004: 919)

There are sound reasons for using groupwork in classroom situations (Brodie and Pournara, 2005). Firstly, learning involves a variety of internal developmental processes that can function only when children are in close contact and interacting with people in their environment, and in collaboration and cooperation with their peers (Vygotsky, 1978; von Glasersfeld, 1984). Secondly, situations at the workplace often require people to work collaboratively in groups (Sanders and Kasalu, 2004; Brodie and Pournara, 2005). Groupwork can enhance learners' social skills (Sanders and Kasalu, 2004; Brodie and Pournara, 2005) by enabling them to develop a *"disposition of tolerance and trust, and can help diverse learners to get to know each other ....*" (Brodie and Pournara, 2005: 34).

Groupwork is not about simply placing learners in groups and engaging them in tasks (Nourse, 1999; Rogan, 2004; Kutnick *et al.*, 2008). Successful groupwork is a skill which learners need to be taught (Rogan, 2004; Brodie and Pournara, 2005), and should be practised and reinforced until it is "*internalised by the learners and only then will the learners reap the full benefit of groupwork*" (Nourse, 1999: 42). Teachers need to move around checking all groups to ensure that every learner is engaged in the given task, and should assist when necessary. Teachers should also manage time well to ensure that report back and discussion at the end of the group tasks is done (Rogan, 2004; Sanders and Kasalu, 2004).

Requirement 8*: Continuous assessment should be used*

The new curriculum tries to move away from assessment which relies only on tests and examinations at the end of a learning experience, which Ferriman *et al.* (1994) say is a traditional way of assessment, to continuous assessment which, according to the Department of Education, *"is the chief method by which*

assessment takes place in the Revised National Curriculum Statement" (Department of Education, 2002: 78). Continuous assessment is assessment which *"takes place over a period of time and is ongoing".* (Department of Education, 2002: 78). In its policy documents, the Department of Education tries to make teachers aware that continuous assessment should be part of every lesson (Department of Education, 2002). However, what is important here is not how frequently assessment is used, but the purposes that teachers use it for (Department of Education, 2002). The literature on assessment suggests that assessment can be used:

- to establish learners' prior knowledge or existing experiences (Ferriman *et al.*, 1994; Osborne and Ratcliffe, 2002) so that teachers are aware of what learners already know and do not know, in order to inform lesson planning.
- to diagnose learners' strengths and weaknesses (Department of Education, 2002, Sanders and Kasalu, 2004) in order to build on the strengths, and address the weaknesses.
- to check whether intended outcomes have been achieved (Sanders and Kasalu, 2004).
- for reporting learners' progress to parents (Ferriman *et al*, 1994), teachers, and learners (Peterson and Irving, 2008).

Continuous assessment can be formative, if the learners are assessed and given feedback in order for them to improve in their learning. According to the Department of Education (2002: 77) formative assessment should be used to "*inform learners and teachers about learners' progress so as* ***to improve learning*** [my emphasis]." Black and Harrison (2001) point out that the value of formative assessment in promoting learning has been recognised in a variety of research studies. Research on formative assessment suggests that

- giving quality comments on learners' work (instead of just marks) offers guidance to learners on how their work can be improved (Black and Harrison, 2001).
- learners become more responsible for their learning (Black and Harrisson, 2001; Markwick *et al.*, 2003), which is line with the idea that assessment should be used as a strategy to promote learning.
- formative assessment "*can be used to raise standards, particularly where pupils have a clear sense of the goals they are trying to reach and how to reach them*" (Spavold, 2005).

Requirement 9: *Learning should be integrated*

"*The principle of integrated learning is integral to outcomes-based education*" (Department of Education, 2002: 13). Integration can be explained as the kind of pedagogy that tries to broaden the focus of learning by linking and relating what is taught (Department of Education, 2002).

According to Adler *et al.*(2000: 2) the main reason for the introduction of integration in the South African education system was to do away with the traditional curriculum practices where knowledge that was transmitted and acquired in schools tended to be *"fragmented, abstract and inert."* In the old curriculum there was also no link between education and training (Adler *et al.*, 2000). After some investigations on integration by the Department of Education it was decided to incorporate integration in the new curriculum in order to link vocational and formal education, thus recognising "*knowledge and skills acquired across different contexts*" (Adler *et al.*, 2000: 2).

Parker (2006) describes three types of integration:

- **inter-discursive integration:** This is integration between subjects (or learning areas) and everyday knowledge. As already explained in the section on relevance on page 13, learners need to be aware that what they learn at school can be applied in real-life situations in order to make learning meaningful.
- **inter-disciplinary integration:** Integration that takes place between different learning areas is referred to as *inter-disciplinary integration*. The new curriculum encourages teachers to integrate across learning areas in their teaching to "*ensure that learners experience the Learning Areas as linked and related*" (Department of Education, 2002: 13). It is important that teachers know what it means to integrate across learning areas, and what is expected of them. Sanders and Kasalu (2004) point out that integration is not only about integrating knowledge but also integrating skills, and the Department of Education suggests that the linking of different learning areas enhances learners' opportunities to "*attain skills, acquire knowledge and develop attitudes and values encompassed across the curriculum*" (Department of Education, 2002: 13).

  According to Adler *et al.* (2000), talking about the South African situation, for some teachers integration across learning areas could prove to be a demanding task because they (teachers) would be expected to have knowledge of other learning areas unrelated to what they were trained for. According to Adler and colleagues, to have a broad general knowledge on matters not in one's teaching area is "*clearly seldom possible and might leave the teacher feeling powerless to cope with the new demands*" (Adler *et al.*, 2000: 6). This means that teachers will either have to consult with their colleagues from other learning areas or get information from other sources (Adler *et al*, 2000), which means more work and more time spent on lesson planning in situations where the extra work teachers have is already too much.
- **intra-disciplinary integration:** This refers to integration that happens within a particular learning area. For example, in the *Natural Sciences* the circulatory system can be integrated with nutrition, that is, how food is carried by the blood to every part of the body.

Teachers should note that integration is feasible and desirable in some situations but not in all (Adler *et al.*, 2000; Parker, 2006). It is crucial that whenever integration is done, it should promote progress towards significant educational outcomes, rather than being done for the sake of cutting across learning areas (Department of Education, 2002; Department of Education, 2003). It is therefore important that before teachers engage learners in activities designed to promote integration they make sure that the activities are educationally significant, and foster the accomplishment of major goals in each learning area (Adler *et al.*, 2000). According to the Department of Education a balance should be struck between integration and conceptual development , that is, integration must be done in order to support conceptual development rather than just for the sake of doing it (Department of Education, 2003).

1.2.4 Revisions and changes to the new curriculum

Even before the implementation of the new curriculum started there were concerns from the public, particularly from secondary and tertiary educators, that the drastic changes required by the new

curriculum, and the time-frames for its implementation, were unrealistic. According to Lelliott *et al.* (2009: 47) the new curriculum "*has been greeted with resistance by some and enthusiasm by others*". Concerns voiced by a number of educationists prior to the implementation of the new curriculum included the following:

- **Few teachers were involved in the development of the new curriculum:** Rossouw and Smith (1997:69) warned that whatever the changes were that were envisaged by the new curriculum "*it is the teachers at the chalk-face that will ultimately determine the extent and effectiveness of this change.*" According to the theory of planned behaviour (Ajzen and Madden, 1986) the intention to participate in an innovation depends on the attitude of the participants towards the innovation. It is important that curriculum developers invite teachers to participate in an innovation because if they do not, whatever they (curriculum developers) have developed "*will be adopted in unanticipated ways*" (Fernandes *et al.*, 2008: 187). If teachers have negative attitudes they will be reluctant to participate (Rogers, 2003). The participation of teachers in an innovation depends on whether they see the innovation to be better than the existing ideas (Rogers, 2003).
- **The lack of qualified teachers to carry out the demands of the new curriculum was a concern:** According to Jansen and Christie (1999: 149) the way the new curriculum was structured "*suggests that highly qualified teachers exist to make sense of* [the challenges]". Statistics for 1995 showed that only 42% of the secondary school science teachers in South Africa at the time were considered qualified to teach science (Arnott and Kubeka, 1997). Unqualified teachers are not well-prepared to deal with challenges presented by curriculum changes (Beeby, 1966). Some schools in some countries (e.g. South Korea) recruit talented teachers and further develop them intensively, and those who do not meet the set criteria are forced to leave the school (The Star, 2009).
- **Inadequate clarification of the terms was a concern:** Policy documents were found to be unclear — for example, the means for achieving stated outcomes were not clearly explained and needed some clarification (Ogunniyi and Rochford, 1997; Jansen, 1997; and 1998).
- **The training of teachers and the development of support materials were not adequately planned:** Two further areas of concern, relevant to this study, were stated by educators (e.g. Jansen, 1997; and 1998; Ogunniyi and Rochford, 1997; Rossouw and Smith, 1997; Sanders, 1999). Firstly, the lack of training of the teachers was likely to affect the success of the implementation of the new curriculum. Secondly there was a lack of suitable support materials to support teachers in implementing the new curriculum.
- **The time set for the implementation of the new curriculum was unrealistic:** The South African education system made false assumptions that teachers were adequately equipped to handle the requirements of the new curriculum (Jansen, 1997; Cross *et al.*, 2002). According to Jansen and Christie the policy requires "*not merely the application of skills but understanding its theoretical underpinnings*" (Jansen and Christie, 1999: 149). They felt that teachers needed more time to understand the policy and be able to transfer their understanding across different contexts. The original intention was that the new curriculum be introduced in three different grades in the first year of implementation (1998), but by the time the booklet for teachers came out in 1997 the time-lines had already had to be relaxed as a result of the public outcry at the speed of change and the lack of preparedness of the teachers. Table 2 (on the next page) shows grades and dates in which

the new curriculum was supposed to be implemented, according to the information provided to teachers in 1997 (Department of Education, 1997a).

The initial time frames proved to be unrealistic, and implementation dates were relaxed. In spite of the published intentions, the new curriculum was initially only implemented at the *General Education and Training* band, starting in 1998 and following the original Grade 1 cohort from that year until the new curriculum had been fully implemented. The new curriculum for the *Further Education and Training* band was eventually only implemented in Grades 10, 11 and 12 in 2006, 2007 and 2008, respectively.

Table 2: Planned implementation dates of the new school curriculum

Grades	Year of implementation
1 and 7	1998
2 and 8	1999
3 and 9	2000
4 and 10	2001
5 and 11	2002
6 and 12	2003

Source: Department of Education (1997a)

After initially ignoring the public's concerns about the implementation of the new curriculum, the government eventually conceded that the system needed to be reviewed. The concession by the government was a result of research identifying a range of problems during the implementation of the new curriculum in the initial years. According to Bloch (2009) the government held much responsibility for the mess. On February 8th 2000 the Minister of Education at the time announced the establishment of a Review Committee that was to assess the implementation of the new curriculum, identify factors affecting the implementation, and give recommendations. The Minister requested (from the Committee) a *substantive review* of the new curriculum, looking particularly at the following (Chisholm *et al.*, 2000): (1) its structure and the extent to which outcomes-based education was understood, (2) success factors and strategies used in the implementation in order to plan steps to be taken in implementing the new curriculum in Grades 4 and 8 in 2001.

Findings of the review committee

The following main problems were identified by the Review Committee (Chisholm *et al.*, 2000):

- **The structure and design of the new curriculum was skewed:** This referred to emphasis being too much on some goals and not on others. The committee pointed out that not enough time had been allocated for development of reading skills, or conceptual knowledge in mathematics and science.
- **The designing and arranging of the content was a concern:** The committee claimed that because the curriculum designers attempted to avoid prescribing the content, the specific design features promoting sequence, pace and progression were weak.
- **Time-frames were unmanageable and unrealistic:** According to the findings of the committee, the implementation of the new curriculum was rushed and therefore inappropriate.

- **There was a lack of understanding of the principles of the new curriculum:** The Committee found that educators were experiencing some difficulties understanding the principles of the new curriculum because of unclear and ambiguous policy documents. The committee also pointed out that insufficient clarification of the policy regarding assessment resulted in too much time spent on managing and administering assessment, and too little time on classroom work.
- **Inadequate training had been provided:** The cascade[2] method that was used to train teachers during the orientation of the new curriculum proved to be inadequate (for more information on the cascade model see Chapter 3, section 3.4.1). Elsewhere the claim has been made that the district trainers often did not understand the underlying principles of the new curriculum, and did not apply the principles in their training (Makgoba, 1999).
- **Lack of follow-up training was a concern:** Due to the shortage of people with the knowledge about the new curriculum, and lack of material resources for supporting the new curriculum, follow-up support and monitoring in the schools were lacking.
- **There was a problem with the supply and use of support materials:** The Committee found that the supply of support materials to schools was uneven. Furthermore, the use of the available support materials overall was found to be low (see Chapter 3 of this thesis sections 3.3.2 and 3.4 for a discussion on the availability of resources and the benefits of support materials), and lack of classroom space was cited as a major constraint on effective use of learning resources.

According to the findings of the Review Committee financial and human resources were the main stumbling blocks in the implementation of the new curriculum.

Recommendations by the Review Committee

The committee recommended that "*a revised and streamlined outcomes-based curriculum be introduced within manageable time-frames to achieve the social and educational goals of a curriculum for the 21st Century*" (Chisholm *et al.*, 2000: 4-5). The recommendations were concerned with three major issues: structure and design of the revised curriculum, pace and scope of implementation, and implementation of the revised curriculum.

Recommendation 1: Structure and design of the revised curriculum must be adjusted. The following recommendations were suggested:

- **Uncomplicated jargon was crucial for better comprehension of the new curriculum demands:** The terminology used in the new curriculum needed to be unambiguous and straight-forward.
- **Simple and easy-to-follow national curriculum statements were needed:** To explain the complexity of the curriculum design the national curriculum statements needed to be simplified.
- **The number of specific outcomes needed to be reduced[3]:** In the *Natural Sciences* the nine specific outcomes were reduced to three learning outcomes.
- **A reduction was needed in what was to be taught, to reduce curriculum overload:** To reduce

[2] Disseminating information to a particular group of people who will, in turn, pass it on to others

[3] The "specific outcomes" were later renamed as "learning outcomes".

overload a reduction of the eight learning areas to six was recommended for the *General Education and Training* band — with only three learning programmes in the *Foundation Phase* and six in the *Intermediate* and *Senior Phases*.

Recommendation 2: The pace and scope of implementation should be revised. The committee suggested that the implementation of the new curriculum be revised within manageable time-frames.

Recommendation 3: Strategies for implementation of the revised curriculum were needed. The Committee suggested that for implementation to run smoothly the following had to be done:

- **A better arrangement was needed to prepare teachers:** The preparation of teachers needed to be coordinated through the assistance of a national strategy.
- **The provision of clear guidelines was essential:** The national curriculum statements should provide clear guidelines to publishers and government for the production of textbooks, and for the evaluation of their quality.
- **The issue of resources needed to be addressed:** There needed be an adequate supply of resource materials, and a special project team should be created in each province to co-ordinate and manage support materials.

The recommendations of the Review Committee came out in 2000. Work started to revise the national curriculum statements for the *General Education and Training* band and a number of drafts were provided from 2002 onwards, for public comment. These revised national curriculum statements were referred to as the "Revised National Curriculum Statement" at the *General Education and Training* level. The Revised National Curriculum Statement still embraced the same principles of the original curriculum, but the structure and terminology were simplified (Lelliott, *et al.*, 2009). Implementation started in 2006.

In July 2009 a panel of experts was appointed by the Minister of Basic Education to investigate the nature of the challenges and problems experienced in the implementation of the new curriculum and to make recommendations for dealing with them (Motshekga, 2009). Their report was handed to the Minister in September 2009. The recommendations resulted in the government proposing some radical changes in the implementation of the new curriculum (Motshekga, 2009; Motshekga, 2010). Changes relating to my study (several being interlinked) include: reverting to some of the original terminology (e.g. "outcomes" back to "aims" and "learning areas" and "learning programmes" back to "subjects"); reduction in teachers' administrative workload; greater specification (in a syllabus-like document for each subject and grade) of what has to be taught and assessed and how; and an expectation for greater use of textbooks rather than compelling teachers to develop their own learning materials, with provision of workbooks for all learners to provide support for the curriculum.

The changes in the implementation of the new curriculum are expected to take place within a framework of a five-year plan, from 2010 to 2014. The minister pointed out that the government is not "*changing the vision of the curriculum transformation process that started after 1994, but implementing changes in order to strengthen curriculum implementation*" (Motshekga, 2009: 2). The new curriculum documents are known as the CAPS documents are being successively implemented from 2012. The new GET *Natural Sciences* curriculum is being implemented in Grades 7 in 2012 (Department of Basic Education, 2011a), and the new FET curriculum for *Life Sciences* (Department of Basic Education, 2011b) will be implemented from 2012 to 2014 in the last three school grades.

1.3 THE PROBLEMS MOTIVATING THE RESEARCH

My study took place within the context of the implementation of the new South African school curriculum, where teachers were required to change their classroom practices in the nine ways described in previous sections. A number of South African educators identified problems with the implementation of the new curriculum, and it was these problems which motivated this study:

- **Lack of understanding of the jargon and principles of the new curriculum:** According to South African research many teachers are struggling to make the required changes because they do not understand the requirements (Chisholm *et al.*, 2000; Pabale and Dekkers, 2003; Sanders and Kasalu, 2004), the terminology (Sanders and Kasalu, 2004) or the principles of the new curriculum (Chisholm *et al.*, 2000). An example has been shown on page 14 under the heading "Requirement 7" dealing with problems encountered in as far as groupwork is concerned. Lelliott *et al.* (2009:53) point out that numerous studies suggest that the interpretation of a curriculum is not easy. For example, the study by Rogan (2007b: 113) revealed that though the participants were willing to engage in the implementation of the new curriculum "*not many aspects of the new policy had been internalized, or even understood*", for example groupwork and teacher facilitation. According to the author, one aspect of the new policy that the participants seemed keen to do was groupwork. However, the participants seemed to believe the new curriculum required that every class activity be done in groups (confirming other studies such as Aldous, 2004) — which is misconception.
- **Many teachers are struggling to make the required changes:** Research on the curriculum innovation in South Africa reveals that a number of teachers are struggling to make the required changes (Chisholm *et al.*, 2000; Pillay, 2002; Rogan, 2004). Research in South Africa shows a number of factors, in addition to the lack of understanding of the jargon or principles of the new curriculum mentioned above, that contributed to teachers struggling to implement the new curriculum. These included:
  - teachers' lack of content knowledge (Rollnick *et al.*, 2008),
  - inadequate lesson preparation practices (Pillay and Sanders; 2002; Rogan *et al.*, 2002; Matimolane, 2004). Some teachers have been found not to have lesson plans at all (Rogan *et al.*, 2002). In their study, Pillay and Sanders (2002: 326) found that the lesson plans of many teachers were "*probably inadequate to focus their attention on the advocated classroom practices ....*".
- **Lack of participation of teachers in developing curriculum materials:** The Department of Education expected teachers to develop their own support materials to assist them make the required changes, but this was not successful. According to Chisholm *et al.* (2000) the idea of teachers developing their own materials was unrealistic.

1.4 AIMS OF THE RESEARCH

This study was part of a bigger project[4] intended to assist teachers make the required curriculum changes, which are well supported by learning theory and likely to improve the quality of teaching and learning, by providing well-designed support materials.

The diagnostic phase aimed to gather research-based data about what could be appropriate information to put in the curriculum package. This included looking at the smoking problems in the schools and how these were being addressed, as well as examining the current situation with regard to implementation of the new curriculum by teachers when teaching about smoking and related matters. The idea was, firstly, to establish the way teachers were implementing the new curriculum when teaching about smoking in order to incorporate good strategies in the curriculum package and, secondly, to identify short-comings in implementing the new curriculum so that those could be addressed in the package.

The aim of the therapeutic phase was to investigate the use of the support materials developed during the study in order to identify factors that affected teachers' use of the materials. The idea behind the investigation was to better understand factors that affected the use of support materials to provide information for curriculum developers to help them design materials that are more likely to assist teachers involved in curriculum innovation. The data gathered were used to inform the development of a model to be used to communicate factors affecting the use of support materials.

1.5 RESEARCH QUESTIONS

A number of questions were developed to direct the study, in order to achieve the aims mentioned in the previous section.

Three research questions, two with a number of sub-questions, directed the diagnostic phase of the study.

Question 1: What is the current situation with regard to the teaching of smoking and the application of the requirements of the new curriculum whilst teaching that section?

In order to answer this question the following sub-questions were asked:

1a) What is the nature and extent of current smoking problems in schools and how is it being dealt with?

1b) How do teachers teach and assess the section on smoking?

1c) To what extent do biology teachers understand and apply the changes demanded by the new curriculum, when they teach about smoking?

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[4] This project started in 1995 and was funded for 10 years by the Foundation for Research Development (later the National Research Foundation). Initially it focused on "effective biology teaching", but the focus shifted to research on "curriculum innovation and change" after the implementation of the revised South African school curriculum started in 1998. The new focus was on research on the implementation process and factors affecting it; effective professional development programmes for science teachers; identification of the types of support materials and support systems teachers required and factors affecting teachers' use of such materials; development and evaluation of effective research-based teaching and learning materials; and investigating and promoting the role of educational technology in curriculum change. Whilst the project focused on research on the implementation of the new school curriculum in the natural sciences, it was also a service to teachers to support them through the changes. Over 30 postgraduate students have been involved in the research, run by Prof M Sanders at the University of the Witwatersrand.

Question 2: What are the existing norms regarding teachers' use of support materials?

Question 3: What needs exist which could be addressed in the package?

In order to answer this research question the following sub-questions were asked:

3a) What do teachers say they want to be included in the package?

3b) What is the nature and extent of teachers' content knowledge about smoking and its effect on human body?

In order to identify factors that affected the use of support materials the following question and sub-questions were used to direct the therapeutic phase of the study.

Question 4: To what extent do teachers understand the nine requirements of the new *Natural Sciences* curriculum after receiving the package?

Question 5: What parts of the support materials do teachers use (and with what modifications) and what factors affect their use?

5a) Which portions of the support materials provided in this study do teachers use, and why?

5b) What adaptations do teachers make to materials, and why?

1.6 IMPORTANCE OF THE STUDY

This study involved research associated with the development of teaching and learning materials to support biology teachers to make the changes required by the new South African school curriculum, whilst teaching about smoking and related matters.The use of these support materials was meant to assist teachers in their transition from the "old" ways of teaching to those required by the new curriculum. The science education literature that I read revealed that although a number of South African studies have researched the implementation of the new curriculum, they have focused on just one or two of the more prominent requirements of the new curriculum, for example groupwork (Brodie and Pournara, 2005); learner-centred learning (Brodie, Lelliott, and Davis, 2002); integration (Adler *et al.*, 2000; Parker, 2006) or relevance (Nyabanyaba, 1999). What makes this study important is that it looked holistically at how teachers understood and applied all nine requirements of the new curriculum (unlike other studies that focused on only one or two requirements). Existing research on the implementation of the new curriculum portrays a fragmented picture of the implementation of the new curriculum. According to Mishra and Koehler (2006: 1018) good case studies are "*important for building understanding*". However, a holistic picture is important for government policy designers, teacher trainers and workshop organisers who try to assist teachers implement the new curriculum. This study provides new information, thus fulfilling one criterion of a successful PhD study.

Originality is the second criterion for a PhD. The model developed in this study provides originality, and is the second important feature of the study. The model looks at factors affecting the use of support materials by teachers, and possible relationships between various constructs in the model. Reflection on the results assisted me to identify factors not previously identified in the literature, as well as allowing me to see new relationships between the factors. Critical analysis of the literature and the results of this study allowed me to construct a model which gave new insights on factors affecting teachers' uptake of curriculum materials. The model is described in detail in Chapter 8.

1.7 CONCLUDING REMARKS

As reported in this chapter, research shows that South African teachers are struggling to implement the new curriculum for a number of reasons. It is evident from the research that teachers need support. This thesis describes how support materials were developed in order to help teachers implement the nine requirements of the new curriculum whilst teaching about smoking and smoking-related matters. This thesis describes the organisation of teachers' workshops to enquire about their needs as well as introducing and explaining the developed support materials to the teachers to familiarise them with the materials before using them.

CHAPTER 2

SMOKING AND RELATED MATTERS

The main purpose of this study was to find out how teachers are coping with the demands of the new curriculum, and how they can be assisted to meet these demands. In order to limit the scope of the study one topic was chosen as the context of the investigation. The topic of "smoking and related matters" was chosen because of public concerns about health and social issues relating to smoking, and because current efforts in the schools, where a serious smoking problem often exists among the learners, seem to be ineffective. The use of tobacco amongst the youth seems to be common, possibly because, as Zipko (1981) and Krupka *et al.* (1996) suggest, it is a readily available "drug".

There are several aspects associated with cigarette smoking which are problematic. These include health-related issues (Crofton and Simpson, 2002; Exley *et al.*, 2006) which are discussed in section 2.1; social issues, discussed in section 2.2, and lack of effective educational programmes to deal with the problem, which are discussed in section 2.3.

2.1 BIOLOGICAL EFFECTS OF TOBACCO SMOKING

The first problem described in this chapter has to do with the biological effects of tobacco smoking. Cigarettes consist of paper tubes containing chopped up tobacco leaf, usually with a filter at the mouth end. They are lit so that the tobacco burns, producing smoke which is inhaled into the lungs of the smoker, as well as being released into the atmosphere. Tobacco smoke is a dense, hot mixture that contains a variety of different chemicals which are released into the air as particles and gases (Department of Health and Welfare, 1985; Cigarette and Smoke Composition, 2001; Crofton and Simpson, 2002). The particles include nicotine, tar, benzene, phenols, hydrocarbons, arsenic and carcinogens, while the gases include carbon monoxide, ammonia, dimethylnitrosamine, formaldehyde, hydrogen cyanide and acrolein (Galbraith, 1993; Cigarette and Smoke Composition, 2001).

The harmful substances found in tobacco smoke are capable of causing serious damage to the systems of the human body, particularly the breathing system, circulatory system, and the nervous system (Galbraith, 1993; Crofton and Simpson, 2002; Exley *et al.*, 2006). Consequently smoking is associated with a number of health problems, which may be fatal. The harmful effects of smoking on the human body were established decades ago, but many people still fall victim to this "deadly" habit. According to the Royal College of Physicians (2001), premature deaths and disabling illnesses caused by cigarette smoking were reported to have reached epidemic proportions by the late 1960's, presenting the most challenging of all opportunities for preventive medicine in the United Kingdom. In the late 1980's evidence was given by the Department of Health and Welfare (1985:9) in South Africa about the existence of

> "*a strong dose-response relationship between smoking and both lung and cardiovascular disease. The more cigarettes smoked per day, the greater the number of years the person smokes and the deeper that inhalation, the more likely the person is to develop heart and lung diseases*" (Department of Health and Welfare, 1985:9)

Some of the main diseases associated with smoking are shown in Table 3. Although smoking affects the nervous system it will be noted that this does not cause diseases.

Table 3: The main diseases associated with smoking

DISEASE	EXPLANATION
Lung cancer	Cancer is any malignant growth or tumor caused by abnormal and uncontrolled cell division. Large numbers of these new cells (from cell division) form hard clusters of cells (tumors). If the cells in the tumors break free and enter the blood stream or the lymphatic system, they move from their primary site to other places in the body, for example, from the brain to the liver (Boyle, 1997; Crofton and Simpson, 2002; Das, 2003; Murray, 2006). The migration of these cells is called metastasis. Lung cancer is caused by the development of tumors in the lining of the walls of the bronchioles (Exley *et al.*, 2006).
Bronchitis	This is a medical problem caused by any type of pollutant in the lungs, including the chemicals in cigarette smoke. According to Boyle (1997) and Exley *et al.* (2006), the polluting substances (like tar) stimulate the protective mechanism of the bronchial passages — i.e. the mucus/cilia mechanism — so that additional mucus is secreted in an effort to rid the breathing passages of the pollutant. This mucus then blocks the air tubes (bronchi and bronchioles). Constant irritation of the walls of the breathing tubes causes degeneration of the cilia, so that the mucus cannot easily be cleared from the passages in the normal way. With time the walls of the air tubes become thickened due to replacement of damaged epithelia (lining of the air tubes). The thickening of the air tube walls causes the passage-ways to narrow and become less flexible, making it difficult to breath air into and out of the lungs.
Emphysema	Emphysema is a condition which slowly destroys the bronchioles and alveoli in the lungs (Taraseviciene-Stewart and Voelkel, 2008). In the early stages the alveolar walls are destroyed, decreasing the area for gaseous exchange, and making it difficult for enough oxygen to be absorbed (Boyle, 1997; Exley *et al.*, 2006). As the disease progresses the bronchioles are damaged and collapse, so that fresh oxygen-rich air cannot reach the damaged alveoli, and air already there cannot escape. This causes the alveoli to swell and burst, producing larger and larger balloon-like structures. A person suffering from emphysema often feels short of breath, because the body is not getting enough oxygen. As the disease gets more severe normal daily activities (such as walking) become difficult because the body is not getting enough oxygen for respiration, which involves the production of the energy bodies need to function.
Cardio-vascular diseases	These diseases affect the heart and arteries. The main problem is caused by "hardening of the arteries" (atherosclerosis), which is a very common disease in any population, estimated to cause more than half of all deaths from diseases (Exley *et al.*, 2006). According to medical reports (e.g. Boyle, 1997; Das, 2003; Exley *et al.*, 2006; Taraseviciene-Stewart and Voelkel, 2008) a number of factors worsen the condition, including high-fat diets and smoking. A fatty substance (plaque) is deposited on the inner walls of the blood vessels, causing the vessels to become blocked so that blood struggles to pass through them. This raises the blood pressure. Carbon monoxide and other chemicals from tobacco increase the build up of these fatty deposits (The World Bank, 1999). In addition, nicotine causes the blood vessels to constrict, further blocking the easy flow of blood. Atherosclerosis of the cardiac arteries which supply the muscles of the heart with blood (and hence nutrients and oxygen) hinders the flow of blood to the muscular walls of the heart so they get less oxygen and cannot function properly (Boyle, 1997; Das, 2003; Exley *et al.*, 2006). The heart therefore is no longer efficient in pumping blood (with oxygen) to the rest of the body. If the supply of oxygen to the heart muscle is completely blocked, a heart attack results (Boyle, 1997).
Liver disorders	One of the functions of the liver is to process chemical substances (e.g. alcohol or drugs) so that they are not harmful to the body. Some of the chemicals in tobacco smoke can cause malfunctioning of the liver so that the speed of metabolism of some of drugs is changed, making them either less effective or more toxic than they would be otherwise (The World Bank, 1999; InteliHealth, 2001). Smoking is also thought to contribute to alcohol-induced liver diseases (InteliHealth, 2001).

2.1.1 Morbidity

Morbidity is the relative incidence of specific diseases in a geographical locality (Miller *et al.*, 1997). In addition to personal traumas this causes it is a serious economic issue because the government and

individuals incur costs when somebody is sick, and employers suffer from a decrease in production due to workers' absenteeism (Murray, 2006). Consequently it is in every country's interest, for the purposes of budgeting and combatting diseases, to compile statistical reports on the number of people who suffer from certain diseases in a given period, for example, a year, five years or ten years. Establishing the demographics of deaths in a specified period of time (mortality) helps health departments find out whether there has been an improvement in fighting the cause of diseases or deaths in a community, or whether the situation is getting worse.

The problem of diseases associated with smoking occurs world-wide. Although the relationship between tobacco and lung cancer has been reasonably well described in developed countries (Boyle, 1997; Crofton and Simpson, 2002 ; Das, 2003; Murray, 2006), according to Mzileni *et al.* (1999:2) at the end of the 20th century "*little or no data are available in sub-Saharan African populations where cigarette smoking is a more recent phenomenon and where population life expectancy is low.*" Consequently, England is used here as an example to show the impact of smoking on the morbidity of a country. In 1998 (when the population of England was about 49,000,000) an estimated 370,000 hospital admissions in England were attributed to smoking and resulted in the diseases shown in Table 4.

Table 4: Estimated number of hospital admissions attributed to smoking in the United Kingdom in 1998

	Disease	No. of admissions
Types of cancer	cancer of the lungs	50,400
	cancer of the upper respiratory tract	10,400
	cancer of the oesophagus	13,800
	cancer of the bladder	21,600
	cancer of the kidney	1,900
	cancer of the stomach	5,500
	cancer of the pancreas	2,400
	cancer (site not specified)	2,200
	myeloid leukaemia (a cancer of the blood)	1,900
Respiratory diseases	chronic obstructive lung diseases (including emphysema)	95,800
	pneumonia	16,000
Circulatory diseases	ischaemic heart disease (blocked vessels supplying heart muscles)	100,800
	cerebrovascular disease (disease relating to blood supply to the brain)	23,000
	aortic aneurysm (bulges of the walls of the aorta caused by weakened walls)	8,400
	atherosclerosis (blockage of the blood vessels)	1,700
Digestive diseases	ulcer of stomach or duodenum	14,100
Total admissions from diseases associated with smoking (year ending 1998)		369,900

Source: Royal College of Physicians (2001)

According to the information in Table 4 the most serious smoking-related diseases were circulatory diseases (36% of the admissions), followed by different types of cancer and respiratory diseases (each about 30% of the smoking-attributed admissions).

2.1.2 Mortality

Diseases caused by smoking contribute considerably to mortality rates (Boyle, 1997; Crofton and Simpson, 2002; Das, 2003; Ezzati and Lopez, 2004; Murray, 2006; Cazzola *et al.*, 2008). Approximately one in five deaths in the United States was attributed to tobacco use in the early 1990's (McGinnis and Foege, cited by Aloise-Young and Hennigan, 1996). In countries where smoking has been a long-established habit, about 90% of lung cancer deaths, 30% of all cancer deaths, and 20% to 25% of cases of coronary heart disease and stroke deaths are attributed to smoking (Crofton and Simpson, 2002). According to research world-wide, between a million people (World Health Organisation, cited by Cembi, 2001) and four million people (Krupka *et al.*, 1996; Crofton and Simpson, 2002; Ezzati and Lopez, 2004) die each year due to tobacco-related diseases.

In South Africa a case-control analysis was used to estimate tobacco-attributed mortality. 'Cases' comprised deaths from diseases known to be related to smoking, and 'controls' deaths from cancers and defined medical conditions expected to be unrelated to smoking (Sitas *et al.*, 2004). Death reports from 5,340 males and females whose smoking status had been given by a relative were analysed (see Table 5).

Table 5: Tobacco-attributed mortality in South Africa (n = 5,340)

	Number of smokers	Number of non-smokers	Number of deaths attributed to smoking
Diseases typically associated with smoking			
Tuberculosis	216	198	87
Lung diseases	315	350	138
Cancer	207	183	113
Heart diseases	132	180	50
Stroke and other diseases	236	547	32
Diseases not typically associated with smoking			
Cirrhosis	89	84	0
Ill defined medical condition	239	498	0
External causes (e.g. accidents)	410	332	0
Total number of deaths which doctors attributed to smoking			420

Source: Sitas *et al.* (2004)

According to the information in Table 5, the highest number of deaths attributed by doctors to smoking was due to lung-related diseases, including chronic obstructive pulmonary disease, tuberculosis and lung cancer. Total tobacco-attributed mortality in that study for that year was ($^{420}/_{5340}$ x 100) 7.9% of the sample investigated (Sitas *et al.*, 2004). This information, though obtained from a relatively small case study, gives an indication of what to expect if a country-wide study is done. Smoking, according to the statistical tests in the study by Sitas *et al.*, played a significant role in the mortality rates. It should be noted that the emphasis in this table is not about the comparison between smokers and non-smokers, but on the number of deaths attributable to smoking.

2.1.3 Dependence on smoking

According to the report in a brochure entitled "Report on Cigarette and Smoke Composition" (Cigarette and Smoke Composition, 2001) cigarettes contain additives (e.g. calcium carbonate, cellulose fibre,

ethylene vinyl acetate copolymer, guar gum, etc.) which are claimed to make the tobacco products more desirable to the consumer. The report suggests that additives can also be used for more sinister purposes, like increasing addictiveness to nicotine.

Nicotine is a mild stimulant drug found in leaves of the tobacco plant. It is poisonous, and doses of about 60mg of nicotine can kill a person. It is an extremely powerful drug which, according to The Royal College of Physicians (2001), causes addiction as do drugs like heroin and cocaine. O'Loughlin *et al.* (2004:422) report that recent studies suggest that "*early nicotine dependence symptoms play a central role in novice smokers maintaining the smoking habit and becoming addicted to tobacco*". Studies indicate that nearly 90% of regular smokers get addicted to nicotine (The World Bank, 1999), and in teenage smokers the process is very rapid (Lindsay and Rainey, 1997). Tobacco dependence is a chronic condition which seems to affect smokers' intended behaviour. For example, heavy smokers find abstinence difficult — some coping with only half a day, a whole day or a week at a time without smoking (The Health Authority, 2005).

According to Moffatt and Whip(2004:101) "*decades of research into smoking cessation have created a plethora of knowledge yet quit rates continue to be low and relapse rates high.*" The fact that smokers cannot do without a cigarette is attributed to the effect of the nicotine on the central nervous system (Marsh and Matheson, 1983; Spring *et al.*, 2008). Nicotine causes neurons to release dopamine, a neuro-transmitter associated with behavioural states. "*The excess of dopamine has a reinforcing effect that leads to dependence on the drug*" (Mader, 2001:842).

When tobacco is smoked, nicotine readily enters the bloodstream through the lungs. When tobacco is sniffed or chewed, nicotine passes through the mucous membranes of the mouth or nose to enter the bloodstream. Nicotine is absorbed by the blood and carried throughout the body and to the brain. Nicotine has serious effects on the circulatory system as well (The World Bank, 1999).

2.2 SOCIAL EFFECTS OF TOBACCO SMOKING

The second problem which motivated the use of smoking as a topic for this study has to do with the social effects of tobacco smoking. Tobacco smoking also has social ramifications, which may affect smokers as well as non-smokers.

2.2.1 Tobacco smoking and ethics

There are two main issues associated with tobacco smoking and ethics; passive smoking (associated with environmental tobacco smoke), and ethical considerations associated with tobacco companies.

Passive smoking

In some countries passive smoking presents a serious and substantial public health impact that affects the morbidity and mortality rates (Sitas *et al.*, 2004). Research has found that passive smoking (breathing other people's tobacco smoke) can also cause heart and respiratory diseases in non-smokers (The Star,

2007), particularly in children (Crofton and Simpson, 2002; Moffatt and Whip, 2004; Tager, 2008). Smoke also has serious effects on unborn children and children born to mothers who smoke (Crofton and Simpson, 2002).

- **Before birth:** According to research, nicotine from the tobacco (smoked by the mother) affects the embryo because it is able to cross barriers in the placenta (Galbraith, 1993), damaging the nervous system of the baby in the same way as in adults. If a woman smokes during her pregnancy it increases the chances of the baby being born dead (stillbirths) (Crofton and Simpson, 2002; Moffatt and Whip, 2004).
- **After birth:** Babies born to mothers who smoke are usually below average weight (Steyn *et al.*,1997; Crofton and Simpson, 2002). Statistics from Johannesburg and Soweto show that babies born to coloured women (who smoke more than women in other groups) have lower weights than babies from women of other groups, although this correlation is not necessarily causal (National Children's Rights Committee, 1993; Richards *et al.*, 1996). Once the baby is born there are additional complications, which include increased pulse rate, and greater chances of cot deaths (Crofton and Simpson, 2002). Nicotine dissolves in fats, so becomes concentrated in the milk of breast-feeding mothers, and can be passed on to babies by breast-feeding mothers who smoke. As in the mothers, nicotine increases the pulse rate of the babies. Scientists have also discovered that smoking in pregnancy is directly linked to cot deaths (Crofton and Simpson, 2002). Cot death occurs when the receptors in the brain, which normally keep sleeping babies breathing, fail to function because of damage done to them by nicotine, causing the baby to stop breathing and die. Passive smoking in children is also known to increase the occurrence of lower respiratory tract illnesses such as pneumonia and bronchitis, particularly early in life (Richards *et al.*, 1996; Moffatt and Whip, 2004). Problems caused by passive smoking extend into adolescence and adulthood.

It is the opinion of many non-smokers that a system of moral principles or rules of behaviour (ethics), in as far as smoking is concerned, has to be observed by tobacco smokers to protect non-smokers from tobacco smoke hazards. Glover *et al.* (1989), in a study examining undergraduate male college students enrolled in a health education class at a southeastern university in the United States of America, concluded that tobacco smokers in most cases tend to ignore, or were careless about, following social regulations as far as smoking is concerned.

In South Africa a smoking control act aimed at protecting children from tobacco, and protecting the rights and health of non-smokers, came into effect on October 1st 2000. This Tobacco Products Control Amendment Act (12/1999) has banned smoking in public areas except those designated as smoking areas (such as pubs, bars, casinos and restaurants). In addition, the act limited tobacco advertising, banned sports sponsorship by tobacco companies, and limited the tar and nicotine content of cigarettes to a maximum of 15mg and 1.5mg per cigarette respectively as from the 1stof December 2001. Since the 1st of June 2006 the tar yield of cigarettes marketed in South Africa has not been allowed to exceed 12mg per cigarette and nicotine yield may not be greater than 1,2mg per cigarette (Government Gazette, 29 September, 2000). Late in 2006 additional tobacco-related legislation was discussed in parliament. In 2007 and 2008, Acts strengthening the already existing law on smoking on public places; and the regulation of the manufacture of tobacco products were passed by Parliament.

Two Acts that amend South Africa's tobacco control laws were proclaimed by President Jacob Zuma in the Government Gazette of August 21, 2009, and are now in operation. The Act strengthens the existing law on smoking in public places with an increase in the fines for smoking or allowing smoking in a non-smoking area. The fine for owners of public places such as pubs and restaurants will be fined a maximum of R50,000 for allowing smoking at these places, while for an individual smoker the fine is R500. Other changes include the following:

(a) Adults may not smoke in a car when a passenger under 12 years is present.

(b) Smoking is not allowed in premises (including private homes) used for commercial childcare activities, or for schooling or tutoring.

The Acts prohibit tobacco companies from using "viral" marketing (the company sending its representatives with boxes of cigarettes to clubs, discos, college campuses or inviting teenagers to parties where they are lured into smoking) to target young people.

According to research done in England, between April and September 2006, more than 400, 000 people in England gave up smoking as a result of the ban on smoking in public (The Star, 2008).

Unethical practices of tobacco companies

Tobacco companies have been accused of not caring about public health, and being interested only in the income they acquire from cigarette sales (New York Times International, 1994; Crofton and Simpson, 2002). They have been accused of unethical practices in their efforts to mislead the public by minimizing health risks associated with smoking. Zitrin and Langford (1999) argue that tobacco companies have concealed information on the addictive and dangerous properties of tobacco smoking. For example, one of the biggest tobacco companies in the United States, Philip Morris (makers of Marlboro cigarettes) was accused in the New York Times International (1994) of

- trying to discredit researchers and anti-smoking groups such as the *American Cancer Society* and the *American Lung Association*, in an effort to deny the effects of smoking;
- confusing the public as far as the effects of tobacco smoking are concerned,
- sponsoring certain programmes to give a false impression that they care about the public; and
- supporting political parties for favours.

The same tobacco company (Philip Morris) has been told recently by a Florida jury (in the United States of America) to pay of $8-million to the widow of a smoker whose death was caused by his addiction to cigarette smoking (The Star, 2009).

Another serious issue relating to the ethics of tobacco companies has been their practice, because of decreasing sales caused by smoking control legislation in their countries, of targeting developing countries and vulnerable targets like teenagers in their advertising and sales campaigns (Hall, 1997; World Health Organisation, 2001). Pritchard *et al.* (1999) report that World Health Organisation statistics in 1997 suggest that there was an increase in tobacco consumption in Africa of 1.2% per annum between 1970 and 1992, compared with a decrease of 0.5% in developed countries. Table 6 shows trends in

cigarette sales in some developed and developing countries, to show the decrease in sales in the United Kingdom and the United State of America, and increasing sales in various African countries.

According to the information in Table 6, South Africa is amongst the countries that showed an increase in the sales of tobacco during the period mentioned. A national survey of smoking in adults conducted early in 1995 in South Africa showed an increase of 1% per year since the 1992 data cited above (Steyn *et al.,* 1997). These authors reported that the rate of increase was greatest in the coloured population, which also had the highest smoking prevalence (59%), followed by Indians (36%) and black people (31%). There was no information given for the white population. It appears that some South Africans (including whites) are still not aware of the results of smoking as far as health is concerned, or do not take the information seriously. This suggests a need to educate people about the biological and social problems of smoking.

Table 6: A comparison of trends in cigarette sales in selected countries

	Annual average cigarettes purchased per adult		
Country	**1970 - 1972**	**1980 - 1982**	**1990 - 1992**
United States	3,700	3,560	2,670
United Kingdom	3,250	2,740	2,210
Algeria	950	1,580	1,600
Cameroon	270	590	740
Congo	880	890	900
Ethiopia	60	70	90
Nigeria	290	300	370
Senegal	430	760	1,050
South Africa	1,340	1,600	1,720

Source: World Health Organisation (1997)

Vulnerability of teenagers to tobacco smoking

In spite of the fact that the government tries to protect people, many continue to smoke. This includes adolescents, many of whom become addicted to smoking. Developmentally, adolescence is a period of rapid and significant change during which teenagers are at increased risk for a variety of problem behaviours, of which tobacco use is one (Chou, 1992). Lindsay and Rainey (1997:124) claim that "*adolescent nicotine addicts observe that life goes on despite their dependence on cigarettes, and this situation causes adolescents to develop a lower risk perception of drug addictions in general.*" In spite of the medical evidence of the dangers of smoking to health, youths continue to smoke from a young age (Marsh and Matheson, 1983; Lindsay and Rainey, 1997; Motlomelo and Sebatane, 1999). Early in the 21st century it was reported that more and more teenagers were starting to smoke, in spite of anti-smoking campaigns (Iowa Health Systems, 2001). Their study showed that the 14 to 22 year-olds they investigated in the United States of America tended not to have a realistic sense of the addictive nature of smoking or the health risks involved.

A number of attitude-related factors extenuate the vulnerability of the youth to smoking. These include

- **peer pressure:** Young people who have friends (particularly best friends) who smoke, are more likely to become smokers (Lindsay and Rainey, 1997). People may begin to smoke to be "accepted" by a particular person or group (Moffatt and Whip, 2004), especially if they have poor self-images. Pressure from peers is very strong, and often forces people who do not want to smoke to start smoking, to be seen as "cool" in order to conform (Moffatt and Whip, 2004). If they are smoking as an act of rebellion, telling them that only adults should smoke only encourages them to continue smoking (Moffat and Whip, 2004).
- **advertising:** Advertisements in the popular media often portray tobacco users as sexy, glamourous, popular, independent, adventurous, macho people, living exciting, fun-filled lives. This, according to recent studies, influences initiation of smoking among young people (Mekemson *et al.*, 2004). By selecting brands that present these images, young people who do not think critically may believe that if they smoke they will find themselves leading a similar life to those people shown in the advertisements.
- **family members:** Some people in families with problems, such as regular drinking and fighting, tend to resort to smoking, believing that tobacco smoking relieves stress (Goldstein, 1996), and research has shown that children of smokers are more likely to smoke than those of non-smokers (Murphy and Price, 1988).

  Parents and family may exert an influence in several ways. Firstly, young children may begin to smoke because of the example set by parents, brothers or sisters. They think it is an acceptable social habit. Secondly, children smoking could simply be a case of "opportunity", as cigarettes are readily available for would-be smokers to experiment with (Zipko, 1981; Krupta *et al.*, 1996; Dent and Biglan, 2004). Thirdly, children might try to imitate a family member they admire, like a favourite uncle, or an older sister. Fourthly, children of non-smoking parents, may begin to smoke as an act of rebellion against their parents in a effort to demonstrate their independence and "adult" status.
- **adults who are admired:** Adolescent youngsters frequently copy adults whom they admire. As mentioned above, this could be a family member. Often the teacher may be such a person, so teachers have a particular responsibility not to smoke in front of learners. Pop stars, sportsmen, actors and other public figures can exert a similar influence on smoking behaviour (Mekemson *et al.*, 2004).

2.3 LACK OF EFFECTIVE EDUCATIONAL PROGRAMMES

The third problem that motivated the use of smoking as the topic for this research was the lack of effective educational programmes about the repercussions of smoking. Despite the fact that advertising has been restricted in some countries, tobacco advertisers are still reaching impressionable teenagers (Iowa Health Systems, 2001). Lindsay and Rainey (1997:124) point out that "*youthful users of tobacco who fail to see any immediate lethal consequences from their use* [cigarettes] *likely conclude the purported dangers of tobacco as greatly exaggerated.*" Goldstein (1996) claims that the use of tobacco in adolescence often goes on to become an addiction which affects the entire future of the adolescent. Whilst there are many possible reasons for teenagers indulging in cigarette smoking, it is possible that

one factor is inadequate education about the issue. Either the school curriculum does not address this issue at all or the approach used by teachers is not effective enough. The fact that more and more teenagers, especially in developing countries, are starting to smoke (Iowa Health Systems, 2001) could be because they lack information on smoking, or are unable to think critically about the issues involved.

The new approach to teaching and learning which is encouraged by the new curriculum in South Africa (described in Chapter 1) lends itself to exciting new ways of educating teenagers about smoking and associated issues. The *Natural Sciences* curriculum focuses on issues relating to the human body and health, and thus offers an excellent opportunity to develop challenging and more effective curriculum materials at an age when the learners are reaching puberty and exploring new ideas, freedoms and vistas opening up to them as they start to enter adulthood. One of the critical outcomes in the new curriculum states that "*Learners should be able to identify and solve problems and make decisions using critical and creative thinking*" (Department of Education, 2002: 1). The fact that the curriculum aims to help learners to make responsible decisions could be used to encourage them to think critically in order to deal with the issue of choosing whether to smoke or not.

2.3.1 Educational intervention programmes on the use of tobacco

The challenge to provide effective tobacco-use prevention programmes to all young persons, particularly teenagers is an ethical imperative. School-based programmes to prevent tobacco use can make a substantial contribution (Hamilton *et al.*, 2005; Fritz *et al.* 2008) to the health of the next generation. However, Fritz *et al.* (2008: 13) point out that research (e.g. Mendez and Warner, 2000) indicates that "*if interventions continue to focus solely on smoking initiation, and not on smoking cessation, the nation will fall short of this goal*". So, addressing both challenges would be an ideal strategy in trying to curb the use of tobacco. The effectiveness of these programmes hinges on proper implementation (Sy and Glanz, 2008). These authors point out that studies have shown that in real-world settings, "*teachers do not always implement tobacco use and substance abuse prevention lessons according to specified guidelines*" (Sy and Glanz, 2008: 265). The implication is that teachers need to be guided and supported on how to implement the programmes effectively. Research on curriculum innovations (e.g. Johnson *et al.*, 2003) reveals that teachers do improve their levels of proficiency in as far as the implementation of an innovation is concerned, provided they get continuous support through in-service training.

Of the research-based tobacco-use cessation programmes that I looked at only six were school-based (Simmons, Webb and Brandon, 2004; Hamilton *et al.*, 2005; Sun *et al.*, 2006; Sy and Glanz, 2008; Fritz *et al.* 2008 and Wang *et al.*, 2011). According to research (e.g. Hamilton *et al.*, 2005) the classroom is the ideal place to reach a vast majority of the adolescents using school curriculum programmes that deal with prevention and cessation strategies. According to these authors one challenge with a population-wide curriculum approach to adolescents smoking prevention is "*creating an intervention that is applicable to all students, regardless of their current smoking behaviour*" (Hamilton *et al.*, 2005: 690). Although Hamilton *et al.* (2005: 689) argue that school-based curriculum programmes have "*yielded inconsistent results*" in solving the problem of smoking amongst the youth, all the six research-based school programmes showed positive results. However, Fritz *et al.* (2008)suggest that these intervention programmes need to be continually developed and evaluated. This is also a call to the South African

research society to develop curriculum interventions. Two of the articles that I looked at were of South African context, one looked at guidelines for smoking cessation counselling with disadvantaged pregnant smokers attending public sector antenatal clinics in Cape Town (Everett-Murphy *et al.*, 2010) while the other explored illicit drug use — cigarette smoking and alcohol drinking behaviour among high school adolescents in the Pietersburg area of the Northern Province (Mado and Matla, 2003). Both did not look at school curriculum interventions.

The information gathered in this section assisted in the development of the package developed in the current study, as explained in Chapter 6, section 6.1.1.

2.4 CONCLUDING REMARKS

According to research, as reported in this chapter, smoking is a health hazard and vulnerable people, especially young children who are targets of tobacco companies, may need to be made aware of the dangers of smoking. Teachers are ideal people to impart this information to young children because they spend a large amount of time with children at school, and are in an ideal situation to be involved in education programmes. Furthermore, the new curriculum in South Africa requires teachers to use teaching strategies that encourage learners, among other things, to become critical thinkers. The issue of smoking and its dangers makes a good topic to link to the teaching of critical thinking skills. It can be used to assist young children to make informed decisions whether to smoke or not.

CHAPTER 3

CURRICULUM INNOVATION: A THEORETICAL FRAMEWORK

A theoretical framework is a collection of interrelated concepts that can be used to direct research, with the purpose of predicting and explaining the outcomes of the research (LeCompte and Preissle, 1993; Caliendo and Kyle, 1996; Gall *et al*, 1996). According to Mishra and Koehler (2006: 1039) a theoretical framework guides the

> *"kinds of questions that we can ask, the nature of evidence that is to be collected, the methodologies that are appropriate for collecting this evidence, the strategies available for analyzing the data, and finally, interpretations that we make from this analysis."*

3.1 IDENTIFYING A SUITABLE THEORETICAL FRAMEWORK

This study investigated the use of curriculum support materials in helping teachers who have to implement a new science curriculum. Therefore the theory which is relevant is theory to do with curriculum change, factors affecting change, teachers as implementers of change, and ways in which changes can be made more successful. There was relatively little theoretical literature on curriculum change prior to the 1960's - possibly because, as Fullan points out, there was little educational change at that time, and attempts at school reform were "*mostly aborted and confused*" (Fullan, 2001:4). However, the 1960's saw a revolutionary change in school curricula in America and the United Kingdom (as discussed in the next paragraph) and associated with these reforms was a development of thinking about curriculum change which led to the development of theory (as discussed later in this section).

The sharp rise in curriculum innovations originated in America. There was already dissatisfaction about science teaching in the early 1950's, as expressed in a 1955 report by the National Science Foundation (Dow, 1996). This report referred to growing concerns about the declining numbers of students enrolling in science and mathematics courses, and the poor teaching of these subjects (Dow, 1996; Park, 2006). The successful Soviet launching of Sputnik (the first satellite to orbit the earth) in 1957 triggered a period of massive curriculum reform in America, starting with what Goodlad, Klein and associates (1970: 3) called "*the education decade*". The federal government made funding available for a wide range of reforms, including construction of new schools, fellowships and loans to promising pupils to groom them to become scientists and technologists who could compete with the Russians, and curriculum reform in the classroom (Goodlad, Klein and associates, 1970; Dow, 1996). Funding from the National Science Foundation, the National Academy of Science, and private foundations supported projects such as the Physical Sciences Study Committee (PSSC) and the Biological Sciences Curriculum Study (BSCS) (Solomon, 1994; Fullan, 2001; Park, 2006). Similar reforms were launched in the 1960's in the United Kingdom, notably Nuffield Science (Solomon, 1994). Following the initial burst of reforms associated with the "education decade" referred to by Goodlad, and Klein in their 1970 book, reforms have continued in spurts. Tobin *et al.* (1994) identify four waves of educational reform in America after the initial reforms of the 1960's.

Curriculum reforms served as a fertile field for academics, many of whom became involved in research associated with the reforms (Dow, 1996). One consequence of their participation was that more theorising on the process of curriculum change took place (Dow, 1996), which led to the growth of literature on theories of change.

In spite of the 40 years of theorising about curriculum change, it was difficult to find a single coherent theoretical framework to use for this study. Goodlad (1979: 45) suggest that "*there is no single theory*" of "curriculum", possibly because, as also pointed out by Fullan (2001) and Abd-El-Khalick and Akerson (2006), educational contexts are so multifaceted and complex that "*given the terrain to be encompassed, the very idea of such a theory boggles the mind*" (Goodlad, 1979: 45). They add that "*the best we can hope for ... are relatively short-range theories ....*" (Goodlad, 1979: 45).

The complexity of the situation (educational contexts) makes it difficult, particularly for beginner researchers, to identify a theoretical framework that would suit the researcher's study (Abd-El-Khalick and Akerson, 2007). According to these authors (Abd-El-Khalick and Akerson, 2007: 188) theoretical frameworks fall on a continuum: on the one end is a "*disconnected listings of a number of theories*" from which one can infer, which is what I did in my study. It was not my intention in this chapter to come up with a single coherent theoretical framework to guide this research. Rather this chapter contains lessons from the literature on curriculum change that will help me design my research and interpret the data collected in this study. On the other end of the continuum "*these frameworks amount to intricate developments of hypothesized links among different theories into a complex web of ideas to help guide research studies*" (Abd-El-Khalick and Akerson,2007: 188).

Because educational situations are so complex many individual researchers focus on one or two different aspects of the change process, rather than looking holistically at the whole picture. For example, many early theories of curriculum change focussed on the **process** of implementation, and models were developed to explain the process. The people who developed these theories often ignored the political and social context of the implementation, hence their theories were limited because they did not look at the whole picture. However, Rogan and Grayson (2003: 1171) developed a theoretical framework, relevant to the South African context, which looks more holistically at curriculum change, drawing on "*school development, educational change, and science education literature*". As shown in Figure 1, on page 40, three constructs were developed to form the basis of the theory, (i) the Profile of Implementation, (ii) the Capacity to Innovate, and (iii) Outside Influence (Rogan and Grayson, 2003). Rogan and Grayson (2003) saw the purpose of this theoretical framework as being to emphasise the importance of the **implementation process** in curriculum innovations which, according to the literature on curriculum change (e.g. Verspoor, 1989 cited by Rogan and Grayson, 2003) tends to be ignored by policy-makers and curriculum developers.

Aspects of curriculum change that are relevant to my study (resources and the use of resources by teachers) form small portions (indicated by red circles in Figure 1) in two of the three constructs of this theoretical framework. The theoretical framework by Rogan and Grayson (2003) was too broad to guide my study. I needed a more targeted theory.

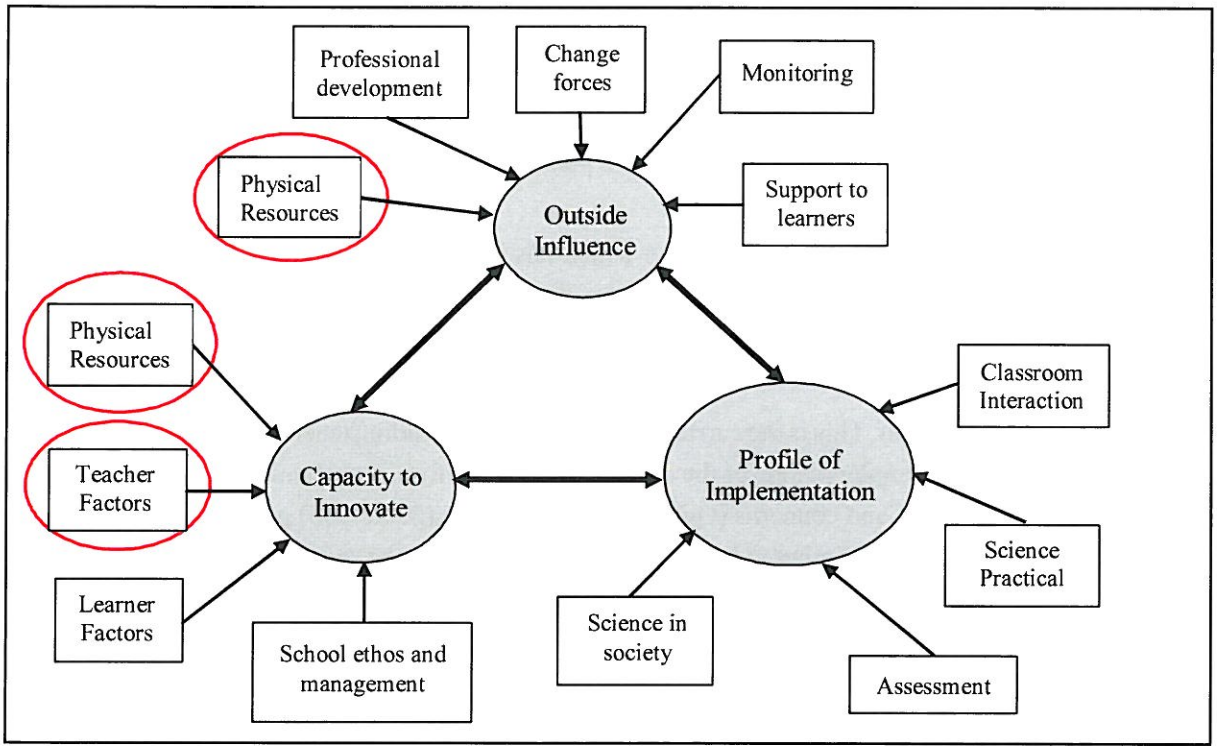


Figure 1: A model of factors affecting curriculum implementation, developed by Rogan and Grayson (2003). (Source: Rogan, 2007a).

It was my aim to develop a more detailed picture of "teacher factors", and to develop a model on adaption and adoption of curriculum materials at the end of my study, once data were analysed. Goodlad. (1979: 46) point out that theories derived in a theoretical-deductive manner have not been particularly productive. After the analysis of data for my research I developed a more coherent model, using a "grounded theory" approach (Strauss and Corbin, 1990). The model I developed (see Chapter 8) was not aimed at encompassing the whole theory of change, but focused on teachers' adaption and adoption of curriculum support materials.

3.2 UNDERSTANDING THE TERM "CURRICULUM"

In order to appreciate the challenges that come with curriculum innovation and implementation it is important to understand the complexity of the concept "curriculum". Defining curriculum is not an easy task because there are different perspectives surrounding the concept (Marsh, 1997), and because "*curriculum is in the eye of the beholder*" (Goodlad, 1979: 30). Kelly (1989) points out that many people tend to equate a curriculum with a syllabus, which is a list of subjects and the content of these particular subjects to be taught in class. According to Kelly (1989) this is problematic because it limits curriculum planning to classroom activities, and ignores many aspects which have a critical effect on how a new curriculum is implemented. Researchers need to be aware of these many aspects, otherwise they may never understand why the implementation of a new curriculum succeeds or fails. Based on emerging research in the 1960's and 1970's, Goodlad (1979) tried to unpack the term "curriculum" to illustrate that it is not just one simple concept. They identified five different "types" of curriculum, the *ideal curriculum*, the *formal curriculum*, the *perceived curriculum*, the *operational curriculum*, and the

experienced curriculum. Other researchers identified two further types the *intended curriculum* and the *hidden curriculum.* These types are explained below.

- **Ideal curriculum**. This curriculum contains the documented ideas of the curriculum planners (Goodlad, 1979). The designers' aim is for the ideas to be conveyed without distortion (Ogborn, 2002).
- **Formal curriculum**. This is a curriculum which has been approved officially for adoption, for example by the state (Goodlad, 1979). This may be modified in subtle ways from the curriculum originally designed. The state might, for example, change the original curriculum to fit in its hidden agenda, which often has political underpinnings.
- **Perceived curriculum**. This is the curriculum that society, including teachers, perceives (Goodlad, 1979). Teachers, as implementers of the curriculum, see the formal curriculum in ways influenced by their own interests and concerns (Ogborn, 2002). Ogborn (2002: 145) points out that if you are not concerned you do not bother to listen, but "*if you are concerned you will understand something that matches your own concerns and ideas.*" Based on a study conducted in Mpumalanga (South Africa) Aldous (2004) reported that a number of teachers found the new curriculum to be more demanding and tiring compared to the old system.
- **Intended curriculum**. This is the type of curriculum that involves "*the planned experiences offered to the learner under the guidance of the school*" (Wheeler, 1967: 11), meaning that which teachers intend to use in class. It may differ from the perceived curriculum because teachers, who are the implementers of the curriculum, are aware of what is in line with *"the needs, abilities and interests of the classes*" (Ogborn, 2002: 143) and may decide to select only what they see as relevant, from the perceived curriculum, to transmit in class. What teachers choose will certainly distort the formal curriculum (Ogborn, 2002).
- **Operational curriculum**. What teachers teach day in and day out in their classrooms is referred to as the "operational curriculum", and may not necessarily be what they intended to implement. The practical realities of the classroom intervene, and influence the way the intended curriculum can be executed. Kennedy (2005: 2) points out that "*routine everyday conditions of classroom life often dictate teaching practice*". For example, if the curriculum requires learners to do some practical work in the laboratory and there is a shortage of chemicals, then the teacher might deviate from the planned lesson to do a demonstration, or might even cancel the practical work. Whatever the teacher decides to do as an alternative will change what was intended.
- **Experienced curriculum**. This is what learners experience in class during teaching and learning, which influences learners' actions (Barone, 1980). For example, if a teacher decides to take learners on a field trip with the intention of achieving certain outcomes, learners, on reaching their destination, may be overwhelmed by what they see and forget to fill in their worksheets. The learning they experience will not be that which the teacher implemented. Thus the experienced curriculum is not always the same as the operational curriculum.
- **Hidden curriculum**. According to Gall *et al.* (1996: 623) a hidden curriculum refers "*to the indirect instruction in attitudes and habits that is continually transmitted by the way in which schools are structured and classroom instruction is organised.*" Most people are not aware of the existence of a hidden curriculum because it is never written down. The hidden curriculum operates at all levels, influencing each of the types of curriculum, as shown in the Figure 2.

These types of curricula are an illustration of how complex it is to have a single definition of "curriculum".

The types of curricula and the relationships between them are illustrated in Figure 2. As shown in the diagram, certain factors act on each type of curriculum, resulting in small changes (called "slippages" by Goodlad, 1979) which transform the curriculum into another "type". These slippages are subtle changes that happen when an ideal curriculum is adopted for use in an educational system. Goodlad. (1979) point out that slippages happen during the initial stages of the curriculum up to when it is experienced by learners in class, as shown in Figure 2. By the time the ideal curriculum gets implemented it will have undergone several changes and become slightly different from the original ideal curriculum.

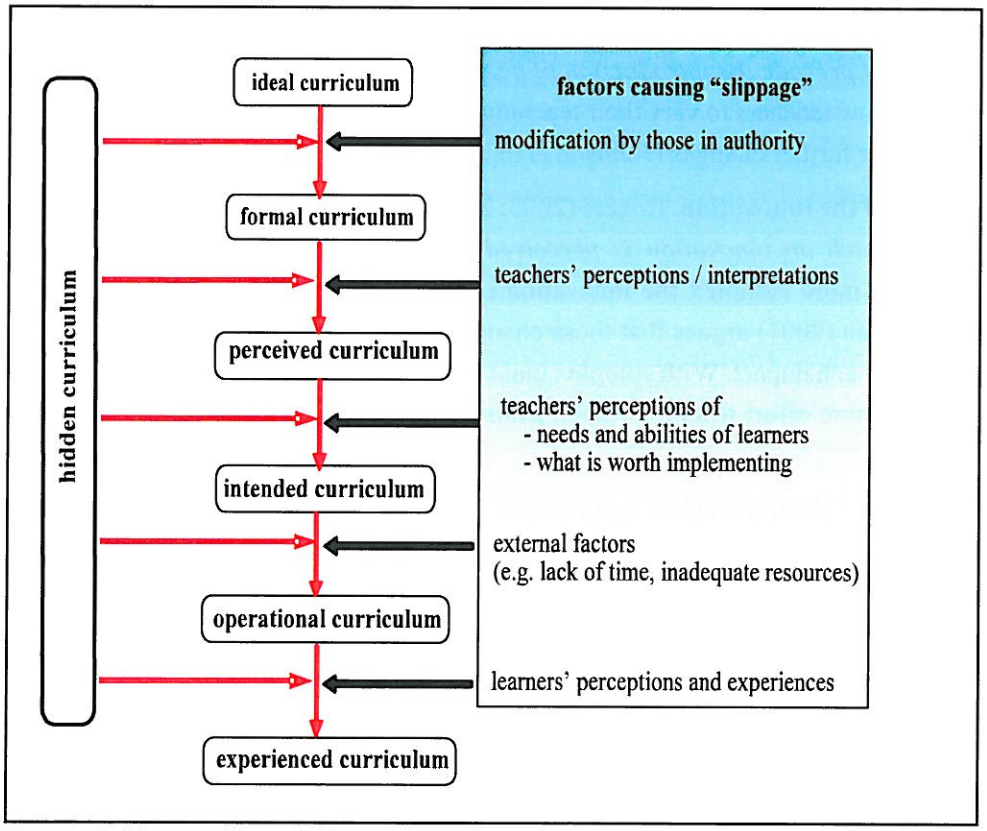


Figure 2: Types of curriculum, and factors resulting in slippages

3.3 FACTORS AFFECTING THE IMPLEMENTATION OF A NEW CURRICULUM

The implementation of an innovation is not easy, and the literature on curriculum change reveals a number of problems associated with change and the implementation of a new curriculum (Rogers, 1962; Fullan, 2001; Rogan and Grayson, 2003; Hall and Hord, 2006). Fullan (2001) points out that the implementation of an innovation involves putting new ideas into practice. Hall and Hord (2006: 4) explain putting new ideas into practice as "*a process through which people and organisations move as they gradually come to understand and become skilled and competent in the use of new ways.*" However, Fullan (2001) points out that at the beginning of change things are not always clear, and uncertainty may delay change. Schweisfurth (2011: 429) points out that whoever or whatever it is that drives change or

hinders it, is "*central to the likelihood of successful implementation*". The literature on curriculum change reveals a number of factors that contribute either negatively or positively towards the implementation of an innovation. This section looks at factors that affect the implementation of a new curriculum.

3.3.1 The characteristics of the innovation

According to Rogers (2003) the design of an innovation plays an important role in whether the implementation will be feasible or not. Below is a list of five characteristics of an innovation and how they affect implementation (Rogers, 2003).

- **The extent of the innovation.** According to Rogers (2003) the adoption rate is generally quicker for innovations that are implemented in small sections than when the whole innovation is implemented at a go. Rogan and Grayson (2003: 1177) point out that simple structural changes "*might need to precede the introduction of deep changes.*" The introduction of small sections of change can allow teachers to vary their teaching strategies, identify successful variations and then be prepared for further changes (Johnson *et al.*, 2000).
- **Complexity of the innovation.** Rogers (2003: 257) defines the complexity of an innovation as the "*degree to which an innovation is perceived as relatively difficult to understand and use.*" Generally, the more complex the innovation is the slower the rate of adoption (Rogers, 2003). However, Fullan (2001) argues that those changes that are simple may be easy to implement, but may not have much impact. With complex innovations there is the promise to achieve more, though they demand more effort from the implementers, and possibilities for failure are higher (Fullan, 2001).
- **Observability of the innovation.** According to Rogers (2003: 258) some innovations can be easily observed and diffused to people while others may not. If an innovation cannot be easily observed and explained it means that adopters will not know what is expected of them, and this could have a negative impact on the adoption rate. According to Rogers (2003) the observability of an innovation affects the adoption rate.
- **Compatibility of the innovation with antecedent norms.** A norm, as defined by Rogers (1962: 57) is "*the most frequently occurring pattern of overt behaviour for the members of a particular system*", and antecedent norms are those norms that exist in the system before the introduction of an innovation. They can have an influence on whether a new idea is adopted or not, and on the rate of adoption. If the innovation is not in line with adopters' needs, and is in conflict with their "*existing values,* [and] *past experiences ....*" (Rogers, 2003: 240) then the rate of adoption is slower.
- **Benefits of the innovation.** The degree to which the innovation is (seen to be) better than the existing practices can affect the rate of diffusion of an innovation (Rogers, 2003), even if antecedent norms are different. According to Rogers the advantages of an innovation over the existing practices have been found to be the most influential factor affecting the rate of adoption. He quickly points out that it has to be the potential adopters' perception, not the innovators', since the adopters are the people implementing the changes (Rogers, 2003). The rate of adoption can be negatively affected if individuals do not see the advantages of an innovation.

Knowledge of the characteristics of an innovation and how they affect its adoption helped me in planning and designing curriculum materials for biology and natural science teachers in this study, and also helped in interpreting the data from phase two of the study (the therapeutic phase).

3.3.2 The context in which the curriculum is implemented

Curriculum developers often fail to take into consideration the context in which an innovation takes place (Driel *et al.*, 1997). Driel *et al.* (1997) argue that if an innovation introduces practices that are against the cultural norms of the particular society in which the innovation is to be implemented it is unlikely that teachers will comply fully with the intentions of the innovators. Walberg (1991) points out that what works in one country many not necessarily work in another.

Lewin (1985) criticises the importing of new ideas from developed countries to developing countries, which often have very different contexts. According to Johnson *et al.* (2000) teachers working in developing countries that are economically poor have constraints that are fundamentally different from those of developed countries, and they argue that the environment in which teachers in developing countries work is more important to look at first than their knowledge. In developing countries, unlike in most developed countries, there are often problems of large classes, lower levels of teacher competence and low availability of resources (Walberg, 1991). The constraints within which teachers work will certainly impact on the implementation of a new curriculum (Guthrie, 1990). According to the literature on curriculum innovation, many of the imported new ideas are not scrutinised initially to ensure their feasibility in the context of developing countries (Stronkhorst and van den Akker, 2006). As a result many of these imported innovations fail (Tabulawa, 1997).

Three major factors may be found in a particular context that affect the diffusion of an innovation.

- **Antecedent norms**. A definition of antecedent norms, and how they can influence adopters, has already been given earlier in this section (see page 43). For curriculum developers it is crucial to be aware of these norms in order not to diverge too widely from the typical practices of that particular society (see Zone of Feasible Innovation on page 43). Antecedent norms can operate at three different levels.
  - *Social system norms:* Rogers (1962: 14) defines a social system as "*a population of individuals who are functionally differentiated and engaged in collective problem-solving behaviour*". According to Rogers (1962) the social system norms of a particular society are expected to have an effect on the way members of that social system behave. If new ideas infringe on the traditional practices of that particular society, the chances of them being adopted are reduced. As explained in Chapter 1 on page 10, in most African societies adults are considered to have authority and children are "*dominated and subordinated*" (Tabulawa, 1997: 195). Thus the social norms of a particular society can influence the pedagogical style in a classroom situation. Learners in many African societies are not expected to question the authority of teachers, and teachers are the people to impart knowledge to learners. Therefore, learners might find it easier to learn the traditional way where they just sit and become passive recipients of information from teachers. This is in contrast to what activity-based and learner-centred practices (as explained in Chapter 1) advocate. This implies that social norms may influence the school's norms if traditional social norms are maintained in the classroom situation.

- *Education system norms:* According to Fullan (2001) the relationship between the education authorities and the school, though complicated, has to be analysed in order to identify and understand factors that affect the school community. Fullan goes on to say that at provincial and national levels political forces and government bureaucracies influence the priorities for education. The implication is that the education system norms can have an influence on the adoption of an innovation.
- *Schools' norms:* Hinde (2004) defines school culture as "*a set of tacit expectations and assumptions that direct the activities of school personnel and students.*" According to Fullan (2001: 80) the local school system " *represents one major set of situational constraints or opportunities for effective change.*" He points out that what is successful in one school may be a disaster in another school. Hinde (2004) argues that change introduced into a school is more likely to fail if innovators do not recognise the culture of that particular school. Principals and teachers at schools are the main agents of change (Fullan, 2001). The principal, in particular, can strongly influence the adoption of an innovation or discourage it, because what the principal does may indicate whether an innovation "*is to be taken seriously*" (Fullan, 2001: 83).

- **The quality of the teachers**. It is widely known that teachers play a crucial role in the implementation of innovations (Stein and Wang, 1988; Driel *et al.*, 1997), where they are expected to change their classroom practices and adopt new ideas. The extent to which the implementation of an innovation will succeed depends on the ability of the teachers to innovate in their classrooms (Lelliott *et al.*, 2009). According to Rogan (2004: 176) "*teachers' own background, training and level of confidence*" is crucial in the implementation of new ideas. Numerous studies in developing countries have shown that the quality of the teaching force may not be as good as in developed countries (Beeby, 1966; Guthrie, 1990; Walberg, 1991; de Feiter *et al.*, 1995).

  Beeby (1966) developed a model which helps us understand why some teachers struggle to implement an innovation the way innovators would like them to do. Beeby worked with schools in New Zealand and Western Samoa from 1945 to 1959 and formulated a model relevant to developing countries, but which could be more widely applied. He points out that teachers operate at different levels of proficiency influenced by the level of general education they have received and the professional training they followed to become teachers. Using these factors he classified teachers into four categories which he called Dame school (I), Formalism (II), Transition (III), and Meaning (IV), as shown in Figure 3.

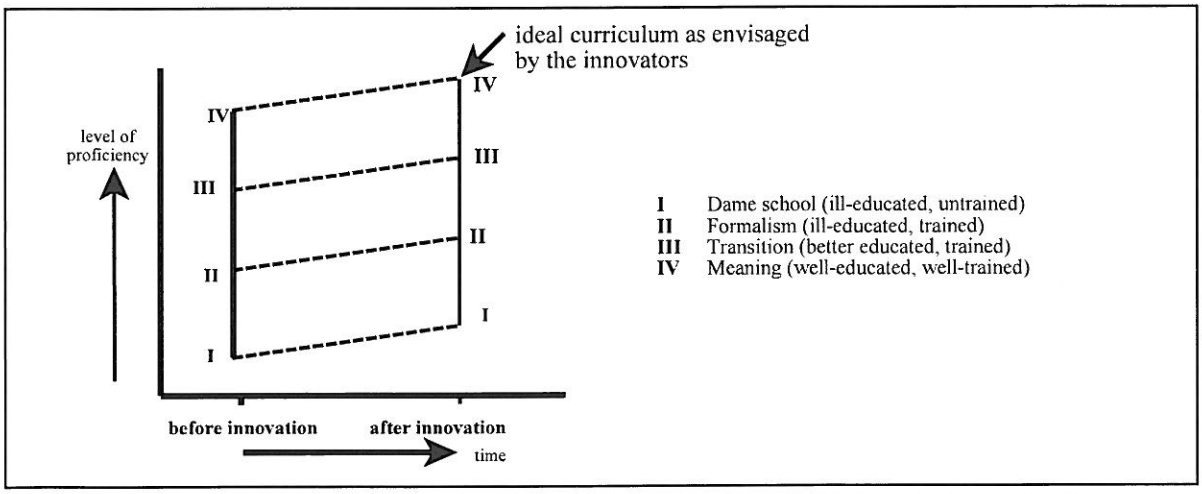


Figure 3: Feasible improvements in proficiency, dependent on initial proficiency levels (based on the ideas of Beeby, 1966)

The diagram shows that teachers operate at different proficiency levels. In situations where a new curriculum is implemented the level of proficiency expected by the innovation is often very high (see the big arrow on the top right side of the diagram). All teachers are capable of making small changes, but struggle to make radical changes (Beeby, 1966, Fullan, 2001). Rogan and Grayson (2003: 1195) refer to the small steps that they are able to take as the "*Zone of Feasible Innovation*". New innovations are often supported by in-service training, and teachers do improve their levels of proficiency. However, only a few really good teachers may achieve what is expected by the ideal curriculum. The implication is that if new ideas are introduced not all teachers can be expected to reach the same level of implementation within the same period. Rogan and Macdonald (1985) point out that Beeby's model gives strong arguments to be careful not to try and implement what may not be possible in certain contexts. Rogan and Grayson (2003) allude to the fact that sometimes policy-makers are too ambitious in that they envisage practices that may not be achievable by all the teachers in a particular context. For example, they point out that in South Africa there is a large range in quality of schools as well as in the teachers' knowledge and skills. Rogan and Grayson (2003) strongly advocate setting goals that are achievable for the teachers in the context of an implementation rather than in some ideal situation which does not really exist in that context — that is, that are within the Zone of Feasible Innovation.

- **Availability of resources**. Resources are items that are used to assist learning. They include teachers, textbooks, magazines, computers, chalkboards, laboratory equipment and others (Klein, 1991). A lack of resources can limit teachers from doing certain activities a teacher could do with the learners (Johnson *et al.*, 2000). According to Lelliott *et al.* (2009: 57) the availability or lack of availability of resources, and teachers' ability to use them, are "*likely to be crucial in any attempts at innovation*". Klein points out that resources should not be confined to the school setting; they also include those resources that are available in the community at large (Klein, 1991). Lack of resources, as is often the case in Africa where there are large class sizes and limited financial support, hinder the implementation of an innovation (Johnson *et al.*, 2003; Scholtz *et al.*, 2004). Developing countries experience the problems of "*static or diminishing resources*" due to economic restrictions (Lewin and Stuart, 1991: 10). In South Africa the issue of human and material resources for teaching and learning is a huge challenge (Adler and Reed, 2002) particularly in situations where learner-teacher ratio is high (Onwu and Stoffels, 2005). Curriculum support materials (as resources) form the core of this study, and a more detailed section on this topic is provided later in this chapter (see section 3.4, page 50).

3.3.3 The implementation strategies used

The implementation of an innovation is a very difficult process regardless of whether it is happening in developed or developing countries (Rondnelli *et al.*, 1990). It is therefore important that strategies that may influence the smooth implementation of an innovation are understood, as explained below.

The implementation model of change followed

The model of the dissemination of an innovation can contribute to the success or failure of an innovation (Lewin and Stuart, 1991; Fullan, 2001; Kelly, 2004). The three typical approaches that have been used

in educational innovations are the *power-coercive, rational-empirical* and *normative-re-educative* approaches (Chin and Benne, 1969, cited by Nickols and Forbes, 2001).

- **The power-coercive approach**. In this approach power from those in higher positions is used to accomplish change (Kelly, 2004; Nickols and Forbes, 2001). The underlying assumption in this approach is that "*people are basically compliant and will generally do what they are told or can be made to do*" (Nickols, 2003: 4), and to be successful in effecting change an exercise of authority and sometimes enforcement is needed (Kelly, 1989 and 2004; Nickols and Forbes, 2001). In the context of curriculum innovation the use of authority means that new ideas and approaches are imposed on teachers who are passive recipients (Kelly, 1989). The centre-periphery model is often used when a power-coercive approach is applied. In this model the ideas for curriculum change are formulated centrally at a national level and then diffused to the less central schools (Kelly, 1977).

  The centre-periphery model has been found to be problematic in disseminating innovations. The literature on curriculum change shows that those teachers "*who want to control their own practices are unlikely to comply with hierarchically imposed standardized curriculums*" (Brooks and Watkins, 1994: 12) as was the case in Hong Kong where classroom teachers often did not implement innovations disseminated by centralised government agencies (Carless, 1997). Strategies that are centralised have also been found to be a stumbling block in the implementation of an innovation because they hinder teachers' development and creativity (Kennedy, 1996).

  The power-coercive approach tends to be more concerned with innovations than with the implementers, which is in contrast with the next approach (Kelly, 1989).

- **The rational-empirical approach**. In this approach the strategy is to research what the problem is (e.g. with regard to implementing an innovation) and to design research-based ways of dealing with the problem. The focus in this approach is to "*attempt to promote change or innovation through demonstrations of their validity and desirability*" (Kelly, 1989: 129). The research, development and diffusion model or the extended research, development, diffusion and adoption model[4] (Havelock, 1971) are examples that use this approach. In this model the change process starts with research before being put into practice (Havelock, 1971). However, a common short-coming of this approach has been that the people who have to implement the innovation are often not consulted. The researcher identifies the problem, looks for possible solutions (through research), and then reports the findings. The implementers of the innovation are then left to carry on with the implementation. In my study I started with research to identify the extent of the problem before developing the materials. In addition I tried to over-come the short-coming mentioned above by consulting with the participants before developing the support materials.

- **The normative-re-educative approach**. In this approach the influence of societal norms on behaviour is recognised, and the assumption here is that people's attitudes, values and skills can only be changed if their socio-cultural norms are acknowledged and addressed (Kelly, 1989;

[5] Havelock (1971) revised his model by adding the *adoption* phase, which included *trial*, *installation* and *institutionalisation*. The *trial* stage is where the innovation is put into practice; *installation* involves conditions to be met to ensure the innovation is set up, and *institutionalisation* ensures that the innovation is established in the education system, e.g using examinations.

Nickols and Forbes, 2001). In the context of implementing an innovation, the focal point in this approach is to redefine and reinterpret teachers' existing norms, attitudes and values and to develop "*commitments to new ones*" that will favour change (Nickols, 2003: 3). Based on a review of research-based information, Hinde (2003) asserts that teachers need to "*establish a culture of change*" for successful reform to occur, and this requires training. According to Hinde (2003) professional development is crucial, particularly at the early stages of reform.

However, the theory of planned behaviour discussed in this chapter (see section 3.5, page 52) shows that changing people's behaviours is not an easy task. It involves several factors which include changing people's attitudes and beliefs towards the behaviour.

In all the three approaches mentioned above the teachers, who are the implementers of an innovation, are seldom involved in the planning of the innovation; they are either encouraged or forced to engage in it. According to Keogh (1987: 13) innovators "*must always ask whether the innovation is sufficiently congruent with the philosophy, practice and ability of the teachers who use it*". Based on a review of the literature, Lewin and Stuart (1991) claim that for change to be effective consultation with teachers is crucial, and where such consultation is marginalised, and the needs of the teachers not recognised, chances of innovations being successful are reduced. Based on case studies done in developing countries, Lewin and Stuart (1991: 13) are of the view that an effective change is that which is "*client-centred, purposive and evolutionary*". Havelock's social interaction model encourages interaction between groups of people who are involved in the implementation of an innovation (Keogh, 1987; Kelly, 1989). This interaction could be used to improve the success of implementation in the three approaches mentioned earlier, particularly the rational-empirical approach.

Although the social interaction model recognises that the "*key to the adoption and implementation of the innovation is the social climate of the receiving body* [teachers] *and that success or failure will hinge on the channels of communication*", it still has an element of the centre-periphery approach (Kelly, 1989: 127). This is because the needs of the teachers are often determined by curriculum developers or government officials and not by the teachers themselves (Kelly, 1989). However, according to Kelly (1989) this model marks the beginnings of the shift of focus from the centre to the periphery.

Kennedy (1996: 80) suggests that the debate on which strategy is best is irrelevant. She argues that "*what is important is a careful consideration of the complementary roles*" that each strategy can play. Research done in Colombia, Bangladesh, and Ethiopia (Dalin 1994, cited by Kennedy 1996: 79) reveals that a combination of strategies in introducing an innovation is crucial because individual strategies have "*an important role to play to provide a mix that will promote successful innovation*". Bearing in mind that context is important where change is concerned, and that it is not easy to generalise findings (Powell and Anderson, 2002), an indication that a combination of strategies could be helpful in introducing innovation should be noted (Kennedy, 1996). A careful selection of strategies that can be effective in a given situation is suggested by some authors (e.g. Fullan, 1991). Perhaps curriculum developers and policy makers should consider looking at how the common strategies (the power-coercive, normative-re-educative, rational-empirical approaches and social-interactive model) compliment each other when disseminating an innovation.

The use of change agents

By the late 1960's curriculum innovators realised that change agents were needed to assist in the introduction of innovations. The idea probably came about because curriculum innovators were trying to understand the unanticipated lack of success in implementing new curricula in the early 1960's. The term "change agent" refers to a person who provides "*a communication link between a resource system with some kind of expertise and a client system*" (Rogers, 2003: 368). Regarding curriculum change, this implies that a change agent is a link between curriculum innovators and curriculum adopters. Initially the change agents were called "coordinators" (Shipman, 1974). According to Rogers (2003) some of the functions of a change agent include:

- To ensure smooth flow of innovations from the source to adopters, as well as relaying feedback from adopters back to the innovators for adjustments to be done in line with the needs of the adopters.
- To make sure that implementors of an innovation know what to do. It is the work of the change agent to see to it that teachers, as adopters of innovations, understand what they are expected to do, otherwise they might implement an innovation in unintended ways (Ogborn, 2002).
- To encourage and support change which, according to Fullan (2001), is crucial, particularly when a new curriculum is first introduced.
- To act as facilitators to make the transition (changing classroom practices) easier.

The work of a change agent is crucial in curriculum change because it can affect the rate of adoption of an innovation (Fullan, 2001; Rogers, 2003).

The term "change agent" was originally coined to refer to a person. But the following section (section 3.4) suggests that curriculum materials do perform many of the functions of change agents because of what they contribute towards the diffusion and implementation of an innovation (see section 3.4 and sub-section 3.41 on pages 50 to 51 for more details on curriculum materials as change agents). I consider the package developed in the current study to be a change agent because it explicitly explains what teachers are expected to do in order to channel their classroom practice in the way advocated by the new South African school curriculum. The package also explains the "jargon" that comes with the new curriculum which, according to the South African literature on curriculum change, creates problems for teachers (Chisholm *et al.*, 2000) as predicted by Ogunniyi and Rochford, 1997 and Jansen (1997 and 1998).

3.4 CURRICULUM SUPPORT MATERIALS

In the context of innovations curriculum support materials include all materials that can assist teachers deal with the implementation of a new curriculum (Ottevanger, 2001). These include textbooks, educational video tapes and cassettes, posters, pamphlets, curriculum packages, and so on.

Ottevanger (2001) uses an effective analogy when he compares the function of well-designed curriculum support materials in the implementation of a new curriculum to that of a catalyst in a chemical reaction (see Figure 4). In the field of chemistry catalysts play an important role by reducing the amount of activation energy needed to start a chemical reaction. Similarly, well-designed curriculum support

materials can enhance the implementation of an innovation by lessening the amount of work and effort teachers have to put in as they implement the required curriculum changes, as shown in Figure 4. For example, if support materials provide teachers with resources such as lesson plans, activity-based worksheets, and assessment tasks and rubrics, then teachers can be saved time and effort (Ottevanger, 2001).

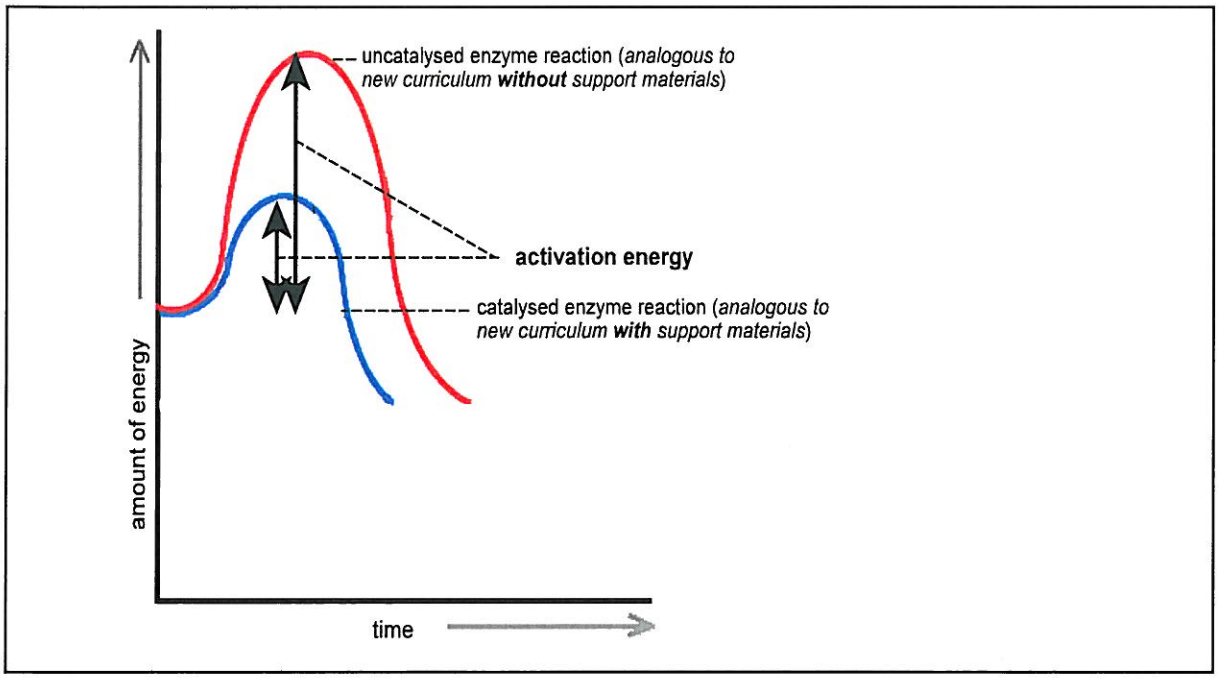


Figure 4: The effect of support materials on curriculum implementation, using the catalyst analogy of Ottevanger (2001)

3.4.1 The role of well-developed curriculum support materials

Curriculum materials play an important part in every teacher's daily classroom practice (Collopy, 2003). Teachers can benefit significantly from appropriate and well-designed curriculum support materials if they use them effectively (Givens and Barlex, 2001; Ottevanger, 2001; Stronkhorst and van den Akker, 2006). Powell and Anderson (2002: 112) point out that curriculum materials have a crucial role in initiating and sustaining reform because they are "*concrete, tangible vehicles for embodying the essential ideas of a reform*". However, they point out that materials, whether well-developed or not, cannot generate change by themselves. They are "*a tool that teachers can use to enact changes*" (Powell and Anderson 2002: 112). Collopy (2003), in her case study, observed two upper-elementary teachers who were learning through the use of what she referred to as "*potentially educative mathematics curriculum materials*", to find out if the materials could assist the teachers change their classroom practices. Extensive class observations and numerous interviews were used. Collopy found that the curriculum materials assisted both teachers to change their classroom practice. Though the results from small samples should not be generalised, this is an indication that curriculum materials can assist teachers change their classroom practice.

The literature on curriculum materials reveals several roles that can be played by well-designed curriculum materials, both during the initiation and sustainability of the reforms (Powell and Anderson, 2002).

- **Support materials serving as "agents" of innovation.** Ball (1990: 258) points out that curriculum-aligned text books "*make good policy messengers because they can represent ideas in a forum that is familiar and concrete*". In the same way, well-designed curriculum support materials can present the ideas of curriculum developers in a simpler way than policy documents hence acting as "*agents for instructional change*" (Ottevanger, 2001: 47) where they can serve to help teachers who are struggling to implement a new curriculum. It is very important to understand what it is that one is expected to do to implement an innovation. According to Ogborn, when innovations are not clearly explained

> "*(t)he 'receiver' or, better, the 'listening partner', has no option but to make their own sense of the message. Either they aren't listening, or if they are, they transmute the message to make their own sense of it*". (Ogborn, 2002: 144)

This implies that if there is no clarification on what is required of the teachers then they will implement the new curriculum in their own way. For this reason it is important that what teachers are expected to do is clearly pointed out, and well designed curriculum support materials can clarify to teachers the importance and implications of innovations and how they can be implemented, which is crucial at the early stages of implementation (Stronkhorst and van den Akker, 2006).

- **Support materials can allay teachers' fears about implementing an innovation.** It would be logical if teachers implementing a new curriculum were to experience some anxiety because of factors such as fear of the unknown, lack of content knowledge, and uncertainty about how to do the teaching. Curriculum support materials can alleviate teachers' concerns and reduce their stress levels, particularly during the early stages of the implementation of a new curriculum (Schneider and Krajcik, 2002; Davis and Krajcik, 2005; Stronkhorst and van den Akker, 2006).

Often when curriculum materials are supplied they include lesson plans, worksheets and some form of assessment, and from my eight years experience as a teacher I have realised that well-developed lesson plans help teachers

- decide what to include in the lesson,
- plan how to go about teaching the lesson,
- logically sequence what they are going to teach, and
- allocate time appropriately.

Appropriately designed worksheets or activities

- are ideal for teachers who are inexperienced as far as activity-based teaching and learning is concerned because they guide teachers on how to go about in implementing activity-based lessons,
- can provide meaningful tasks, and
- can enhance the construction of knowledge by promoting thinking about activities being carried out.

If teachers are assisted with well-designed assessment tasks, that would save teachers time, particularly those teachers who are inexperienced.

The package developed in the current study has lesson plans (with clear suggestions on how teaching **could** be done). Several of the lessons have background information (content) to assist those teachers who might need additional information. All the lessons include worksheets which could be used to guide activities. It should be noted that the lessons are not prescriptive: teachers can choose those that they view as "*consistent with their classroom climate and students' past experiences*", as stated by Barab and Luehmann (2003: 455).

- **Curriculum support materials acting as an alternative to the cascade model.** Well-developed curriculum materials can be used as an alternative to the "cascade" model of diffusion of an innovation commonly used in African countries, including South Africa. Cascading is a strategy used for large-scale training by disseminating information to a particular group of people who will, in turn, pass it on to members of a further group. For example, in South Africa a number of education officers were trained, and they in turn trained the teachers.

  However, this model has been criticised as being an inadequate model for delivering effective training (Makgoba, 1999; Khulisa Management Services, 2002) because often valuable information gets lost or distorted along the way as the dissemination process continues from one group to another. This means that a group of participants further down the chain may receive misinterpreted information and that they miss out on some important information. In South Africa a review committee (as explained in Chapter 1, section 1.2.4, page 19) found that, because of the inadequacy of the cascade model, trainers "*lacked confidence, knowledge and understanding to manage the training process*" (Chisholm *et al.*, 2000: 2). Members of a South African educators' union (the Professional Educators' Union) complained about the quality of workshops organised to disseminate information that would assist them make the changes required by the new curriculum because the workshop facilitators felt insecure because "*they were still in the process of learning*" about implementing the new curriculum (Makgoba, 1999: 73). Lewin (1992) suggests that the use of well-developed curriculum support materials can help reduce problems such as the distortion of information resulting from in-service models that depend on the "cascading" of new ideas.

  A study by Givens (2000) reveals that well-designed support materials can be of great assistance in the implementation of an innovation. Givens (2000) reports on a case study of two teachers (from different schools in England and Wales) using Nuffield publications with one of their classes. Although both teachers had little training on how to use the materials the findings of the study revealed they (the teachers) used the materials "*with surprising sophistication*" (Givens, 2000: 82). This case study implies that well-designed support materials can be of assistance where the cascade model fails.

3.4.2 The ways in which teachers use curriculum materials

In the early 1960's curriculum developers developed materials which they viewed as "teacher-proof" (Loucks-Horsely, 1996), meaning that teachers were intended to use all the materials in ways intended by the designers. Although the developers may have viewed them as "teacher-proof", research soon showed that this was not an ideal goal.

According to Olson (1981: 259) when teachers are introduced to an innovation which they are supposed to adopt "*they face new uncertainties about their role in the classroom, the effectiveness of their methods*

and the purposes of their instruction". Perhaps the same can be said about how teachers look at, and use, curriculum support materials. Warwick *et al.* (1992: 307) argue that curriculum support materials will succeed only when teachers are aware of and understand their purpose, and *"believe they are helpful, and want to use them*". Many teachers choose not to make use of curriculum materials, or do not use them as intended. When teachers do use such materials they tend to be selective in their use, using certain sections of the materials to support their specific needs and those of the learners (Ball and Cohen, 1996; Johnson *et al.*, 2003; Hall and Hord, 2006). The reason for adapting curriculum materials (i.e. teachers selecting the materials they want and changing them to suit their classroom practice), is probably because materials can never be specifically tailored to exactly what and how individual teachers want to teach (Draper, 1998).

Several authors support the idea that classroom teachers should have the opportunity to choose, from curriculum materials, what they think will benefit their learners (Schwab, 1978; Draper, 1998; Davis and Krajcik, 2005). According to Davis and Krajcik (2005) denying teachers the opportunity to choose what they want, and having prescriptive curriculum materials, might prove to be less effective than letting teachers decide what to use. Bloomer argues that ,

> "*Teachers are not merely points in some conduit linking centralised prescriptions to learners' desks. They are not technicians, faithfully acting out the detail of prescribed blueprints. Rather, they 'act upon' prescriptions in order to create learning opportunities*". (Bloomer, 1997, cited by Givens, 2000 : 72)

According to Johnson *et al.* (2000: 186) only practices that fit social and material constraints in the context of their use are likely to be used, and "*novel practices that do not fit the environment will not be repeated, even if tried*". This is why in recent years materials have been developed with the expectation that teachers will adapt them. Consequently, curriculum packages now often act as a source of materials and ideas from which teachers can choose and adopt or adapt.

3.4.3 Factors affecting the use of curriculum materials

According to the literature on innovation in general (e.g. Brown and Mclntyre, 1978: 19) the way teachers judge and value innovations is likely to depend on two factors, "*the extent which the goals of the proposals ...*" are in line with their classroom practice, and " *on the problems they can foresee arising from the various constraints under which they habitually work*". Perhaps the same can be said about how teachers look at, and use curriculum support materials. There are several factors that may affect the use of curriculum support materials by teachers, as explained below.

Teachers' beliefs about teaching

Research on the use of curriculum support materials (e.g. Olson, 1981; Stoffels, 2005) suggests that teachers' beliefs about teaching can affect the way they use curriculum materials. The literature on curriculum change (e.g. Pajares, 1992; van Driel *et al.*, 2005) reveals how teachers' beliefs can influence their (teachers') decision to engage in a change. According to Modisenyane *et al.* (2004: 142) the "*reciprocal relationship between behaviour and belief*" often leads to difficulties in the implementation of change. No matter how willing teachers are to engage in an innovation, they generally adapt it

according to their individual needs and beliefs (Doyle and Ponder, 1977, cited by Lambdin and Preston, 1995). This suggests that if provided with curriculum materials teachers are likely to interpret them according to their beliefs (Eisenhart *et al.*,1988; Pajares, 1992), and decide whether they adopt, adapt or reject them, as shown in the South African studies reported by Stoffels (2005) and Rogan (2007b).

In a case study (Rogan, 2007b) conducted in one school in Mpumalanga (South Africa) teachers were supplied with new textbooks to use in class. What the teachers did was to select (from the textbooks) only those activities that they believe "*could be successfully achieved*" taking into consideration the context of their school, that is, the kind of resources available at the school, "*the cognitive level of their learners, and their own level of comfort with the subject matter*" (Rogan, 2007b: 115).

Stoffels (2005) reports on a case-study where one science teacher was provided with support materials to use in class. The findings of the study revealed that the teacher did not follow the demands of the materials. The teacher conducted practical work his own way, which was different from what was prescribed in the support materials. The study presents an indication that teachers' beliefs about teaching can affect the way teachers use curriculum materials. Olson (1981) reports on a study where eight teachers in England tried to use curriculum materials, but found that they couldn't because what was expected of the teachers was in conflict with their classroom practice. The teachers were in a dilemma, whether to abide by the requirements of the project or do what they commonly did. The study found that the teachers opted for their own classroom practice. According to Fullan (2001: 39) there are at least three aspects at stake in the implementation of an innovation, and one of them is the "*possible alteration of beliefs*". He maintains that changes in "*beliefs and understanding are the foundation of achieving lasting reform*" (Fullan, 2001: 45). The three studies mentioned suggest that developers of curriculum materials need to be cognisant of teachers' beliefs when introducing materials to teachers.

Teachers' content knowledge

Teachers' content knowledge can play an important role in their decision to use or not to use curriculum materials, as shown in the South African case study by Stoffels (2005) mentioned earlier. Stoffels observed a teacher taking a different approach to what was prescribed, while using the support materials provided, because of content knowledge problems. Initially the teacher did every practical activity as a teacher demonstration, even those that required groupwork. However, with one particular practical activity the teacher let the learners do it as homework. When the researcher tried to find out why the teacher opted for learners to do the activity by themselves it transpired that the teacher's content knowledge with regard to that particular activity was limited. According to the researcher the teacher "*volunteered, on numerous occasions, that his limited content knowledge in the Geography or Biology oriented themes made him reluctant to engage in such SciGuide practical activities*" (Stoffels, 2005: 152). During classroom observation sessions involving biology and geography sections the teacher either rushed through the sections or only touched on them superficially.

According to Onwu and Stoffels (2005) to successfully implement a new curriculum, it is important that teachers are knowledgeable in their areas of specialisation and confident in terms of being able to disseminate information. Rogan (2007b: 117) points out that the successful implementation of a new

curriculum hinges on a "*sustained effort to enhance teachers' understanding of subject matter*". As mentioned earlier, having content knowledge contributes towards the decision to use or not use curriculum materials. According to Harley *et al.* (2000) content was not spelled out in the new South African curriculum documents because the Department of Education regarded teachers as professionals and expected them to decide on the relevant content and activities for their particular learners. However, this did not work well as some teachers were found lacking in content knowledge (as reported in Chapter 1, section 1.3). In order to deal with this problem, in my study teachers were provided with suggested activities and lessons plans (with background information) to choose from.

Amount of support and training for teachers in using curriculum materials

Among the factors identified as affecting teachers' use of curriculum materials, the training of teachers in using the curriculum materials emerges as important (Ball and Cohen, 1996). These authors point out that although the development of curriculum materials was in progress as early as the 1950's and 1960's, their use was not uniform because curriculum innovators neglected the teachers (Ball and Cohen, 1996). After reviewing the literature on curriculum innovation these authors reported that curriculum innovators often overlook the fact that teachers needed training on how to use curriculum materials.

Castro (2006) suggests that teachers need training (in the form of teacher education programmes) in the use of curriculum materials since some teachers' knowledge in using these materials is limited. She claims that knowledge on how to use curriculum materials will be of great assistance to teachers "*when making teaching decisions*" (Castro, 2006: 15), and that such materials can enhance teachers' development in the "*conception of teaching and learning that is consistent with recent reform ideas*" (Simon and Schifter, 1993, cited by Castro, 2006: 15). Teachers not only need training in order to use curriculum materials appropriately, but according to Barton (2005), they also need continuing support. Huberman and Miles (1984: 273) point out that "[l]*arge-scale, change-bearing innovations lived or died by the amount and quality of assistance that their users received once the change process was under way*".

The *Teaching of Science to Large Classes Project* is an indication that, given appropriate curriculum materials, training on how to use the materials, and continuing support, teachers can engage in curriculum change. In South Africa, the *Teaching of Science to Large Classes Project* introduced teachers (from 379 secondary schools in the Western Cape) to "translation activity" teaching materials to assist them in implementing the new curriculum (Johnson *et al.*, 2003). According to these authors teachers received training (from trained project staff) in large groups and follow-ups were made with teachers in small clusters. The teachers not only received training, but were provided with materials and monitored in their classroom practice (Johnson *et al.*, 2003). According to these authors this project was found to be capable of promoting "*better understanding and confidence to adopt new teaching styles and adapt them to each school environment*" provided there is continued support (for teachers) from project trainers, and provision of support materials (Johnson *et al.*, 2003: 94).

3.5 UNDERSTANDING FACTORS AFFECTING TEACHERS' CHANGES IN BEHAVIOUR

As has already been alluded to in section 3.4.3 on page 54, teachers' beliefs play a crucial part in determining whether teachers change their classroom practices. According to Pajares (1992) all teachers hold beliefs about their teaching which have an influence on their decisions to engage or not to engage in change. Teachers' beliefs about teaching "*influence their perceptions and judgements, which, in turn, affect their behavior in the classroom*" (Pajares, 1992: 307), and for an innovation to be successful teachers' beliefs with regard to the way their subjects should be taught have to be taken into consideration by curriculum innovators (Barton, 2005; van Driel *et al.*, 2005). Pajares (1992) argues that this does not necessarily mean that beliefs do not change, but they are difficult to change.

The new South African school curriculum currently being implemented requires teachers to change their classroom practices in nine ways, as discussed in Chapter 1. Because changing teachers' classroom practices and their use of curriculum support materials involves behavioural changes on the part of the teachers, theories about behavioural change are useful for examining factors which affect the changes (Sanders, 2006). This section looks at the theory of planned behaviour which, according to Ajzen (1991: 181) is developed to "*predict and explain*" individuals' behaviours. Zint (2002: 819) points out that "[g]*iven the consistency of results across studies, the Theory of Planned Behavior augmented with past behaviour is concluded to provide the best attitude-behavior model for predicting science teachers' intention to act*".

According to Ajzen and Madden (1986: 454) the "*immediate antecedent of any behaviour is the intention to perform the behaviour in question*". The stronger the intention to perform the behaviour the more likely that it would happen (Ajzen, 1991). Ajzen and Madden (1986) point out that the intentions are influenced by three factors, the individual's attitudes towards the intended behaviour, subjective norms and perceived behavioural control (as shown in Figure 5).

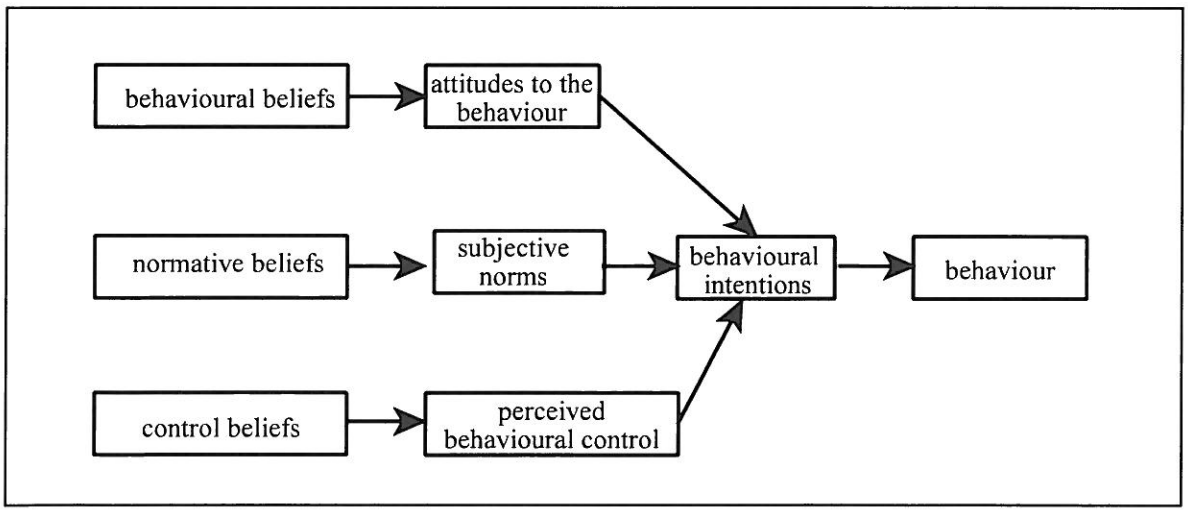


Figure 5: The theory of planned behaviour (as outlined by Ajzen and Madden, 1986)

An individual's attitude to the behaviour is a personal factor involving the degree to which the person has a favourable or unfavourable evaluation of the behaviour in question (Ajzen and Madden, 1986). This determinant is influenced by a set of beliefs — the behavioural beliefs (What one perceives and believes about the behaviour, and "*the cost incurred by performing the behavior*", Sanders, 2006: 643). Teachers will change their classroom practice if they believe that it will improve their ways of teaching and benefit learners (van Driel *et al.*, 2005).

The second determinant to affecting behavioural intentions are subjective norms. These refer to the "*perceived social pressure to perform or not to perform the behaviour*" Ajzen and Madden (1986: 454). This determinant is also influenced by a set of beliefs — the normative beliefs, how likely "*important referent individuals or groups would approve or disapprove of performing the behavior*" (Azjen and Madden, 1986: 455).

The third determinant to whether an individual will engage in a behaviour is the perceived behavioural control — which refers to "*people's perception of the ease or difficulty of performing the behavior of interest*" Azjen, 1991:183). According to Azjen and Madden (1986) there are many factors that might prevent an individual from being in control of the intended behaviour. These factors can be internal to the individual (e.g. skills, ability, knowledge etc.) or external (e.g. time, opportunity etc.).

According to Zint (2002) attitude-behaviour theories such as the theory of planned behaviour can be very useful for a theoretical framework in assisting researchers understand individuals' behaviours and factors affecting behavioural change. In educational contexts such understanding of individuals behaviours can assist in finding ways of improving teachers' professional development (Zint, 2002). In situations where teachers are required to change their classroom practice understanding their behaviours could assist in changing their attitudes towards the intended behaviours .

In the current study the theory of planned behaviour was used to interpret data on (1) the factors likely to promote or inhibit teachers' change of classroom practices to those advocated by the new South African school curriculum, and (2) the adoption and adaption of curriculum materials by a group of South African science teachers in the Johannesburg area (as explained in Chapter 6).

3.6 CONCLUDING REMARKS

The literature reviewed in this chapter reveals the complexity of the implementation of an innovation, possible reasons for the failure of curriculum innovations in the past, and potential ways to improve implementation. A number of lessons learned from the literature influenced the current study.

- **Curriculum support materials which are non-prescriptive are more likely to be used**, as discussed in section 3.4.2. Therefore the package developed in this study allowed teachers to choose materials that they found relevant to what they were doing in classes. The materials were not intended to be "teacher proof".

- **Changes not understood by teachers are less likely to be implemented:** In section 3.4.1 the use of curriculum materials as agents for change is discussed, especially the role in helping teachers understand the curriculum materials. Well-developed curriculum support materials can thus act as good policy messengers if they represent the ideas of curriculum developers in an easily and understandable way. Consequently a section needed to be included in my package to clearly explain to teachers what changes had to be implemented in the classroom.
- **Well-developed materials can allay teachers' fears**. During innovations teachers are insecure and lack confidence. This is discussed in bullet number two, section 3.4.1, which also explains how this lesson from the literature influenced my package design.
- **Teachers use curriculum support materials only if they want to, understand their purpose, and believe that the materials will improve teaching**. The links between beliefs and behaviour were discussed in section 3.5. The literature reveals that curriculum innovators often overlook the fact that teachers needed training on how to use curriculum materials. In-service training of teachers can be used to convince teachers to make the changes and improve their level of proficiency. In my study a workshop was run which introduced teachers to the whole package and how it would promote the new requirements and improve learning. The teachers tried out the different activities (walked in the learners' shoes) in the hope that this would convince them of the value of the activities to promote understanding, so that they would be more likely to use the materials.
- **Curriculum materials imposed on teachers are less likely to be used**, so the implementation strategy is important, as discussed in section 3.3.3. The involvement of teachers in the development of the materials is crucial as they are the people responsible for its implementation. In an effort to consult with teachers in my study, a workshop was run in which teachers were part of a situational and needs analysis, allowing them to have input into the development of the package.
- **A lack of content knowledge may inhibit teachers' use of support materials**, as discussed in section 3.4.3. A number of South African studies reveal a lack of content knowledge by some teachers, so I developed a package that contained background information on the topics in the package.
- **A lack of resources can inhibit the implementation of a curriculum**, as discussed in the last paragraph in section 3.3.2. I therefore included a range of resources in the package I developed.

Lessons learned about the factors that affect the adoption of a new curriculum and materials for supporting teachers through the change process helped me in planning and designing curriculum materials for biology and natural science teachers in this study. The theoretical framework developed in this chapter also helped in interpreting the data from therapeutic phase of the study, in spite of the fact that the theoretical framework is made up of the constructs I read about relevant to innovation and change, and is not a single coherent theory (as no such theory exists).

New information (i.e. information that is not provided in the South African literature on curriculum change) from my study.

- In order to assist teachers change their classroom practices to meet the demands of the new curriculum my study provides and thoroughly explains all the nine identified requirements and their characteristics, unlike other studies that concentrate on one or two of the requirements.
- The intervention designed in this study, besides being based on theory, was based on educational guidelines, and it provides information for the teachers on content knowledge as well as resources to use in class.
- The study provides a model to explain factors that affect the use of curriculum material in this study