CHAPTER 4

THE DIAGNOSTIC PHASE: RESEARCH DESIGN AND RESEARCH METHODS

Although this chapter focuses on the diagnostic phase of the study, it is appropriate to first look at some aspects of the research that are relevant to both the diagnostic and the therapeutic phases, to avoid repetition. These aspects are addressed in sections 4.1, 4.2 and 4.3.

4.1 RESEARCH

According to Leedy (1989: 4) the term research "*has been so loosely employed in everyday speech that few people have any idea of its real meaning*". It is important to define the term before looking at the research design in order to give the reader a picture of what research means in the context of educational research. Research is not merely an act of collecting data (Leedy, 1989). It can generally be described as a systematic and purposeful investigation of a problem (Gay, 1981; Leedy, 1989; Fraenkel and Wallen 1990; McMillan and Schumacher, 1993), and Leedy emphasises the need to support findings with "*demonstrable fact*" (Leedy, 1989: 5). Mouly (1978), cited by Cohen and Manion 1994: 40), defines research as "*the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis, and interpretation of data.*"

4.2 RESEARCH PARADIGM

All researchers, whether aware of it or not, have a belief system which influences their research — a research paradigm. Guba and Lincoln (1994: 105) define a paradigm as "*the belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways*". Smaling (1994: 234) explains a paradigm as "*a constellation of beliefs, norms and values which guide scientific action.*" In simple terms, paradigms involve certain philosophical assumptions that guide the thinking and acting of researchers (Mertens, 2005), and help them decide which of the things they have seen are important to report on (LeCompte and Schensul, 1999). Different researchers have different philosophical assumptions and, according to Gall *et al.*(1996: 28), "*if you choose one set of assumptions, you will conduct one type of educational research*". According to Guba and Lincoln (1994) the paradigm of the researcher influences the choice of research methods used.

Before looking at the research paradigm followed in this study, I will briefly look at the history of paradigms, to explain the paradigm I followed. Traditionally there were two common paradigms used in educational research, the "positivist" paradigm (Tashakkori and Teddlie, 1998; LeCompte and Schensul, 1999; Mertens, 2005), sometimes misleadingly referred to as the "quantitative" research paradigm, and the "constructivist" paradigm (Tashakkori and Teddlie, 1998; LeCompte and Schensul, 1999; Mertens, 2005), also referred to as the "qualitative" research paradigm. The widespread use of the alternative methodology-linked names for the paradigms (quantitative and qualitative) has lead many researchers to identify themselves with the methods rather than the underlying belief system (paradigm) which directs their research - i.e. they do not realise that researchers do not start by identifying the methods, but should start by identifying their ontological and epistemological beliefs.

The positivist paradigm is one of the dominant paradigms that guided early educational and psychological research (Mertens, 2005). According to Mertens (2005: 8) the underlying assumption guiding this paradigm is the belief that "*the social world can be studied in the same way as the natural world*", that is, that the social world can provide explanations of "*a causal nature*" (Mertens, 2005: 8). The proponents of this paradigm believe that there is one reality out there, which is "*observable and understandable*", and that if a properly representative sample is selected the findings of the research are "true" and can be generalised to the study population as a whole (LeCompte and Schensul, 1999: 42). Researchers working within this paradigm tend to believe the people being investigated in a study should be treated as entities, and that the observer should not become emotionally attached to or involved with the participants (Johnson and Onwuegbuzie, 2004). Because of the belief that truth exists that can be investigated, researchers situated within this paradigm tend to use quantitative research methods, experimental design, and statistical analysis, seeing them as the "*epitome of good science*" (Patton, 1980: 19).

The constructivist paradigm started to emerge in educational research in the 1970's. The basic beliefs that guide this paradigm are that knowledge is socially constructed by people, who should become participants in the research process, and that "*researchers should attempt to understand the complex world of lived experience from the point of view of those who live it*" (Schwandt, 2000, cited by Mertens, 2005: 12). This implies that researchers working within this paradigm try to make sense of what they observe, or to interpret explanations from people who give them information (Mertens, 2005). Hence the type of research approaches and methods that these researchers would opt for are those that allow interaction with the participants (typically thought of as "qualitative research methods") such as case studies, which use data-collecting instruments such as interviews, observations and document analysis (Mertens, 2005). The idea is to get in-depth information from close contact with participants (Patton, 1980). Some authors (e.g. Gall *et al.*, 1996; Babbie, 2005) point out that a richer understanding of many social events may be achieved through verbal interactions with participants.

Over a period of decades, proponents of the positivist and constructivist research paradigms have "*engaged in an ardent dispute*" which Johnson and Onwuegbuzie (2004: 14) refer to as the "*paradigm wars*". According to these authors positivists and constructivists both tend to view their paradigms as linked to the only appropriate approaches to research, and believe that the paradigms and their research methods cannot and should not be mixed. Johnson and Onwuegbuzie (2004: 14) refer to this as the "*incompatibility thesis*". This argument has been countered by researchers such as Patton (1980) and Sale *et al.* (2002), who state that particular methods are not linked to one or other of these two paradigms. Stenhouse saw mixing qualitative and quantitative methods as "*complementary approaches to education research*" (Stenhouse, 1980, cited by Sanders, 1986: 45), and Patton (1980) saw the methods as alternatives from which researchers could choose. According to Patton (1982) such attempts were not accepted by many evaluators at the time because they argued that the two paradigms are based on two different philosophies so the research methods followed are different and cannot be combined. However, Green *et al.* (1989: 256) point out that neither type of methodology (typically considered to be qualitative or quantitative) is "*inherently linked to any particular inquiry ...*"

A new paradigm emerged in the early 1980's which outlined a third belief system which made it possible to mix methods previously traditionally associated with one or other of the two dominant paradigms. One of the earliest proponents was Patton (1980), who called it the "paradigm of choices". This paradigm has

been more recently referred to as the eclectic - mixed methods - pragmatic paradigm (Reeves and Hedberg, 2003). This is an appropriate name in that it reveals the belief system of the people working within this paradigm. According to the Collins English dictionary (1991: 1222) the term "pragmatic" means "*advocating behaviour that is dictated more by practical consequences than by theory or dogma*", which characterises the belief system of the proponents of this paradigm. The rest of the name refers to the fact that supporters of this belief system are willing to use methods previously associated with one or other of the dominant paradigms. "Eclectic" means "*selecting what seems best from various styles, doctrines, ideas, methods, etc.*" (Collins English dictionary, 1991: 493), implying the use of various research methods is appropriate. Patton (1982) argued that a combination of the two types of methods would assist researchers interpret data from different angles. Mixing methods allows researchers to "*draw from the strengths and minimize the weaknesses of both in single research studies and across studies*" (Johnson and Onwuegbuzie, 2004: 14), by selecting what seems to be the best from various data-collecting and problem-solving methods (Reeves and Hedberg, 2003). According to Patton (1980) the paradigm of choices recognises that different methods can be applied appropriately where necessary, but the choice of a method is decided by the purpose of the research. It is this underlying pragmatic stance which characterises the belief system of researchers identifying themselves with this paradigm. Patton goes on to say that what is important for researchers is to make sure that what they do makes sense, and that they present a detailed report of how and what was done during the research, and the implications of the findings (Patton, 2002). It is important to note that whilst researchers can mix methods they cannot mix paradigms because of their differing ontological assumptions. Furthermore, although methods can be (and are) mixed, pragmatic researchers do not necessarily balance the methods used (Gorard and Taylor, 2004). Indeed, the research approach of a pragmatic researcher could be fully quantitative or fully qualitative, depending on what approaches are most suitable for answering the research questions asked.

"Eclectic - mixed methods - pragmatic paradigm" is a cumbersome name, and calling this paradigm the "mixed-methods" paradigm (e.g. as done by Johnson and Onwuegbuzie, 2004) gives the misleading impression that the paradigm is about methods rather than the researcher's beliefs. To avoid this confusion this paradigm will be referred to as the "pragmatic paradigm" in this study, as done by authors such as Mertens (2005).

The pragmatic paradigm allows researchers to use methods thought by some researchers to be either qualitative or quantitative, and to use both types of methods to collect data, as long as the data gathered answer the research questions. Although I have some positivist beliefs (e.g. there are situations where I believe there is a reality which can be measured) I do not believe they hold true in all educational contexts. There are educational contexts where different perceptions of reality are held by different people, as contended by the constructivist researchers. I cannot completely situate myself in either of the two traditional paradigmatic camps. I therefore align myself with the pragmatic paradigm, which permits researchers to do whatever is methodologically necessary to answer the research questions, and which does not restrict the way research is conducted.

4.3 RESEARCH DESIGN

According to Leedy (1989), before proceeding with research researchers must have in mind a plan which summarises the steps they intend to follow in gathering and interpreting data, such that the problem under investigation can be resolved. In research this plan is referred to as a "research design". Explaining

research design, LeCompte and Preissle (1993) point out that a research design, in general terms, includes determining the purpose of the research and questions that will guide the research, identifying the kind of information that will answer the research questions, and choosing appropriate strategies for gathering such information. According to Gay (1981) the research design should include a detailed presentation of steps the researcher is envisaging to take during the investigation, with carefully selected appropriate research instruments based on the nature and size of the sample that will be used in the research. In trying to show the importance of a research design to researchers, LeCompte and Schensul (1999) use a helpful analogy by pointing out that "*research designs are to researchers as road maps are to vacationers or blue-prints are to architects and contractors; they tell the investigator how to proceed*" (LeCompte and Schensul, 1999: 61).

A systematic planning and preparation phase was conducted before the actual research was carried out, as displayed in Figure 6 on the next page. This clearly illustrates how it preceded and led to the two main phases of the actual study.

The first thing that I did was to identify the research problem. The research problem in my study was two-fold (1) the difficulties teachers encountered when implementing the new South African school curriculum and (2) a serious smoking problem existing among young learners at secondary school level. In educational research the identification of a problem is crucial as it is "*at the very heart of every research project*" (Leedy, 1989: 45). According to Leedy (1989) the success of a research project is not only determined by identifying the research problem but ensuring the researcher's clear understanding of the problem. For researchers situated in the pragmatic paradigm the problem and research questions strongly influence the methods eventually chosen for the study.

In order to understand the research problem better I started an extensive literature review by reading journal articles and books relating to the problem. To understand how to deal with the first problem I read extensively on the new South African school curriculum, its requirements, and the problems encountered during implementation. I used this information to write Chapter 1 of this thesis. Since the Department of Education in South Africa expected teachers to teach in ways advocated by the new curriculum (and seemingly teachers were having problems implementing the new ways) I then read further on curriculum innovation, particularly on factors that cause the failure or success of curriculum innovations. The information that I gathered from this part of the literature assisted me in writing Chapter 3 of this thesis.

The next phase of the literature review was on smoking and smoking-related matters. I consulted medical journals and biology books dealing with health and social problems associated with tobacco smoking, to establish the seriousness of the problem. I read further on factors (personal and environmental) influencing onset of smoking, particularly in children because the teaching and learning package I was planning to develop targeted young learners. I also looked at the role played by the Government of South Africa in addressing the problem of tobacco smoking, and educational programmes put in place to deal with the problem at school level. The information I gathered from this phase of the literature review assisted me in writing Chapter 2 of this thesis. Whilst still on the topic of smoking and smoking-related matters I also looked at existing curriculum materials on smoking and started gathering potential materials to be included in the planned package, such as activities (because I envisaged an activity-based package). One of the objectives of the new South African school curriculum is to engage learners in activity-based lessons.

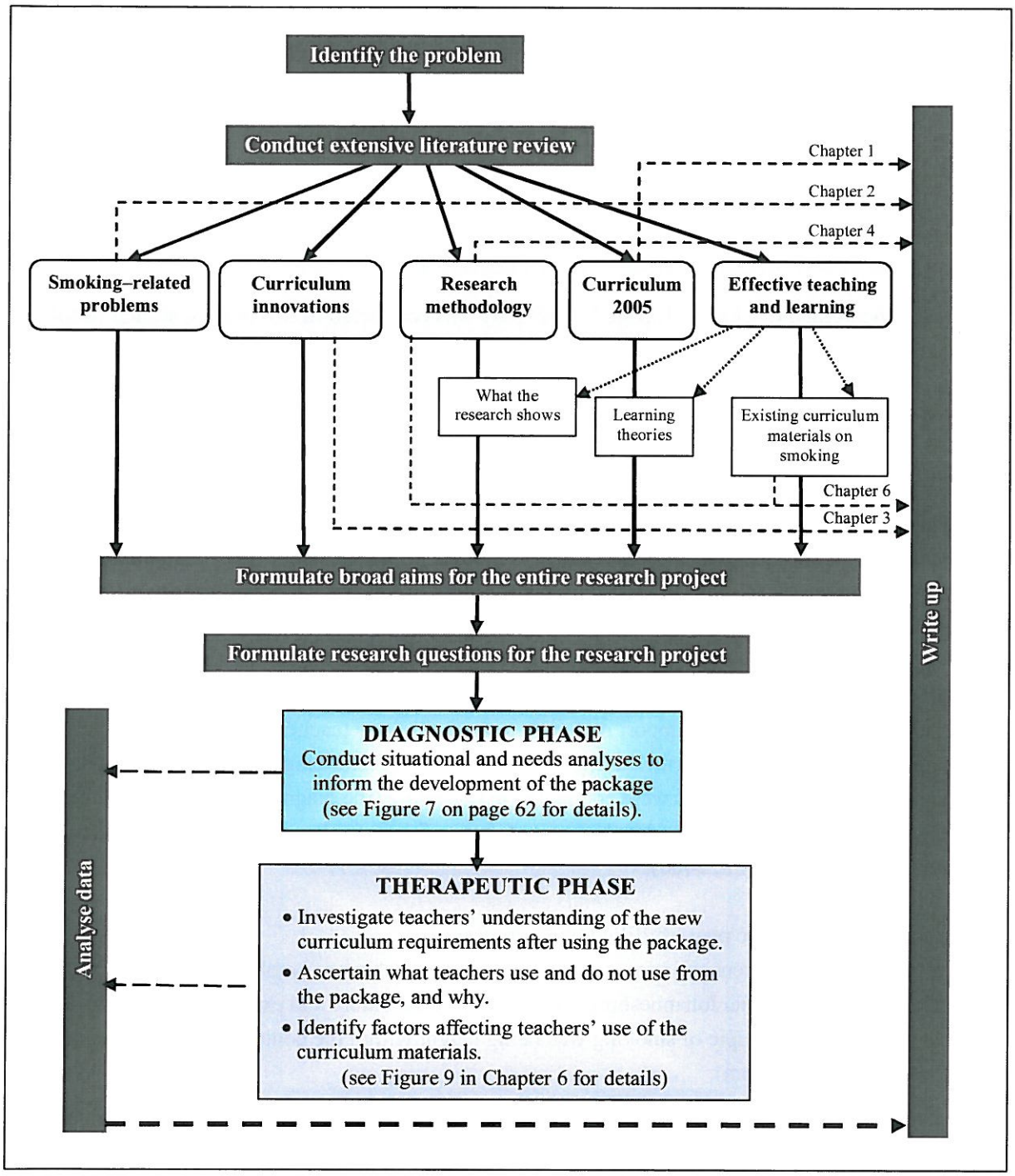


Figure 6: Flow-chart outlining aspects of the research design for the study, emphasising the preparatory stage

Since I had planned to come up with an intervention in the form of a teaching and learning package I had to look at what the literature says about effective teaching in order to get some strategies and ideas on how the topic on smoking and smoking-related matters could be taught effectively. Whilst still on the literature on effective teaching I looked at the learning theories because they examine various constructs about learning and how to use the constructs to promote effective learning (Kerlinger, 1986). The information gathered from this literature assisted me in writing Chapter 6 of this thesis.

The next phase of the literature review was to peruse literature on research methodology and in order to be able to identify an appropriate research approach to follow in this study, and to gather advice on designing data-gathering instruments. The review of this literature assisted me in formulating broad aims and research questions of this study, as well as planning the whole study, starting with the diagnostic phase.

4.4 THE PURPOSE OF THE DIAGNOSTIC PHASE

As already mentioned in Chapter 1, page 1, this study was conducted in two phases, similar to those in action research, and referred to by Cohen and Manion (1994) as the "diagnostic" and "therapeutic" phases. The rest of this chapter focusses on the diagnostic phase and the research methods used in this phase.

The term "diagnosis" is perhaps mostly common in medical situations, where it refers to *"the identification of diseases from the examination of symptoms."* However, the term is also used outside of this medical context to mean a *"thorough analysis of facts or problems in order to gain understanding and aid future planning"* (Collins English dictionary, 1991). In educational research the word "diagnosis" is used in this more general way.

The aim of the diagnostic phase in this study was to obtain research-based information that would inform the development of curriculum support materials to assist biology teachers make the changes required by the new South African school curriculum while teaching about smoking and smoking-related matters. A situational and a needs analysis were conducted in this phase (the diagnostic phase). Such situational and needs analyses are crucial in the development of successful curriculum materials (Joyce and Showers, 1988, cited by Johnson *et al.*, 2000).

In this study the diagnostic phase fulfilled two purposes,

- establishing the current situation with regards to the teaching of smoking and related matters by biology teachers in the Johannesburg area (including the nature and extent of smoking by learners as well as how the topic of smoking was being taught within the context of the changes required by the new curriculum).
- establishing the needs of teachers having to teach about smoking and related matters using the new approaches to teaching and learning advocated by the new South African school curriculum.

The reasons for choosing the topic on smoking and smoking-related matters were explained in Chapter 2.

4.5 RESEARCH QUESTIONS TO BE ANSWERED DURING THE DIAGNOSTIC PHASE

Although the research questions for the study were listed in Chapter 1 (page 23) the research questions for the diagnostic phase are repeated here for the reader to have a quick reference when looking at the research methodology in this chapter.

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 Question 1 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?

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 the human body?

The last question was asked to ascertain the need to provide content-based information in the package.

4.6 RESEARCH APPROACH

The research approach used in the diagnostic phase of this study was a survey. The word "survey" means "*to look or to see beyond the casual glance or the superficial observation*" (Leedy, 1989:141). Surveys involve finding information from a group of people about a particular topic or issue of interest (Fraenkel and Wallen, 1990). Bell (1987) points out that the main emphasis of surveys is on fact-finding. Surveys can be an inexpensive and quick way of obtaining information from entire populations or large samples (Coleman and Briggs, 2003) if they are well structured and piloted (McMillan and Schumacher, 1993).

Details of the research design for the diagnostic phase of this study are summarised in Figure 7 on the next page.

4.7 DATA-COLLECTING TECHNIQUES

In surveys various research instruments can be used to gather the data, for example (1) questionnaires, (2) interviews, or (3) checklists administered by the researchers (Bell, 1987; Fraenkel and Wallen, 1990; McMillan and Schumacher, 1993; Gall *et al.*, 1996; Coleman and Briggs, 2003). In this phase of the study data was gathered using questionnaires and interviews, as explained in the following sections.

4.7.1 The questionnaires

Questionnaires are data-collecting instruments used to obtain factual data, opinions or attitudes from respondents (Galfo, 1975; Best and Kahn, 1998). According to the literature on educational research, questionnaires were the most used data-collecting instruments (Galfo, 1975; Fraenkel and Wallen, 1990) at that time.

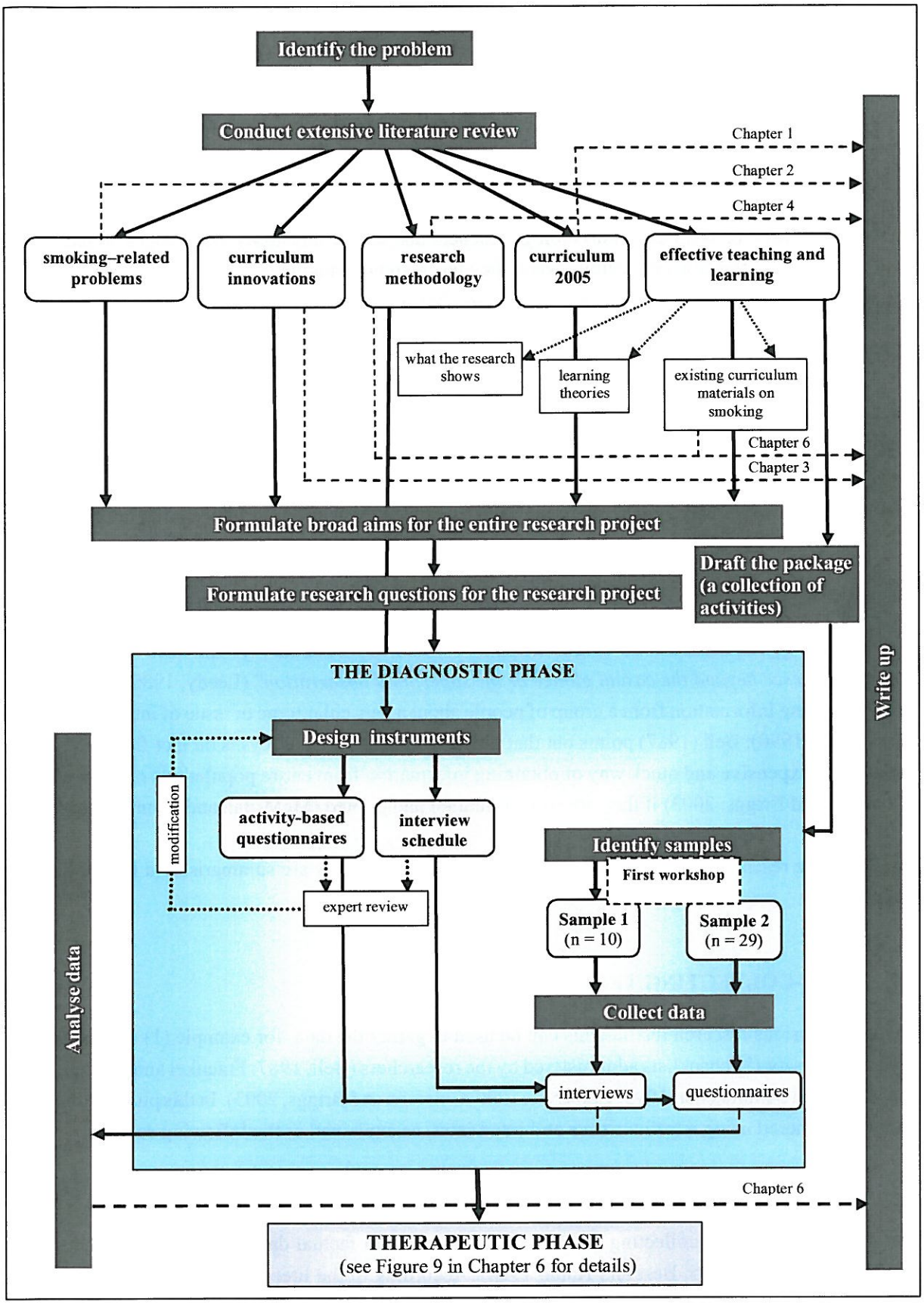


Figure 7: Expanded flow-chart showing details for the design of the diagnostic phase of the study

Advantages of questionnaires

Questionnaires have a number of advantages as data-collecting instruments.

- They are quick and easy to administer (Oppenheim, 1966; Gay, 1981; Gall *et al.*, 1996).
- They are suitable for large samples (Oppenheim, 1966; Gay, 1981; Gall *et al.*, 1996).
- They do not require expertise to administer (Oppenheim, 1966; Gay, 1981; Gall *et al.*, 1996).
- The researcher does not have to be there when participants are responding to the questions (Bell, 1993; Cohen and Manion, 1994). This allows people within an institution (e.g. teachers, if the questionnaire is administered to school children) to administer the questionnaire so that respondents are not aware that anything special is happening (e.g. will see it as a normal part of the lesson if administered at school). This avoids the possible validity problem of data being influenced by a "novelty effect".
- Data collected by means of well-structured questionnaires are usually easier and less time consuming to process in terms of data analysis than for other instruments (e.g. interviews) (Oppenheim, 1966; Vockell, 1983; Bell, 1993), which is important when the sample size is large.

Limitations of questionnaires and how they were dealt with in this study

Like other data-gathering instruments, questionnaires also have limitations. The following are the limitations of questionnaires:

- Questionnaires may "*present difficulties to respondents of limited literacy*" (Travers, 1969: 133), who may have problems following instructions or understanding the questions (Cohen and Manion, 1994). However, this was not an issue in my study because the questionnaires were issued to biology teachers, which ruled out the problem of illiteracy with regard to responding to the questionnaires.
- Unclear, or seemingly ambiguous questions, cannot be clarified by the absent researcher, and the respondents have no chance to elaborate on, or react verbally to, a question of particular interest or importance (Oppenheim, 1966; Fraenkel and Wallen, 1990). However, in my study I was present, and could have elaborated had there been questions.
- There is no flexibility in questionnaires. For example, the researcher cannot decide to change the sequence of questions during the administration of the questionnaire, or probe further (Oppenheim, 1966; Vockell, 1983; Cohen and Manion, 1994).

Designing good questionnaires

Numerous authors point out that designing a good questionnaire is not as simple as one might think (Oppenheim, 1966; Tuckman, 1978; Sanders, 1995; Gall *et al.*, 1996; Opie, 2004). A lot of planning and preparation is crucial when constructing a questionnaire, because poorly constructed questionnaires often affect the reliability and validity of data collected (Oppenheim, 1966; Gall *et al*, 1996). Before constructing a questionnaire one has to think about what it is that needs to be achieved from the data that is going to be collected (Gall *et al.*, 1996), followed by brainstorming of questions to be asked (Oppenheim, 1966; McMillan and Schumacher, 1993; Gall *et al.*, 1996). Consultation of experts before and during the development of questionnaires is also very important as valuable assistance can be

obtained from them, for example, whether the wording is unambiguous or not, and whether the sequencing of questions is logical (Oppenheim, 1966).

Based on a review of the research methodology literature a set of guidelines for designing good questionnaires can be obtained.

- Questionnaires should be as short as possible, and only long enough to get the essential data (McMillan and Schumacher, 1993; Gall *et al.*, 1996; Best and Kahn, 1998). According to Fraenkel and Wallen (1990) long questionnaires may discourage respondents from completing them, resulting in low returns.
- Ensure the questionnaire is free of grammatical errors and spelling mistakes as this can be confusing to respondents (McMillan and Schumacher, 1993).
- Avoid the use of abbreviations (McMillan and Schumacher, 1993) because there is no guarantee that all respondents are aware of what they stand for.
- Questionnaires should be attractive in appearance (e.g. use brightly coloured paper), neatly arranged and clearly duplicated or printed using a good printer (Gall *et al.*, 1996; Best and Kahn, 1998), as this improves the appearance of the questionnaire and attracts the respondents (Frary, 1996).
- It is advisable to have a logical sequencing of questions and to group related items together (McMillan and Schumacher, 1993; Best and Kahn, 1998).
- Researchers should avoid biassed or leading questions (Gall *et al.*, 1996), because this may lead respondents to answer questions in a way that is suggested by the questions (Bell, 1987).
- Researchers should avoid "double-barrelled" (two questions in one) questions "*that require the subject to respond to two separate ideas with a single answer*" (Gall *et al.*, 1996: 294). According to McMillan and Schumacher (2001) respondents may be confused by this type of question and end up giving conflicting responses.

The literature on educational research reveals that there has been a long debate on which type of questions are best to use in questionnaires (Neuman, 1994). A questionnaire can be used to collect "*both closed and open-ended information from a widespread sample*" (Gall *et al.*, 1996: 292). This implies that researchers can choose question types when constructing a questionnaire, depending on the kind of data they want to collect.

With open-ended questions respondents are asked to give their own answers to the questions and to write them in the space provided in the questionnaire (Oppenheim, 1966; McMillan and Schumacher, 1993; Neuman, 1994; Best and Kahn, 1998). The main advantage of open-ended questions, as Oppenheim (1966: 41) suggests, is "*the freedom that it gives to the respondent.*" The respondents are free to let their thoughts "*roam freely, unencumbered by a prepared set of replies*" (Oppenheim, 1966: 41). The common disadvantage of free-response questions is that though they are easy to ask, they are time-consuming to answer, and for the researcher they are more difficult to analyse and interpret than closed-ended questions (Oppenheim, 1966; Tuckman, 1978;Best and Kahn, 1998).

Close-ended questions involve respondents being given options to choose from, or involve them in writing limited short responses (Oppenheim, 1966; Neuman, 1994; Best and Kahn, 1998). The advantage of using closed-ended questions is that they are easier to code than open-ended questions (Neuman, 1994; Best and Kahn, 1998). The disadvantage of using closed-ended questions is that they can suggest ideas that the respondent would not otherwise have so that respondents might answer questions when they have no opinion or knowledge of the answer (Neuman, 1994; Best and Kahn, 1998). Neuman (1994: 232) argues that it is not a case of which form is the best, and that the "*researcher's choice depends on the purpose and the practical limitations of a research project.*"

Designing the questionnaires for this study

The information on how to develop good questionnaires and appropriate formats to use in questionnaires assisted me in constructing (from scratch) my own questionnaires for this study. The data I needed to answer my research questions were complex and unusual, and I found no existing instruments which I could use. An novel type of questionnaire was used in this study, referred to as "activity-based questionnaires" by Mashalaba and Sanders (2003). They can be used during in-service workshops for teachers to serve a dual purpose, (1) as an activity in the workshop to encourage active participation and reflective thinking of the teachers present, and (2) to gather research data. These data-collecting instruments are classified as "questionnaires" because they were paper-based, and involved the respondents answering questions in writing. However, the manner in which they were used was not the traditional questionnaire situation. Each provided a written record of some activity in which teachers at the workshop were involved, either after individual reflection or based on group discussions. In several cases they served as stimulus materials for some activity designed to get the teachers thinking critically about some particular aspect of their teaching context or practice.

In order to avoid long, time-consuming and sometimes boring questionnaires, six short activity-based questionnaires [see Appendix D] were developed, as summarised in Table 7 on the next page. Each activity-based questionnaire was designed in such a way that the information gathered assisted in answering the research questions guiding the current study. The information gathered from the six questionnaires was also later used to inform the development of a teaching and learning package meant to assist biology teachers change their way of teaching to that required by the new curriculum, whilst teaching about smoking and related matters.

The questionnaires were face-validated before they could be used. Although I discuss aspects of validation in various places in this chapter as I explain how my instruments were developed, a more extensive explanation of validity and reliability is provided in section 4.10, "Improving rigour", starting on page 81. Face validity involves checking by an "expert" (for example, by a research methods expert) to judge whether the instruments are likely to measure what they are designed to measure (Bell, 1987; Gall *et al.*, 1996), so they can make suggestions for how the instruments could be improved.

Table 7: Overview of the activity-based questionnaires

Questionnaire	What the questionnaire checked	Purpose of the questionnaire	How questions were asked	Research question addressed
Using curriculum packages	• The extent to which teachers have previously used support materials. • How they used them (with modifications or without modifications). • Likelihood of teachers using everything or parts of the package, and reasons for doing so.	To decide on a suitable format for the package depending on likely usage.	A combination of closed and open-ended questions.	2
The main demands of *Curriculum 2005*	Teachers' knowledge of the main requirements of the new curriculum.	To find out if there is need to include a section on the new requirements in the package.	An open-ended question.	1c)
Diagnostic questionnaire on content knowledge	Teachers' content knowledge on the effects of smoking on the human body.	To decide whether background content should be included in the package.	A combination of closed-ended questions (table completion, Likert scale, and diagram annotation) and open-ended questions.	3b)
Smoking situational analysis	• Teachers' attitudes to smoking. • The smoking situation (learners) at the school. • How the school deals with this situation. • Questions for smokers	• To help teachers see the potential relevance of having an educational programme to deal with the issue. • To establish information on the current situation.	A combination of closed and open-ended questions.	1a)
What teachers want to know more about (on smoking and smoking-related issues)	Aspects where teachers wanted more information.	To decide what to include in the package.	An open-ended question.	3a)
What teachers want in the package	• Areas where teachers thought, after discussions during the workshop, they needed help. • Which teachers would be interested in trialing the package once it was completed.	To identify areas where teachers needed help in order to develop a package that would attempt to address their needs.	An open-ended question.	3a)

In this study I asked an English first-language person (who happened to be my supervisor), to face-validate the instruments before they were used to collect the data. She was considered an research methods expert because of her long engagement in research-related matters and her level of knowledge in such matters. She was the first person to run a Masters topic in Science Education at this university (in 1986), had chaired the committee investigating the structure of the Masters in Science Education degree started at this university in 1988, ran the "Research methods and design" course for this degree for a number of years, and has facilitated numerous methods-related workshops both nationally and internationally. She has successfully supervised more than 40 post-graduate research students. She checked the instruments to assess whether

- the questions were likely to obtain answers to the research questions in this study,
- the instructions for completing the questionnaires were clear and unambiguous,
- the questions asked were simple and easy to understand, and
- the language and grammar were correct.

For the questionnaires designed to assess teachers' content knowledge on smoking (as part of the needs analysis), this expert also checked content validity, by assessing whether the questionnaire adequately covered the content knowledge on smoking and related matters the teachers might be expected to know if they taught this section of work. Content validity and construct validity are explained in more detail in sections 4.10.

I made corrections based on the feedback given to me. This process of receiving feedback and making corrections was repeated until both the expert and myself were satisfied with the questions and the design of the questionnaires.

Although it is strongly advised that instruments be piloted to improve rigour in research, the timing of the instrument construction relative to the "immoveable" date for the workshops, made piloting the questionnaires impossible. However, as mentioned in Chapter 1, section 1.4, I was part of a research group engaged in a community of practice. It comprised several staff members and up to ten teachers at any one time doing post-graduate studies in science education. My research peers were all biology teachers doing part-time studies in science education, and several of them did look at the instruments while they were being developed, and gave me feedback. However, this was not an official pilot study. This limitation is discussed further in Chapter 8.

Administering the questionnaires

The questionnaires were administered to teachers attending an in-service workshop, as explained in section 4.8. The workshop facilitator ran the workshop and my role at the workshop was to ensure that the questionnaires were administered and the necessary data gathered. The facilitator explained to the teachers that the workshop was part of a research project aimed at developing a teaching and learning package to assist teachers make the changes required by the new South African school curriculum whilst teaching about smoking and smoking-related matters. The facilitator pointed out that the workshop provided a forum for teachers to discuss matters relating to the new curriculum, as well as matters relating to teaching about smoking. A major aim of the workshop was for teachers to explain what help they needed in this regard. The workshop facilitator pointed out that the participation of the teachers in the workshop would help develop a package which would help them by addressing their needs. Teachers were offered a chance to trial the materials in their schools once the package was completed.

The thirty-two teachers who attended the workshop were invited to (1) share ideas about how they were teaching the section on smoking and related matters, (2) comment and make suggestions on the collection of activities (draft package) on smoking and related matters so that it suits their needs. During the workshop participants were asked to fill in the activity-based questionnaires (as reported in a subsection of section 4.7.1 on page 67). The usual ethical practices spelled out by the university's Ethics Committee for Human (non-medical Research were followed. We asked permission to use the filled-in

questionnaires for research purposes. Participants were assured of anonymity and confidentiality. We promised them that their names would not be mentioned in the research report. Participants were not asked to write their names on the questionnaires except in one questionnaire where we needed contact details of teachers who wanted to trial the package once it was completed so that we could contact them.

4.7.2 The interviews

I used interviews in my study to get in-depth information from teachers which could not be obtained from brief questionnaires.

Interviews in research involve gathering data through direct verbal interaction between the interviewer and the interviewee (Cohen and Manion, 1994). They differ from questionnaires in that with the latter respondents are required, in some way, to write down their responses.

Advantages of using interviews

- Interviews can serve some purposes which other instruments (like questionnaires) cannot achieve. For example, they can gather data from young children and illiterate people (Fraenkel and Wallen, 1990; McMillan and Schumacher, 1993) or second-language scholars. Young children can understand and communicate much better in spoken than written language (Seddon *et al.*, 1990), whilst second-language scholars are also likely to be able to explain their ideas more effectively in an interview situation than in writing, especially if they are allowed to use their mother-tongue (Mokuku, 1993).
- Interviews allow the respondent and the interviewer to ask for clarifications (Vockell, 1983; Fraenkel and Wallen, 1990; Babbie, 2005). If respondents do not understand what they are asked they have the opportunity to ask for clarification from the interviewer. In the same way if interviewers do not follow what the interviewee is saying, they also can ask for clarification from the interviewee. This is crucial because it improves the chances of obtaining valid information from respondents, which helps the researcher to make more valid claims based on the data.
- Unlike questionnaires, interviews allow the researcher to probe responses for more detail (Mouly, 1970; Dyer, 1979; Gay, 1981; Bell, 1987). This means that if interviewers feel that the interviewee is withholding some information they can probe for more. In this way it is possible to obtain data which is less likely to be accessed in a written format.
- Interviews allow for the observation of behaviours made by the respondent, for example, signs of evasiveness, anger, embarrassment, uncertainty or non-cooperation, which a questionnaire can never do (Mouly, 1970; Bell, 1987; Babbie, 2005). This is an advantage to researchers because they will be in a position to determine whether responses by the respondent have been affected by those factors, and decide whether to accept the information as part of the data collected because such data may affect both reliability and validity.
- Incompleteness of returns is rarely found when data are collected by interviews (Travers, 1969; Babbie, 2005). Obtaining data from all respondents allows for generalisations of the findings (if the sample is large enough) as the sample is less likely to be biassed.

Limitations of interviews

Like any other data-collecting instrument, interviews also have limitations.

- The primary disadvantage of interviews is their potential for subjectivity and bias (Gay, 1981; McMillan and Schumacher, 1993; Yin, 1997; Coleman and Briggs, 2003). This can affect the validity of data collected and claims made by the researcher about the population from which the sample is drawn.
- Unlike questionnaires, interviews are time-consuming to conduct (Bell, 1987; Fraenkel and Wallen, 1990), transcribe and analyse (Sanders and Mokuku, 1994).
- The presence of the researcher may inhibit responses from respondents so that they do not say what they really think (Fraenkel and Wallen, 1990, 1994; Coleman and Briggs, 2003). It is vital that the researcher collects valid data otherwise it will be a waste of time conducting interviews. Researchers need to find a way of alleviating respondents' fears when they conduct interviews.
- Interviews require a level of skill usually beyond that of beginner researchers (Gay, 1981; Fraenkel and Wallen, 1990). A warning to first-time researchers is that formulating questions is not as easy as it seems (Leedy, 1989; Bell, 1993) and that careful piloting is necessary to ensure that all questions mean the same to all respondents (Bell, 1993). Fraenkel and Wallen (1990) advise beginner researchers that it is better to exploit existing instruments because such instruments are usually prepared by experts who possess the necessary skills. Leedy (1989:148) argues that interviews should be "*considered as professional situations that demand equally professional planning and conduct on the part of the interviewer.*"

It is important to train beginner interviewers as they need to have the basics in interviewing, for instance, to establish rapport with their interviewees and put them at ease; to know when and how to "follow up" on unusual answers or those that are ambiguous; to be aware of certain gestures, manner and facial expression — such as a frown at the wrong time being discouraging for respondents who then may not even attempt to answer the question (Fraenkel and Wallen, 1990).

The type of interview used in this study

Interviews may be structured, unstructured, or semi-structured. Structured interviews involve planning and development of carefully worded questions before interview sessions (Cohen and Manion, 1994; Coleman and Briggs, 2003). The questions are done in advance in the form of a schedule which the interviewer may not change, either by adding probing questions (Gay, 1981) or by changing the sequence of questions (Cohen and Manion, 1994). This lack of flexibility is a serious limitation in an instrument well-suited to probing.

With unstructured interviews there is "*flexibility and freedom*" (Cohen and Manion, 1994: 273). According to Gall *et al.* (1996) unstructured interviews do not require a detailed schedule. They point out that interviewers ask questions that would eventually lead interviewees to give the information that is desired. In this type of interview interviewees are allowed the freedom of saying a lot, but these interviews require some skill from the interviewers to make sure that focus is maintained (Cohen and Manion, 1994; Coleman and Briggs, 2003). According to Gall *et al.* (1996: 311) this type of interview is "*highly subjective and time consuming*", which is a limitation for researchers.

Unlike structured interviews, semi-structured interviews are flexible, in that interviewers need not strictly follow the sequencing in the interview schedule (Opie, 2004), if the interviewee has already given the desired information. Furthermore, semi-structured interviews allow interviewers to probe further for clarification. This is the type of interview I used in this study because of its benefits and lack of limitations.

Development of the interview schedule for this study

In this study I had to develop an interview schedule from scratch because there were no existing interview schedules to adapt. I drafted some interview questions bearing in mind what kind of information I was looking for in order to answer my research questions (see Appendix E for the interview schedule). Thompson (1978) advises researchers to design questions that are related directly to the purpose of the study and that can yield the kind of information desired.

The fact that I developed interview schedules during my Master's degree course and the fact that an expert in research methodologies gave useful guidance, made things easier for me when designing the interview schedules for this study. I was aware that it is not easy to conduct interviews and that it requires experience to master the necessary skills. Posner and Gertzog (1982) point out that

> "*... nearly every experienced interviewer emphasises that interviewing skills can only be developed by conscious effort over an extended period of time.*"
>
> (Posner and Gertzog, 1982: 198).

Because of the importance of developing interviewing skills, I participated (during my Master's degree) in a short course on interviewing. I went through an extensive preparation on interview techniques. This included reviewing the literature and drawing up guidelines of the "do's" and "don't's of interviews. Participants in the course then prepared interview schedules based on what they had learned, and were video-taped conducting short interviews. The rest of the participants were observing so that they could pick up weaknesses and strengths of the interview. The subsequent televised playback of the individual interviews was followed by discussion involving first a self-critique and then constructive feedback from peers and the course lecturer. This exercise was very helpful in knowing how to prepare and conduct interviews. In addition to the short course, I had conducted interviews for my Master's research, which allowed me to practise my research skills. In preparation for this study I re-looked at what the literature on the development of interviews suggests researchers do when developing interview schedules and conducting interviews (see Table 8 on the next page).

The interview schedule I designed was of a semi-structured nature [see Appendix E]. It was developed (1) to establish the content teachers taught when dealing with the section on smoking and (2) what they say with regards to the requirements of the new curriculum when teaching about smoking. This information was essential in order to identify areas where teachers needed help.

Table 8: Advice on what to do when preparing for and conducting an interview

	Advice	Reasons	References
Getting started	• Define the purpose and objectives of your study and translate them into main questions of the interview schedule.	• To determine the type of the interview and questions in order to eventually gather data that will address your research objectives. • To avoid formulating questions not related to the objectives of your study because they are not going to generate useful data.	(Fraenkel & Wallen, 1990; Gall *et al.*, 1996; Cohen & Manion, 1994)
Wording effective questions	Questions should be phrased in such a way that language familiar to the respondents is used. and should avoid complex words and leading statements.	To avoid confusing interviewees as this might give responses that may have serious validity problems.	(Oppenheim, 1966; Borg & Gall, 1983; Fraenkel & Wallen, 1990).
	Questions should be made simple, clear and understandable.	To avoid ambiguity which could result from long and complex questions.	(Cohen & Manion, 1994; Gall *et al.*, 1996; Bell, 2005)
	The order of sequence of the questions is important. Start with easy, impersonal questions. It is also better to start with factual questions before looking at questions involving attitudes.	To create a relaxed atmosphere for the interview session.	(Oppenheim, 1966; Cohen & Manion, 1994; Gall *et al.*, 1996)
Piloting	Check the following: • communication problems. • clues for a need to rephrase some questions. • threatening questions.	• To ensure that there are no flaws in design, and that reasonably unbiased data will be gathered. • To eliminate any ambiguous, confusing or insensitive questions that might reduce the validity of data collected.	(Borg & Gall, 1983; Fraenkel & Wallen, 1990; Gall *et al.*, 1996)
Gaining access	Make sure you abide by research ethics. • seek informed consent from participants • ensure anonymity and confidentiality	To ensure that participants' rights are observed.	(Cohen & Manion, 1994; Bell, 2005)
	Invite only people who possess the desired information, and are willing to be interviewed.	There is danger of gathering invalid data from people who participate against their will.	(Fraenkel & Wallen, 1990; Cohen & Manion, 1994;)
	Make an effort to get a commitment of cooperation from the participants.	To avoid having to look for more participants in case some decide to pull out at the last minute.	(Gall *et al.*, 1996)
Conducting the interviews	Explain to the interviewees the purpose and significance of the study, why you wish to interview them, what will be involved and what you will do with the information.	To ensure that interviewees see the importance of their responses.	(Galfo, 1975; Bell, 2005)
	If you wish to use a tape recorder during the interview, ask permission from the interviewees.	Not all interviewees will be willing to be recorded.	(Gay, 1981; Bell, 2005)
	In circumstances where an interviewee does not understand a particular question, rephrase it without changing the meaning	To make sure that interviewees understand the question before giving a response.	(Bell, 1987)
	You must probe or ask for clarification in cases where the interviewee gives an ambiguous response or does not go far enough.	To gather clear, in-depth information for validity purposes.	(Oppenheim, 1966; Cohen and Manion, 1994)

The interview schedule consisted of a number of main questions arranged in a particular sequence. The sequencing of questions did not matter much because of the flexibility of this type of an interview schedule (as explained earlier). For each main question a reason why the question was asked, was stated as a reminder to me as the researcher. Each main question was followed by pre-planned potential probing questions, in the interview schedule, in case more information or clarification was required from interviewees.

My supervisor again performed the face-validation task as the instrument was developed, in this case the interview schedule. She checked that

- the questions were likely to obtain data which could be used to answer the research questions in this study,
- the wording of the questions was clear and unambiguous,
- the sequencing of the questions was logical.

I made corrections based on the feedback given. The process of getting feedback and making corrections was done until we were both satisfied that the schedule was ready to be used. This exercise was done to improve validity in this study (see section 4.10 for details on the issues of validity).

Conducting the interviews

The interview sample for the diagnostic phase of the study, and how it was chosen, is explained in section 4.8 under the heading "Sample 1". The first thing that I did after identifying the sample was to set up interview appointments. We (myself and the teachers) agreed on dates, time and venue for the interview sessions. I noted this information in my diary for reference. All the interview sessions were conducted at the interviewees' workplace. The interview sessions did not interfere with the day-to-day teaching at schools.

At the start of every interview session conducted I first acknowledged the willingness of the interviewees to participate in my study, and then explained the purpose of my study, as explained in the letter of invitation mentioned in section 4.8. Before conducting the interviews I asked permission, from the interviewees, to use a tape recorder, and whether I could use the information from the interviews in my study. I assured the interviewees that their names would not be mentioned in the research and that the information gathered would be used strictly for research purposes. None of the teachers had a problem with the use of a tape recorder, and the information being used for research purposes.

I conducted the interviews and tape recorded them, probing where responses from the interviewees were unclear. At the end of each interview I thanked the interviewees. All went well except for one case where one teacher did not honour an appointment and we had to reschedule the interview session.

4.8 SAMPLES

It is common knowledge that in educational research researchers seldom investigate entire populations, but select smaller samples of individuals for the study they intend to carry out (Gall *et al.*, 1996). Leedy (1989: 152) points out that sampling is appropriate "*wherever large populations that have an outward semblance of homogeneity are to be investigated*". In order to generalise results from the sample a random selection to the population should be done in such a way that "*the characteristics of each of the units of the sample approximate the characteristics of the total population*" (Leedy, 1989: 153). However, in education research researchers usually want to look at a particular group and they often use convenience sampling. Convenience sampling involves selecting the sample because it is readily available or is the nearest to serve as respondents (Cohen and Manion, 1994; Gall *et al.*, 1996). Researchers using convenience sampling have to be more cautious about generalising from their samples because there is no guarantee that the sample is representative of the bigger population from which it was taken.

The samples in my study were convenience samples because I wanted to work with teachers who were teaching about smoking and smoking-related matters, and whose schools were close to the university. In the diagnostic phase of this study there were two linked samples involved (as indicated in Figure 7 on page 67), which I will refer to as Sample 1 and Sample 2.

Sample 1: Teachers who had already taught the section on smoking

Sample 1 consisted of biology teachers in and around the Johannesburg area who were already teaching about smoking and smoking-related matters. I wanted to talk to the teachers about their understanding of the requirements of the new South African school curriculum, and how they were applying these requirements when teaching about smoking and related matters.

In Gauteng province there are many teachers, some geographically far away from the university. I needed to target schools that were close to the university for convenience. This would allow me to visit the schools without serious worries about costs and transportation. Teachers would also easily be able to come to the university for the workshops. I therefore asked the Gauteng Department of Education for a list of schools in the Johannesburg area and they recommended four geographically close districts, and sent me a list of schools in the four districts.

After receiving the list of schools I sent invitation letters (together with a reply form) to natural science and biology teachers, in all schools in these four districts, 219 schools in total, inviting them to participate in my study [see Appendix I]. I included a covering letter to the principals of the schools [see Appendix H]. In the covering letter I asked the principals to draw the invitation (and reply form) to the attention of all Natural Sciences and Biology teachers at their schools as soon as possible because there was a deadline for replies. I used stamped reply envelopes to improve chances of returns. I was advised by one senior official in the Gauteng Department of Education to use the districts' mailing system[5] as a

[5] The head office in the city centre receives mail for the school districts. The mail is sent to school district offices where it is checked by the district director before it can be put into pigeon holes of individual schools. Then the principal of each school has to come every day to collect mail for the school. In case the principal is not available, the deputy must collect mail for the school.

convenient and fast mechanism to distribute the invitations. The invitations were placed in pigeon holes of the four school districts by the Gauteng Department of Education mail distributer at the head office. A note was addressed to the mail distributer [see Appendix G] informing him that permission had been granted by the Gauteng Department of Education for me to use the district pigeon-holes to distribute notices to the four school districts and to ask him to distribute them as soon as possible.

In the reply form [see Appendix I] I asked for teachers' contact details; whether they were teaching about smoking and in which grades; how long they spent on the topic; and at what time of the year they usually teach the topic. This information was needed so that I could fit my research schedule around their teaching work. Fifty-nine teachers returned the form to me either by mail or fax. Twenty-five of the 59 teachers had already taught the section on smoking. I then telephoned these 25 teachers and asked if they were willing to be interviewed. Only ten out of these 25 teachers said they were willing to be interviewed, and I set up interviews with these ten teachers. They became Sample 1.

Sample 2: Teachers who were keen to participate in the development of the package

Three months after sending the first invitation and analysing data from the interviews another invitation [see Appendix J] was sent to all schools in the four school districts. Natural Sciences and Biology teachers were invited to a workshop on meeting the requirements of the new curriculum while teaching about smoking. Forty-six teachers booked for the workshop, although only thirty-two of these teachers eventually attended the workshop[6]. Out of the thirty-two teachers only 29 submitted their activity-based questionnaires for purposes of my study. This was their right, as had been promised when the project was explained to them. They became Sample 2. Sample 2 therefore consisted of teachers voluntarily attending a workshop to hear about ideas on how to handle the section on smoking in a classroom situation while addressing the requirements of the new curriculum, and to see materials on smoking and related matters that had been collected for the package being developed.

There was an overlap in Sample 2 as some participants from the first sample were also part of the second sample. The 59 teachers who had responded to the first invitation indicating they wanted to get involved in the research (including the few who had participated in the interview sessions, as explained in Sample 1) were sent individual invitations by fax [see Appendix K]. The invitation included a map to direct participants to the venue where the workshop was held.

4.9 DATA ANALYSIS

McMillan and Schumacher (1993) point out that it is difficult to interpret data unless one organises them, and organising and interpreting data is referred to as 'data analysis'. Data analysis depends on the kind of questions asked and the information gathered from them, and the kind of questions asked are influenced by the type of research a researcher undertakes (Coleman and Briggs, 2003; Babbie, 2005). In this study data gathered from the activity-based questionnaires were analysed in two ways. Data gathered from close-ended questions were analysed by doing frequency counts. For open-ended questions

[6] We have found that approximately 20% of teachers booking to attend workshops do not arrive, even after careful instructions on how to get to the venue, provision of maps, and telephonic reminders.

where respondents had provided more detailed answers trends emerging from the answers were clustered and put into categories (open coding, as explained below), followed by frequency counts.

Data gathered from interviews are usually transcribed into text data, followed by open coding. According to Strauss and Corbin (1990: 16) open coding is "*the process of breaking down, examining, conceptualizing and categorising data*". This type of coding is used in coding data generated by open-ended questions. Other authors (e.g. McMillan and Schumacher, 1993, and Creswell, 2012) explain coding as the process of dividing and labelling text to form descriptions and broad themes in the data.

In this study data gathered from interviews were initially organised into categories and patterns derived with the guidance of research questions and the interview schedules. McMillan and Schumacher (1993) label categories developed with the guidance of research questions, the structure of the research instrument, prior knowledge from field experience, or categories found in the literature, as 'predetermined categories'. Unlike the case with the open-ended questions from the activity-based questionnaires mentioned earlier, where there were no predetermined categories, the analysis of the interviews started with predetermined categories and identified sub-categories, and checked for them in the transcripts. McMillan and Schumacher (1993) point out that predetermined categories are only starting points and "*must be provisionally applied and refined*". As new trends emerged from the transcripts they were added to the coding system already developed, which was refined using open-coding methods, as more and more transcripts were analysed.

What followed next was checking inter-coder reliability, which is a measure of agreement among multiple coders for how they apply codes to text data (Kurasaki, 2000; Lombard, 2004). Kurasaki (2000) argues that researchers who use text data are likely to make errors throughout the complex task of coding text data, and that experienced coders should be used to check inter-coder reliability. Once again my supervisor (an experienced researcher) was asked to check the appropriateness and accuracy of the categories identified from the interview transcripts. Where we had allocated different codes we discussed discrepancies until the problem was identified and an agreement was reached. Kurasaki (2000: 179-180) points out that an agreement between coders "*demonstrates that the themes are shared constructs and not simply a figment of the investigator's imagination*". The expert was also called on to check the frequency counts once the data had been analysed, also an aspect of improving reliability of data and hence validity.

4.10 IMPROVING RIGOUR

The interpretation of data is crucial in educational research because, as Sanders and Banda (1997: 12) point out, "*classroom practitioners rely on educational researchers to find more effective methods of teaching and learning science subjects*". If teaching policy and practices are going to be changed based on research, it is essential that the quality of the research is not in doubt. It is therefore vital that researchers ensure that their research is sound and trustworthy (Cohen, Manion and Morrison, 2000). Different terms are used in the research literature to define the criteria of robustness, but the most common are 'validity' and 'reliability'. Guba and Lincoln (1983) proposed alternative terms for use in qualitative research, and these terms are used by some authors (e.g. Marshall and Rossman, 1989). However, the terms 'validity' and 'reliability' are still widely used for discussing qualitative research in

research methodology textbooks (e.g. Cohen *et al.*, 2000; Creswell, 2012), even books that are exclusively devoted to qualitative designs (e.g. Silverman, 2004). Mellor (2001, 474) cites the opinion of Scheurich (1996) that while post-positivists are *"quite willing to dump conventional science* [they] *continue to cherish the associated notion of validity* [and] *they will not leave home without it*". Lenzo (1995: 17) says that the transition of terms is not a "*coherent, linear progression of the validity discussion in which old forms are discarded in favour of new ones. Traditional validity criteria in fact co-exist with newer criteria*". Hubley and Zumbo (1996) talk of modern conceptions of validity, but they still use the term 'validity'. For all these reasons I have therefore used the terms "validity" and "reliability" in the following discussion.

4.10.1 Improving reliability

According to Gay (1981: 116) the term reliability is used to refer to "*the degree to which a test consistently measures whatever it measures*". Fraenkel and Wallen (1990) refer more generally to reliability as the consistency of the inferences researchers make based on the data they collect, expanding the meaning to go beyond the measurement in "tests" which typifies positivist research. Gay (1981) points out that a reliable instrument does not necessarily mean that it is valid, as it can consistently measure the 'wrong thing', but if the test is valid and reliable it repeatedly measures the 'right thing'. There are many factors that affect reliability (Gay, 1981; Creswell, 2012), some of which researchers can control to improve reliability, such as the characteristics of the test itself. For example, the process of **face-validating** instruments can reduce the ambiguity of test items and poorly worded instructions which might cause administrative problems (e.g. directions not properly followed), and this can improve the **reliability** of tests. However, other factors which can affect reliability are beyond the control of the researcher, such as the condition of the participants taking the test (e.g. tiredness; lack of motivation; time of the day, etc.). Furthermore, reliability is also affected if respondents guess answers in a random fashion which is not replicable if the instrument is used a second time with the same group.

In typically "quantitative" instruments which are longer, and use homogenous item types, reliability coefficients can be used to calculate the level of reliability of an instrument when used in a particular context, using methods such as split-half reliability or applying a formula such as Kuder Richardson which checks for internal consistency of the instrument. But the heterogeneous nature of the questions in my questionnaires prohibited such calculations. In my study three things were done to improve reliability: i) face-validation of the instruments to enhance reliability, ii) taking steps to motivate the teachers before they completed questionnaires or were interviewed, so that they answered with commitment, and iii) inter-coder reliability checks, as explained above.

4.10.2 Improving the validity of the research findings

Validity refers to "*the degree to which evidence supports any inferences a researcher makes based on the data he or she collects using a particular instrument*" (Fraenkel and Wallen 1993:139). Many writers (such as Gay, 1981) define validity as the degree to which an instrument ascertains what it claims to check, but this is only one aspect of validity. The second aspect in Fraenkel and Wallen's definition above is perhaps more important, the extent to which inferences from the data are accurate or appropriate. Validity is not a fixed value for an instrument, and varies in different contexts and with different groups (Cohen *et al.*, 2000).

Research methodology textbooks typically list more than ten terms describing validity. However, Gall *et al.* (1996: 249) argue that validity is a "*unitary concept*", and other authors suggest that the named types of validity (e.g. face validity, convergent validity, discriminant validity) are just different ways to gather evidence about validity (Gay, 1981; Gall *et al.*, 1996), based on either logical or empirical arguments (Gay, 1981). The following descriptions differentiate between two major types of validity relevant to my study.

- *Content validity* determines the extent to which an instrument like a test measures a representative sample of the subject matter, and is determined by systematic examination of items included in the instrument (Vockell, 1983; Fraenkel and Wallen, 1993; Cohen and Manion, 1994). This means that content validity is concerned with the completeness with which the data elicited covers the area being explored. Gay (1981) points out that content validity requires both "item" validity and "sampling" validity. According to the author item validity is concerned with whether the test items represent measurement in the intended content area, and sampling validity is concerned with how well the test samples the total content area. With reference to tests, a good test is the one that **adequately** samples the appropriate content, but this is not easy to achieve because to "*measure each and every aspect of a certain content area, the required test would be* [too] *long*" (Gay, 1981: 111). Content validity, classified as logical validity, is determined through judgment and usually experts in the area covered by the test are asked to assess its content validity (Gay, 1981).

  In order to improve content validity of the questionnaires and interviews in this study, an experienced researcher was consulted to determine whether all required data implied in the research questions were likely to be elicited by the instruments. In the case of the instruments "testing" teachers' knowledge of smoking and smoking-related matters the "content validation" was more conventional, in that the validator carefully checked all items on the test and made judgements concerning how well they represented the intended content area.

- *Construct validity*, which has to do with the extent to which an instrument measures what it is intended to measure. Gall *et al.* (1996: 249) refer to construct validity as "*the extent to which a particular test can be shown to assess the construct that it purports to measure*". Although traditional researchers saw constructs as traits that cannot be observed (e.g. intelligence) and which thus have to be inferred from their observable effect on behaviour (Gay, 1981; Gall *et al.*, 1996), more recent interpretations have emerged. For example, although constructs are usually theoretical traits, knowledge or understanding of factual material can also be validated in this way (Lubben *et al.*, 2000). The term "construct" is defined in everyday English as "*a complex idea resulting from a synthesis of simpler ideas*" or "*a model devised on the basis of observation, designed to relate what is observed to some theoretical framework*" (Collins English dictionary, 1991, 344). This clarifies that constructs such as "attitudes to science" are "complex ideas" or "models", made up of smaller components. In my study each research question generated a "construct" (a complex idea containing smaller components). For example, for research question 1c (*To what extent do biology teachers understand and apply the changes demanded by the new curriculum, when they teach about smoking?)* The main construct was teachers' understanding of the new curriculum requirements, but to "measure" this required investigating the individual requirements which made up the new demands (the smaller components referred to by the definition provided).

  When instruments measure a single construct, such as "attitude to science" or "understanding of the nature of science" using long tests of homogeneous items, validity can be statistically checked

by calculating validity coefficients. But the instruments in this study were neither long nor homogeneous in the question format. Other methods, such as convergent and discriminant validation, in addition to not being amenable to calculated measures, could not be used because the unique construct being measured by the instruments meant there was no other instrument which could be used for comparisons. Construct validity can, however, be improved (but not measured) by means of face validation, where experts are asked to consider the likelihood that the instruments will gather the construct information they are designed to gather, or whether design factors (for example, misunderstood questions) might influence the results. The researcher can then modify and improve the instrument prior to using it. In this study face validity was widely used to validate the instruments.

Since this study involved educational research it was my intention that the results be used in a classroom situation in order to improve the quality of teaching and learning in schools and the effectiveness of education. It was crucial that I took cognisance of reliability and validity and took steps to try to improve them in the instruments, as well as when making inferences from the data. Various potential threats to validity for this study are discussed in Chapter 8, section 8.1.

4.11 ETHICS IN EDUCATIONAL RESEARCH

Researchers, in their quest to gather information, have to ensure that the rights and values of those participating in the research are not compromised (Gay, 1981; Cohen and Manion, 1994). According to Cohen and Manion (1994: 347) ethical concerns a researcher may encounter, particularly in educational research, are "*complex and subtle and can frequently place researchers in moral predicaments which may appear quite unresolvable*". There are fundamental issues that researchers need to consider before getting in contact with the participants, including "*confidentiality, informed consent, anonymity and the right to privacy and knowledge*" (Cohen and Manion, 1994: 373).

Researchers must first get permission from relevant authorities to access information, for example from the Department of Education in the case of teachers, or parents in the case of learners. It is imperative for researchers to explain to the participants what their study entails, either in written form or verbally (Gay, 1981; Cohen and Manion, 1994). Researchers have to inform participants that their involvement in the research is at their (participants) own free will. The use of coding systems to ensure anonymity is crucial in research (Gay, 1981; Cohen and Manion, 1994).

In my study contact was made telephonically with a senior official in the Gauteng Department of Education with regard to getting permission from the department to invite teachers to participate in this study. I wrote a letter to the same senior official with reference to the phone conversation about Gauteng teachers' participation in my study. The letter was written in order to keep a record of any correspondence involving the research. Permission to get teachers involved in the study was granted by the Gauteng Department of Education [see Appendix F for the letter to the senior official and permission from the Department].

Confidentiality with regard to data collected in this study was maintained and a coding system was used to ensure anonymity. Initially, names of participants were used only so I could link answers from a

particular teacher and table numbers so forms could be returned to teachers for their records. Other than that names of teachers and schools involved in this study were not mentioned, instead they were assigned codes (e.g. School A; Teacher A1).

4.12 CONCLUDING REMARKS

The extensive literature review and advice from expert in educational research informed the decision to select carefully the research design and research instruments that were used in this study. Constant consultation with the research methods expert in whose research group I worked assisted in developing the research instruments used in this study. Data collected during this phase are presented in Chapter 5.

CHAPTER 5
RESULTS AND DISCUSSION OF THE DIAGNOSTIC PHASE

This chapter presents an analysis and discussion of the findings from data gathered from teachers during the diagnostic phase of the study. In this "results" chapter the "messy" nature of research which is increasingly being written about in the educational research (e.g. Mellor, 2001; and Law, 2003) becomes very apparent. Mellor (2001) explains that research is a "messy" and "error-strewn reality" because the real world which the researchers are investigating is complex and it is difficult for researchers to reduce their research to neat procedures, laws and claims. Abd-El-Khalick (2007) point out that education research is multifaceted and complex. The phenomena studied in educational research are not easy to predict or control, especially when working with situations involving human beings who "*are by far the most complex of all organisms*" (Gay, 1981: 6). Gall *et al.* (1996: 1) point out that educational research is a "*human process and, therefore, prone to error and bias.*" Mellor (2001, 473) argues that research is not the linear process researchers tend to expect, and that in reality researchers encounter blind alleys, errors and "off-shoots". Law (2003: 3) points out that "*in practice research* ... [is] *messy and heterogenous, because that is the way it, research, actually is.*" Gall *et al.* (1996) point out that researchers try to minimise the influence of error and bias, but according to Law (2003) research methods can only reduce the "mess", not eradicate it. Law (2003: 7) points out that "*as we seek to know the world .... however much we want to be comprehensive, to know something fully, to document or represent it, we will fail*". It is therefore crucial that researchers acknowledge that research is complex and "messy", and that if one encounters blind alleys it is not a sign of methodological inadequacy or failure (Law, 2003). Many writers (Lenzo, 1995; Mellor, 2001; and Law, 2003) go further than this, urging that researchers should be honest when they report their research. Lenzo (1995: 19) says this is difficult even for experienced researchers, and that "*the difficulties are magnified* ... [for] *the doctoral dissertation student who both strives for legitimacy and wishes to challenge knowledge legitimation practices*". Law (2003, 7) urges that researchers do not "repress" or "deny by exclusion", but that they are honest about problems they encounter.

As mentioned in Chapter 4, data were gathered using activity-based questionnaires administered during professional development workshops held for teachers and during face-to-face interviews. Data gathered were analysed (1) to find out how teachers taught the topic and whether they complied with the new curriculum demands (2) to find out what teachers felt they needed to help them handle the topic in a classroom situation, and (3) to establish teachers' content knowledge about smoking and related matters, as part of the needs analysis.

Activity-based questionnaires were completed by 29 of the 32 teachers who attended the workshop. Each questionnaire provided a written record relating to some activity in which teachers at the workshop were involved, either after individual reflection or based on group discussions. They provided crucial information for me to use during the development of the support materials.

Face-to-face interviews were conducted with ten teachers from seven schools. This was done in order to get in-depth information on how teachers dealt with the topic and what they said about complying with the new curriculum requirements in their teaching (as explained in Chapter 4, section 4.7.2).

5.1 SMOKING-RELATED PROBLEMS IN THE SCHOOLS

The information in this section is used to answer research question 1. The following question and sub-questions are answered in sections 5.1.1 and 5.1.2.

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?

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

5.1.1 The nature and extent of the smoking problem in the schools

It was important to find out the nature and extent of smoking problems in the schools, as most previously documented studies done on smoking in South Africa have looked at its impact on the public in general (e.g. Diener, 1996; Fickl, 1996; Strydom, 1996; De laRoviere, 1997) and not at its seriousness at school level. The information was needed to decide whether an educational programme was necessary to address the situation. Those studies that have concentrated on smoking amongst school children (e.g. Goldstein, 1996; Ahmed, 1998; Swart *et al.*, 2001) did not involve intervention programmes that would assist learners in handling the problem of smoking. In order to gather information on the smoking situation at schools, teachers from 15 schools (12 secondary and 3 primary schools) represented at an in-service workshop were asked to describe the situation at their schools regarding smoking. A smoking situational analysis questionnaire was used to elicit the information [see Appendix D].

First teachers were asked:

> ***Is smoking a problem among learners at your school? Please tell us more about the situation at your school regarding smoking among learners.***

In reporting the data schools and teachers participating in the workshop were given codes[7] for anonymity. Table 9 summaries the smoking situation at the 15 schools.

Table 9: The extent of smoking problems in the 15 schools, according to the teachers

	Primary schools (n = 3)	Secondary schools (n = 12)
Number of schools where teachers said smoking is a problem	1	11
Number of schools where teachers said smoking is not a problem	2	1

[7] For those schools participating in the workshop the code "Q" was used, to remind readers that data was obtained using a questionnaire. The 15 schools are coded as A - O. Teachers were given numbers, for example QN5 means teacher number 5 at school N attending the workshop and replying to an activity-based questionnaire, and so on.

Twenty-five teachers answered this question. Twelve out of fifteen of the schools indicated that they were having problems with smoking and its consequences at their schools. Based on what the teachers said, the smoking problem seems to be more prevalent in secondary schools than in primary schools. Eleven of the twelve schools with smoking problems were secondary schools. Teachers at two out of the three primary schools said they did not experience any smoking problems at their schools, although one was not completely certain about it. QM1 indicated that *"one may not be 100% sure"* that there is no smoking problem at their school. The question is, when does smoking become a problem? Certainly teachers will have different perceptions in as far as the smoking problem is concerned. What one teacher perceives as a smoking problem another teacher, even from the same school, may not see as a problem. For example, two teachers from one primary school (QN) gave responses with different degrees of certainty to the above question. One teacher (QN1) gave a definite response "Yes", while QN2's response *"Not really"* lacked some certainty. However, from their comments about the smoking situation it seems smoking at their school (as in most of the primary schools) was not considered a problem because *"children that smoke hide it and no one has ever spoken about it"* (QN1). QN2 pointed out that

> *"at primary level the situations are not really visible. You will only hear one complaint from one educator not often / not even sure, to say some of the Grade 7 might be involved. Not that I personally have seen, but I suspect because they are at an experimenting phase of their age"* (QN2).

From what teachers from the three primary schools said, the general impression is that it is a matter of what teachers perceive "a problem" to be. According to the theory of planned behaviour (see Chapter 3, section 3.5) an attitude about a behaviour is influenced by behavioural beliefs (that is what one **perceives** and believes about the behaviour) which in turn influences one's behavioural intentions. In the case of teachers who perceive the school's smoking situation not to be a problem, they are unlikely to see the need to deal with smokers. In other words teachers' perceptions of a problem may influence the way they react to the problem.

Teachers' comments about the smoking situation at their schools provided some insights into the nature of the problem, as summarized in Table 10. This includes comments from teachers at the 12 schools saying there was a problem, and one school indicating that smoking occurs, but it was not a problem.

Table 10: Teachers' comments about the nature of the smoking problem

		No. of schools n = 12	No. of teachers n = 13
What they smoke	Some learners go as far as smoking dagga	6	8
Gender	Boys are the main problem when it comes to smoking	3	3
	Girls are also involved in smoking	2	2
	Boys and girls smoke	2	3
Where they smoke	On school premises	3	4
	Learners smoke in the school toilets	4	4
	In the classroom	1	1
Smoking is a habit to the learners		1	1
Learners are exposed to smoking everyday		1	1
Learners smoke and experiment from an early age		1	1

According to the literature on smoking (e.g. Chou, 1992; Lindsay and Rainey, 1997) children at the adolescence stage are at increased risk for a variety of problem behaviours, of which tobacco use is one. As already mentioned, in 12 out of the 15 schools teachers pointed out that smoking was a problem at their schools. Teacher QH1 allude to the fact that "*boys and girls at a young age experiment in all sorts of cigarettes* [including] *dagga*". This is evidenced by the fact that eight teachers from six schools reported that some learners smoked dagga.

Although the issue of gender in smoking was not emphasised in the question, teachers at three schools (QA, QF, and QJ) claimed that boys were the main problem when it comes to smoking. Three teachers from two schools (QF and QH) indicated that boys and girls were involved in smoking. The discrepancy of perceptions of two teachers at school F should be noted.

Peer pressure is so strong that young people will smoke in order to be "accepted" by their age group (Lindsay and Rainey, 1997). One teacher at QH claimed that some learners at the school smoked because of peer pressure (QH3). Another teacher from a different school indicated that at the school it appeared as if, if you were a learner and you did not smoke, you were "*taken as a fool*" (QB1).

The crucial thing about smoking, which learners may not be aware of, is the fact that it is addictive. The nicotine found in cigarettes is a drug, and like any other drug is addictive (Royal College of Physicians, 2001), and according to The Health Authority (2005) once you are addicted it becomes difficult to stop. Smoking is so addictive that some people cannot spend half a day without a cigarette (The Health Authority, 2005). According to Lindsay and Rainey (1997) the process of addiction in young people is more rapid than in adults.

Eight teachers from the 12 schools who said they had a smoking problem indicated that learners at their schools smoked on the school premises, four mentioning toilets, and one teacher claiming that learners even smoked in classrooms. Learners spend more than five hours a day at school. Obviously, when the craving need to smoke arrives they will want to smoke, and where else to smoke other than the toilets. At school QF teacher QF1 pointed out that they usually caught the smoking culprits "*when they are from break or lunch, from the smell in their mouths*". According to one teacher from school QH, when learners were asked why they smoked some would say "... *its good for their brain, makes them think better*" (QH3).

- ***The extent of the smoking problem***: As already mentioned, smoking is a very addictive habit. One teacher indicated that the smoking habit "*is so strong that* ***even the younger learners*** *join the older ones*" (QB1). In school QC teachers estimated that **half of the learners** in Grade 9 smoked. In another school one teacher (QA3) said that "... ***most of the learners*** *go to the toilet to go and smoke*" during break.
- ***Behavioural consequences of the problem of smoking:*** Comments by the 12 teachers saying there was a smoking problem at their schools revealed a number of behavioural consequences for learners who smoked, as summarised in Table 11 below.

Table 11: Behavioural consequences of the smoking problem, as indicated by the teachers (n=12)

		No. of schools	No. of teachers
Learners missing class	Toilet visits (during class) to smoke (not at break)	3	5
	Learners bunk classes altogether	1	2
	Learners absent because of smoking-related illenesses	1	1
	Miss important things in class (when going to toilets to smoke)	1	1
Learners' means of survival	Learners sell cigarettes for survival	1	1
Effect of smoking on learners' classroom behaviour	They are slow in their learning due to dagga smoking	1	1
	Learners become unruly after smoking dagga	1	1
	They become sleepy especially after smoking dagga	1	1
	Erratic and funny behaviour after smoking dagga	1	1
Other behavioural consequences	Smoking affects non-smokers	1	1
	Children who smoke hide it	1	1
	Learners not scared of being seen by teachers while smoking	1	1
	Cigarette smoking lead to smoking dagga and drugs	1	1

Based on what the teachers said, many learners excused themselves from class in order to smoke. Nine teachers from six schools pointed out that when learners leave classrooms to go and smoke they miss part or all of a lesson. One teacher explained that "... *they miss important things in class*" (QA1). Two of the nine teachers said learners bunk classes altogether, so that they can smoke. This results in them missing whole lessons.

Three teachers indicated that learners reacted strangely in class after smoking dagga. According to teacher QH1 learners "*tend to be unruly*" after smoking dagga. Because dagga is a drug some learners "*tend to be sleepy*" (QH1) after smoking dagga, and *"some become slow learners due to the effect of dagga smoking*" (QA2).

As already mentioned, smoking is addictive. For young addicted learners who do not have jobs it becomes difficult for them to buy cigarettes everyday. For some learners "*it leads to stealing others' money to go and purchase dagga*" (QA2). This is a serious situation which needs to be addressed by both parents and teachers, who spend a lot of the time with learners at school.

5.1.2 How the problem is being addressed

In order to find out how schools dealt with the problem of smoking, teachers were asked,

Does the school have a policy to control the situation? What does the school do?

However, not all teachers were asked to respond to these questions, only those teachers who said smoking is a problem at their schools. Teachers' responses to the question on whether the school had a policy on smoking are summarised in Table 12, on the next page.

Table 12: Teachers' responses regarding their school's policy about smoking

	No. of schools (n = 15)	No. of teachers (n = 25)
The school has a policy	8	12
The school has no policy, but reacted to smoking	3	8
No response to the question	4	5

Four schools, including those where teachers said they did not have smoking problems at their schools, did not respond to question about smoking policy. One-quarter of the schools (4 out of 12 with smoking problems) did not have a smoking policy at their schools. According to what the teachers said two-thirds of the schools (8 out of 12) had a school policy to attempt to curb the situation.

According to the teachers' comments the smoking policies differed from school to school. In three of the eight schools (QA, QG, and QI) learners found smoking were punished. They were either given detentions or expelled from school. In some cases police were invited to intervene (QA1, QL1), but it is not clear whether police were only called during incidents that involved dagga smoking. Three other schools (QD, QE, and QJ) had school policies, but the teachers did not state how smokers were dealt with. In one school (QJ) addicted learners were referred to the South African National Cancer Association (SANCA).

At school QG learners seemed to be "*out of control*" (QG1) despite having a school policy. According to QG1 learners would rather "*risk expulsion from the school than ... quit smoking*". Teacher QA3 indicated that they tried to warn learners against smoking, but there was "*no room for improvement*". In school QH one teacher lamented that learners were "*no longer afraid of* [the] *teachers*".

The data show that a smoking problem does exist and is fairly extensive and serious. Thus the production of a package to help teachers address the issue was thought to be a worthwhile exercise.

5.1.3 Teachers' classroom practice

The data presented and discussed in this section is to answer research question 1b).

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

The analysis of information gathered from interviews with the 10 participating teachers reveals some compliance with the requirements of the new curriculum, though there was still some traditional teaching as well (see Table 13 on the next page for a summary on how teachers complied with the new curriculum).

Table 13: A summary on how the teachers complied with the new curriculum

School A (teachers A1 and A2)	School B (teachers B1 and B2)	School C (teachers C1 and C2)
They had changed their approach since two years ago, when they mainly just gave information [teacher A2, lines 36-38] 1. Some initial traditional teaching was done on the breathing system (structure and function), during which learners completed a worksheet on the breathing system and smoking-related issues [teacher A1, lines 33-34] 2. Learners then did a group research assignment. Each group decided what they wanted to know about smoking, and then interviewed people about their smoking habits and related matters. They tabulated and graphed the data and drew conclusions [teacher A1, lines 53-61], and teacher A2 said they presented their findings to the class. They were given a rubric at the start so they knew what was expected in the investigation (see interview teacher A2, lines 57-60) and were given guidance in the initial planning [teacher A1, lines 144-148] 3. Learners did seem to be doing meaningful activities, but teacher warned that success depended on the learners taking their work seriously (teacher A1, lines132-151]. Some were not interested and did a poor job. 4. They had a guest speaker who talked about smoking, although this seemed to have been a general visit to the whole school as part of the Life Orientation programme, and seemed to have happened at a different time. 5. Letting learners choose what they wanted to know about smoking meant that there was no systematic coverage of all the issues, although some had been covered in the initial "taught" section. **Curriculum 2005 compliance**: Although still doing some "traditional" teaching of the content, they had added an investigation , and allowed learners to choose what they were interested in investigating (showing a degree of relevance, learner-centeredness and activity-based learning). The topic was relevant (as there was a smoking problem in the school) and integration occurred across Natural Science and Life Orientation learning areas. In terms of facilitation they were given a rubric and clear instructions about the investigation before they started. One teacher appeared to be facilitating learning by helping when learners needed help, the other gave no assistance at all with the investigation. **Concerns**: There was no apparent teaching of the necessary skills. Activities were limited to one (good) investigation, otherwise teaching was traditional. Other than for the investigation, assessment was not used to promote meaningful learning.	• In science learners started by "doing" the CTA coke-bottle breathing model [teacher B1, lines 47-50], (though it was not mentioned how), and completing a worksheet [teacher B1, line 93]. Teacher B1 said she did not "teach" the smoking part [teacher B1, lines 168-169]. • The learners were given a case-study on emphysema [teacher B1, lines 55-56], • Learners did "research" where they had to visit a local clinic to learn more about bronchitis, pneumonia, tuberculosis and lung cancer [teacher B1, lines 52-57] They presented their findings in groups of three. • Teacher B2 mentioned that they had given them hints at the start of the year on how to do research (lines 110-112) • In Life Orientation learners monitored the number of cigarettes smoked by other learners [teacher B1, lines 78-80]. and tried to get parents not to smoke if children were in the room. [teacher B1, lines 80-82, 85-91]. Curriculum 2005 compliance: Learners at this school were engaged in a variety of activities to "discover" information for themselves. There was integration across learning areas (Natural Sciences and Life Orientation), and the tropic was relevant to the school in view of a smoking problem they had. Some group-work was used, and there was some effort to teach generic skills. Concerns: There was no apparent learner-centred approach (dealing with variation amongst learners). Other than testing no formal assessment appeared to have been done, so assessment was not being used to promote meaningful learning.	• The teachers started with a brief introduction on the breathing system, and the effects of smoking [teacher C1, lines 50-60],which one teacher said was "superficial" [teacher C1, line 69], • Learners conducted an investigation on smoking [teacher C1, lines 22-24, 33-43]. Learners worked in groups at the school [teacher C1, lines 76-83]. Each group of learners set 5 questions for a questionnaire on smoking [teacher C1, lines 107-108]. The teachers reviewed the questions from eight grade 9 classes and selected 10 to go in a questionnaire [teacher C2, lines *45-47],* and gave help when needed [teacher C1, line 55] Each learner then had to interview 20 smokers of different ages [teacher C2, line 48, 50-54] then individually tabulate and graph their data, [teacher C1, lines 125-127, 134-135]. The teacher carefully marked their work using a rubric. Time constaints prevented presentation of findings [teacher C2, lines 184-186] • They made posters to warn people in their community about diseases caused by smoking [teacher C2, lines 40-41], an activity also assessed using a rubric. • Smoking was dealt with in Life Orientation and Natural Science learning areas [teacher C1, lines 281-283] and skills were integrated across learning areas [teacher C1, lines 152] and across themes within the natural sciences involving "energy and change" [teacher C1, lines 269-275]. Curriculum 2005 compliance: At this school learners were involved in two relevant activities, facilitated by appropriate assistance throughout the investigations and guidance by rubrics given to direct the activities. There was integration of both knowledge and skills across learning areas. The work was relevant (dealing with smoking as a life skill and an issue of national concern, and the health of the community) A degree of learner-centeredness appeared as learners chose questions they were interested in for the investigation. Learners at the school usually worked in groups to facilitate learning. Concerns: Although teacher C2 mentioned teachingskills in all areas, no specific skills appeared to have been taught in this section. Although a rubric was used assessment of attitudes remained informal. As there was no time to present findings, groups did not benefit from data found by other groups.

Table 13 (continued)

School D (teacher D1)	School E (teacher E1)	School F (teacher F1)	School G (teacher G1)
• The teacher said he did not teach about smoking [lines 77, 79]. He admitted that he was supposed to have taught the learners [line 164]. He said he simply followed the module [line 64] • Learners completed a table dealing with advantages and disadvantages of smoking [lines 81-84] • Learners worked in groups as required by the new curriculum [line 124]. • They made a poster cutting and pasting pictures of smokers and non-smokers [lines 121-122]. • Learners did not go out to search for information [line 112]. ***Curriculum 2005 compliance:*** Learners worked in groups, which the teacher saw as a requirement of the new curriculum. **Concerns:** Only two activities were done, one seeming to lack a purpose other than keeping learners occupied. Learners were not given the chance to find out things for themselves. There was no apparent link to learner's lives (relevance) and no effort to integrate across learning areas. Grades were allocated for work done, but work was then filed, not returned so students could learn from the assessment. There was no indication of facilitation of learning. The teaching seemed very traditional,	• The teacher's planning documents showed she had given a traditional section on the "respiratory system" for Grade 12s, including how smoking affected the lungs. • Smoking was covered in a double period in which learners asked questions and she explained [lines 65-66]. The teacher said it was a general talk about smoking [lines 69-72], which did not form part of her lesson planning [line 79], **Curriculum 2005 compliance:** There was no compliance at all with the Curriculum 2005 approach, possibly because the section on smoking was taught in Grade 12, where the new curriculum has not yet been implemented. **Concerns:** No formal preparation was done, and the section was taught "off the cuff" in a rather "hit-and-miss" way, using whole class teaching. No activities were done. The work was not assessed "because it was not in the exam". There was no integration, and the relevance to pupils lives was not utilised, although there was a smoking and drug abuse problem at the school.	• This was a matric class where the work was linked to the gaseous exchange system, taught in a traditional way [lines 40-63]. • As part of their portfolio work learners had an optional activity building their own lung model, at home, after guidance and a demonstration by the teacher [lines 102-105, 113-114]. Groups then demonstrated it to the teacher who went around the class and marked the models [lines 157-161, 163-173]. • The teacher said they dramatised the section on smoking in class [line 78], looking at what influences a person to smoke [lines 80-81], and the end results of smoking [lines 83-84]. • The teacher said there were no other activities because this topic was "not a subject on its own" [line 191]. **Curriculum 2005 compliance:** This was a matric class, so perhaps the new approach had not yet been implemented. The claims made by this teacher were not always convincing, and were sometimes contradictory. The teacher did not claim to be teaching according to the new curriculum, and did not see smoking as a major topic and only spent some time on it because he was an anti-smoker and wanted to discourage others. ***Concerns:*** Lessons were very teacher-centred with little if any "facilitation". One of the two activities described was "optional". The teacher missed the opportunity to make the work relevant by linking smoking to the learners' lives in a meaningful way. The work was not assessed as it "was not part of the exam", and assessment of attitudes was claimed to be "random" (meaning it was not formally done). No integration happened. Group-work was claimed for demonstrating the model made, but this had been an individual and optional homework activity.	• This teacher "put up the topic" and then brain-stormed, together with the learners.[teacher G1, lines 50-51]. There seemed to be little systematic coverage of the topic. • He demonstrated, by lighting a cigarette in class, how cigarette smoke diffuses [teacher G1, lines 63-64]. to demonstrate passive smoking [teacher G1, lines 66-67]. • Learners drew sketches of a smoker and a non-smoker [teacher G1, lines 70-71]. ***Curriculum 2005 compliance:*** There was no apparent compliance with the approach required by the new curriculum. ***Concerns:*** This teacher appeared to have problems with his content knowledge, and did not cover the content effectively. The learners were actively involved in only one rather purposeless drawing task. Learners were not given chance to look for information on smoking, and there was no integration, skills development or group-work. Assessment was not used to promote learning.

The teachers tried to engage learners in a variety of activities (e.g. investigative activities). Nine out of the 10 teachers claim that they assessed the learners. Only one teacher did not assess the learners. Assessment of the topic was done in a variety of ways, there was group assessment where learners were given grades in their groups. There was also self-assessment where learners were given a checklist to tick what they did. In some instances assessment was informal. For a more detailed analysis on how each teachers taught and assessed the section on smoking and related matters see the next section.

5.1.4 Teachers' application of the new curriculum requirements when teaching about the topic

Teachers in South Africa are expected to change their way of teaching to that advocated by the new curriculum (as reported in Chapter 1, section 1.2.3 on page 4). This section looks at how teachers were teaching the topic of smoking after the introduction of the new curriculum, but before they were introduced to the teaching and learning package designed for this study. To gather the data I interviewed 10 teachers from seven schools, who had already taught the topic, to find out the extent to which they were applying the requirements of the new curriculum. The analysis of the data focussed on answering research sub-question 1b). However, the "understanding" part of the sub-question was not answered during the diagnostic phase, but in the second phase (the therapeutic phase) of this 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?

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

In order to answer the sub-question above, I developed and face-validated an interview schedule in which I was looking for evidence of lessons which showed an application of the requirements of the new curriculum. It was not easy to determine whether the 10 teachers participating in this study actually applied the requirements in their lessons because at that stage there were no set criteria explaining what teachers had to do in order to be seen to be applying the requirements of the new curriculum. At that stage our research group, whilst investigating changes in the practice of teachers implementing the new curriculum, was looking for eight features which policy documents suggested were required by the new curriculum: teaching which was outcomes-based, activity-based, learner-centred, relevant, and where the teacher acted as a facilitator, promoting groupwork, assessing continuously and teaching skills.

However, Sanders and Kasalu (2004: 917) soon realised that the existing analytical frameworks "*were not sophisticated enough to cater for the complex nature of the requirements of* [the new curriculum]". They developed a framework that could be used by education researchers to "*analyse and quantify the nature and extent of teachers' understanding of the requirements of the new curriculum*" (Sanders and Kasalu, 2004: 918). They validated a list of nine requirements for the new South African school curriculum, adding " integration" to the eight features already mentioned above. In addition, they identified the distinguishing characteristics of each requirement, which would allow researchers to look for specific "features" of the new curriculum when researching its implementation. Sanders and Kasalu (2004) suggested that researchers wanting to investigate implementation of curriculum could modify *the profile of understanding* to a *profile of implementation*. However, their list was not available at the time of the diagnostic phase of this research, so my interview schedule did not probe for those features.

Furthermore, I was trying to avoid leading the teachers by asking questions about specific practices. I used open-ended questions so that teachers could tell me what they were doing in class when teaching about smoking.

Some of the schools that participated in this study, especially schools A[8], B and C, seemed to be adopting the new approach, although careful analysis of the interviews showed that this application still needed some guidance from those who have knowledge on the requirements of the new curriculum (see Table 13). Some schools (e.g. D, E, F and G) seemed to need more guidance.

Dealing with ambiguous responses from the interview sessions

One of the limitations of interviews is that respondents' answers can be influenced by the presence of the interviewer (as reported in Chapter 4, section 4.7.2 on page 74). Respondents may say things to please the interviewer or withhold important information, and this can cause validity problems with the data. In order to check the validity of the claims by the 10 teachers I looked critically at the language they used in their responses. I used the criteria in Table 14 as a guideline to suggest whether the claims made by the respondents may have possible validity problems. It should be noted that the wording used by the teachers might have been problematic because of their difficulty with expressing themselves in English, which was not their mother-tongue.

Table 14: Criteria used to interpret respondents' claims

Language used by respondents	Implications
• use of tense (present or past) in responses (e.g. "*Actually **we design** our drama ...* [Teacher F1, see full quote on page 101]	Claims made in the past tense are more likely to describe things that actually happened. In English using the **present tense** suggests generalisations, which implies possible validity problems as this may not necessarily mean that things did happen. Activities really done would be more likely to have been described using the **past tense** (e.g. we designed ...).
• use of tentative language ▸ "sometimes ..." ▸ "maybe ..." ▸ "if I remember well ..." (e.g. "*They submit it, maybe in group A, B,C,D...*" [Teacher D, see interview extract on page 113]	The use of tentative language by respondents suggests uncertainty and raises possible doubts about their claims being true - as if they are making it up as they go.
• vague response (lacking in detail) (e.g. "*Actually we just performed **some sort of activity**.*" [Teacher F1, see full quote on page 101]	If respondents give incomplete or vague responses when probed for more detail, it raises doubts as to whether what they are saying is what really happened.

What follows is a report on how teachers said they were implementing each of the nine requirements. In order to do this I have created tables which list the distinguishing features (based on Sanders and Kasalu, 2004) for some of requirements, and used these as a checklist to report on evidence from the interviews. For the purposes of presenting the results of this study the schools that participated have been coded A to G, and teachers have been coded by number, after the school's letter. For example, A1 and A2 refer to the two teachers from School A.

[8] Schools A to G are schools whose teachers participated in the interviews sessions conducted in the diagnostic phase of this study

How teachers from the seven schools said they applied the nine requirements of the new curriculum

Using *outcomes* to direct lessons

Teachers were not specifically asked about outcomes in the interview because I was hoping to get this information from their lesson preparation documents.

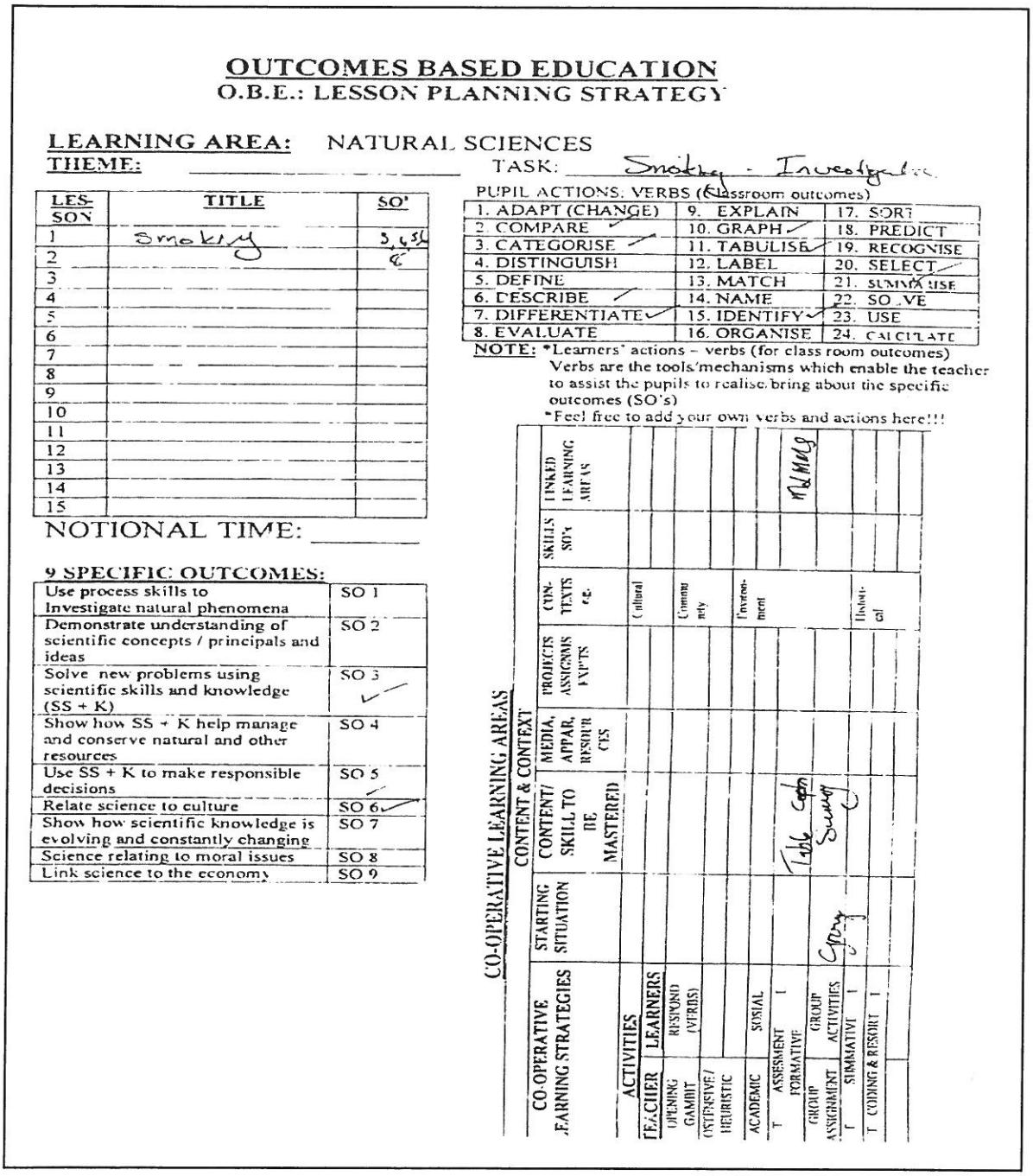
Although all 10 teachers agreed, during the interview, to give me lesson plans for the section on smoking and related matters, only one teacher (Teacher A2) ever gave me her documentation. None of the other nine teachers ever gave me their lesson preparation documentation, even though they had promised to let me have copies, and I sent them fax messages and even telephoned to remind them. This implies that the nine teachers did not have lesson plans. I came to realise that generally teachers do not make lesson plans when I started teaching. Matimolane (2004) revealed that some of the teachers she worked with in her study did not have lesson plans. Without the lesson preparation documentation from the other nine teachers, and with limited information from the interview sessions, it is difficult to tell whether the teachers considered outcomes when they planned their lessons, other than for Teacher A2. From the information gathered from 10 teachers interviewed none of them mentioned anything about using outcomes to direct their teaching in class. However, the lesson preparation documentation of one teacher (Teacher A2) was available for analysis.

The whole issue of teachers not submitting their lesson plans and not having enough data is an example where research was messy. Lesson plans from the 10 teachers were supposed to provide data on whether they (teachers) considered outcomes when planning their lessons. However, because they neither presented their lesson plans nor mentioned anything on outcomes in the interview, it makes it difficult for me to draw definite conclusions. Marshall and Rossman (1995) point out that data analysis can be a messy, ambiguous and fascinating process.

Although Teacher A2 taught two lessons on the topic (according to the interview) she only had one lesson plan and it was just a single page which appears to be a template provided for teachers at the school (see Figure 8 on the next page).

A lesson plan template is a guide to planning a lesson, which includes checklists to be ticked and provides some space where teachers can fill in necessary details. Lesson plan templates "*ensure that certain aspects of the lesson are considered and thought about during planning*" (Matimolane, 2004: 56). According to Matimolane (2004), although lesson templates save time, they have limitations. Firstly, because of the limited space provided, they tend to be restrictive in terms of the amount of detail that teachers can include.

Secondly, if important aspects of the lesson plan are excluded from the template, teachers do not consider these aspects in their lesson plans.



OUTCOMES BASED EDUCATION
O.B.E.: LESSON PLANNING STRATEGY

LEARNING AREA: NATURAL SCIENCES
THEME: _____ TASK: Smoking - Investigate

LESSON	TITLE	SO'
1	Smoking	3, 4, 5 & 6
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

NOTIONAL TIME: _____

9 SPECIFIC OUTCOMES:

Use process skills to Investigate natural phenomena	SO 1
Demonstrate understanding of scientific concepts / principals and ideas	SO 2
Solve new problems using scientific skills and knowledge (SS + K)	SO 3 ✓
Show how SS + K help manage and conserve natural and other resources	SO 4
Use SS + K to make responsible decisions	SO 5 ✓
Relate science to culture	SO 6 ✓
Show how scientific knowledge is evolving and constantly changing	SO 7
Science relating to moral issues	SO 8
Link science to the economy	SO 9

PUPIL ACTIONS: VERBS (Classroom outcomes)

1. ADAPT (CHANGE)	9. EXPLAIN	17. SORT
2. COMPARE ✓	10. GRAPH ✓	18. PREDICT
3. CATEGORISE ✓	11. TABULISE ✓	19. RECOGNISE
4. DISTINGUISH	12. LABEL	20. SELECT ✓
5. DEFINE	13. MATCH	21. SUMMARISE
6. DESCRIBE ✓	14. NAME	22. SOLVE
7. DIFFERENTIATE ✓	15. IDENTIFY ✓	23. USE
8. EVALUATE	16. ORGANISE	24. CALCULATE

NOTE: *Learners' actions – verbs (for class room outcomes)
Verbs are the tools/mechanisms which enable the teacher to assist the pupils to realise/bring about the specific outcomes (SO's)
*Feel free to add your own verbs and actions here!!!

CO-OPERATIVE LEARNING AREAS
CONTENT & CONTEXT
CO-OPERATIVE LEARNING STRATEGIES
STARTING SITUATION
CONTENT/ SKILL TO BE MASTERED
MEDIA, APPAR, RESOUR CES
PROJECTS ASSIGNMS EXPTS
CON-TEXTS e.g.
SKILLS SO's
LINKED LEARNING AREAS
ACTIVITIES
TEACHER
LEARNERS
OPENING GAMBIT
RESPOND (VERBS)
(OSTENSIVE/ HEURISTIC
ACADEMIC
SOCIAL
ASSESMENT FORMATIVE
GROUP ACTIVITIES
GROUP ASSIGNMENT
SUMMATIVE
CODING & RESULT
Cultural
Community
Environment
Ecological
Table Cloth
Survey
Graphs

Figure 8: Lesson plan for teacher A2

Matimolane (2004: 25) believes that some teachers may do what is referred to as "mental planning", where the teacher *"visualises the future classroom events and develops alternative comprehensive planning images"* without putting the plans down on paper. However, aspects not intended in the lesson plan may not be thought about at all.

The lesson plan provided by Teacher A2 shed some light on how teachers may be using outcomes. What follows is a report on the extent to which Teacher A2 complied with the features of the requirement to make teaching outcomes-based. The sequence of the features of the requirement is discussed in the order in which teachers would conduct the actions (not in the sequence of understanding in the list by Sanders and Kasalu (2004)

- Teachers are required to use all levels of outcomes when planning their lessons (fourth feature on the list). The first level refers to *critical* and *developmental outcomes.* In the new South African school curriculum *critical outcomes* and *developmental outcomes* apply across all grades and through all learning areas (as explained in Chapter 1, on page 6 in section 1.2.3). The lesson template of Teacher A2 did not include this type of outcome. The teacher seemed to focus only on doing what the template dictated her to do and it was inadequate for really thinking about these outcomes. She did not mention critical or developmental outcomes during the interview session.

  The second level requires teachers to use subject-linked *specific outcomes* (renamed as learning outcomes when the revised curriculum was implemented in 2006). The lesson template for Teacher A2 shows two areas for recording these outcomes. In one area there are specific outcomes (numbered from 1 to 9) already listed (see Figure 8) where teachers tick the ones they are going to use in their lessons. Specific outcomes 3, 5 and 6 are ticked. The other area is where teachers write down next to lesson topics numbers of the specific outcomes they will use. Teacher A2 has written the numbers for specific outcomes 3, 4, 5, 6 and 8. This inconsistency in the choice of the outcomes might suggest that this teacher simply ticked the outcomes and filled in numbers without giving it thought, which suggests "token planning". Matimolane (2004) found that a number of teachers she investigated appeared to be doing token planning to satisfy authority figures using one-page templates they had been provided with and simply ticking listed items or writing in codes without giving further details to show they had really planned the lesson carefully. According to Matimolane (2004) token planning is unlikely to promote a shift towards outcomes-based teaching.

  The third level of outcomes requires teachers to provide their own outcomes for each lesson. Teacher A2 did not write down her own lesson outcomes. In the lesson plan provided by Teacher A2 there is no indication, by the teacher, of what is expected of learners after the lesson. In the lesson template there is a list of action verbs — also referred to (in the template) as "classroom outcomes". Spady (1994) recommends that action verbs be used to define and develop outcomes. Teacher A2 did not use the action verbs to develop outcomes. She only ticked the verbs listed in the lesson template.

- Sanders and Kasalu (2004) point out that when teachers state outcomes they should be worded as what learners should be able do after the learning experience which they could not do before. According to Clarke (1997), for one to know whether learning has taken place learners "*must have acquired skills, attitudes or knowledge that they did not previously have*". However, the outcomes in this lesson plan are not written as "At the end of the lesson learners must be able to ...". It appears that this teacher might have regarded the outcomes as a list of activities to be done in the lessons, and not things she had to teach learners to do. In outcomes-based curricula clearly defined outcomes spell out what learners should achieve through the learning process (Clarke, 1997). According to the information in the lesson plan this teacher did not apply this feature.

- Teachers are required to have outcomes that specify skills and attitudes in addition to knowledge to be learned. According to Sanders and Kasalu (2004: 920) "*the skills to be developed should be stated as outcomes in teachers' lesson preparations and thus targeted in their lessons.*" What Teacher A2 has ticked (in the lesson template) implies "knowledge" and "skills".

- In the new curriculum teachers are expected to identify the outcomes they wish to target in their lessons, and then design their lessons around them (Department of Education, 1997). However, the lesson plan provided by the teacher does not show how the lesson will be conducted. Because Teacher A2 is an experienced teacher — having taught for 18 years — she might have had the other

necessary details of the planning in her head, what Matimolane (2004) refers to as "mental planning". Therefore, there is not enough evidence to establish whether the teacher planned her lessons to achieve outcomes.

In summary, based on the information from the interview and the lesson plan provided, Teacher A2 only partially applied the three different types of outcomes, did not achieve the second and third features, and it did not come out clearly whether she planned her lessons to achieve pre-stated outcomes. This teacher is one of the more effective teachers I interviewed, and it seems that the other teachers would be less successful than her at this. However, because they neither presented their lesson plans nor mentioned anything on outcomes in the interview, I cannot draw definite conclusions.

Learning should be *activity-based*

In order to establish whether the 10 teachers were applying "activity-based" learning, I used a list of the features of activity-based learning (based on Sanders and Kasalu, 2004), as a checklist (see Table 15 on the next page). It should be noted that it is not a case of teachers complying with one feature in order to be implementing an activity-based approach; it has to be a combination of the features. For example, it is not enough for teachers to actively engage learners in activities. For learning to be activity-based activities should be used as a **starting point** of the lesson in order for learners to be able to construct their own knowledge. The activities must be meaningful and should be "minds-on". This means that when introducing a topic an activity should be used as a starting point to get the learners thinking, so the theoretical explanation of science emerges.

Table 15: A summary of how the 10 teachers applied the features of activity-based learning

	Teachers									
For teachers to be using activity-based approaches they must....	**A1**	**A2**	**B1**	**B2**	**C1**	**C2**	**D1**	**E1**	**F1**	**G1**
• actively involve learners in the learning process.	✓	✓	✓	✓	✓	✓	½	½	½	½
• have activities as the starting point for learners to construct knowledge.	✓	✓	✓	✓	×	×	½	×	–	×
• involve learners in meaningful (purposeful) learning activities (usually to achieve stated outcomes determined by teachers).	✓	✓	✓	✓	✓	✓	×	–	×	–
• use a variety of methods or strategies to engage learners actively in the learning process (to achieve a broad range of outcomes relating to knowledge, skills and attitudes).	–	–	✓	✓	✓	✓	–	–	–	–
• engage learners in "minds-on"activities.	✓	✓	✓	✓	✓	✓	×	×	½	✓

Note ✓ means the feature was achieved – means the feature did not come out from the interview session.
½ means the feature was partially achieved × means the feature was not achieved

Involvement of learners in activities

All the teachers in this study engaged learners in activities to some extent, as shown in Table 16. Although a range of different activities were mentioned not all can be considered to promote activity-based learning. Table 16 shows three main categories with sub-categories and relevant activities that learners can be engaged in (adapted from Mashalaba and Sanders, 2003).

Table 16: A summary of activities teachers said learners engaged in

			Teachers									
Category		Activities	A1	A2	B1	B2	C1	C2	D1	E1	F1	G1
Practical activities	Investigations	• designing a questionnaire	✓	✓	–	–	✓	✓	–	×	–	–
		• gathering data	✓	✓	✓	✓	✓	✓	–	×	–	–
		• tabulating data	✓	✓	–	✓	✓	✓	–	×	–	–
	Demonstrations	• teacher demonstration	–	–	–	–	–	–	–	×	–	✓
	Making models	• building a lung model	–	–	✓	–	–	–	–	×	✓	–
	Visits	• visits to local clinics	–	–	–	✓	✓	✓	–	×	–	–
Communication activities	Writing tasks	• making posters	–	–	–	–	✓	✓	✓NM	×	–	✓NM
	Oral tasks	• presentations	–	✓	–	✓	–	×	–	×	–	–
		• debates	–	–	–	–	–	–	–	×	✓	–
		• brainstorming	–	–	–	–	–	–	–	×	–	✓
		• discussion	–	–	–	–	–	–	–	✓	–	–
	Role plays		–	–	–	–	–	–	–	×	✓	–
Text-based activities	Completion tasks	• completing a table	–	–	–	–	–	–	✓	×	–	–
	Analysis tasks	• summarising	✓	✓	–	–	✓	✓	–	×	–	–
		• a case-study	–	–	✓	✓	–	–	–	–	–	–

✓ means activity done NM means not meaningful
× means activity planned but not done
– means not mentioned in the interview

According to the new South African school curriculum, teachers are required to engage learners in various meaningful activities and make sure that they (learners) all participate in these activities to allow them to construct knowledge (Sanders and Kasalu, 2004). The level of participation of learners in activities is important to ensure that all learners are engaged in the learning process. There are three common types of engagement in the learning process, whole class-question-and-answer, groupwork, and individual work — as indicated in Table 17 on the next page.

Table 17: Types of participation

Type of engagement	Benefits	Potential problems
Whole class question-and-answer	▸ it potentially gives every individual learner an opportunity to participate, provided the teacher does not involve active individuals only. ▸ is a quick way for the teacher to check whether learners have learned something, if effectively done. ▸ it gives the teacher an opportunity to identify those learners who are shy so that they can encourage them to participate in class. ▸ it gives learners an opportunity to articulate ideas verbally, as some may be good in writing and struggle in speech.	▸ there is no guarantee that everyone will participate actively; some could be busy with other personal things and not listening at all or even sleeping. ▸ if the teacher does not take control learners may respond in chorus when asked questions. ▸ the teacher cannot easily assess individual learners.
Group work	▸ could be used to enhance learners' social skills, such as sharing information, cooperation, listening and discussion. ▸ learners potentially get an opportunity to listen and discuss different points of view which may assist them in "construction of knowledge".	▸ not everyone participates actively. ▸ often active learners dominate the proceedings ▸ there is a possibility that some learners in the group might be distracted by matters not associated with the task at hand. For example, one of the members of the group might decide to tell others what he or she saw on television.
Individual work	▸ active participation of everyone is guaranteed provide the teacher monitors each individual.	▸ if classes are overcrowded it would be a huge challenge for the teacher to assess each individual effectively.

The extent of active mental engagement of learners in meaningful tasks was not the same with all the schools. At some schools (e.g schools D, E, F, and G) the activities done by the learners were either meaningless or there was an element of doubt whether such activities were done or not. The claims by teachers in the four schools raised some doubts in my mind.

- At school E there was only one activity done, a whole class discussion. Although whole class discussion is one way of engaging learners, in most cases it does not provide learners with the opportunity to **do** things other than listen and answer questions. In addition, this strategy does not guarantee participation of **all** the learners in class. For example, one or two learners could dominate the proceedings, that is, answer questions. Some learners may be busy doing their own thing. It is easy for an individual to choose not to participate in the discussion.
- A demonstration was done at School G where the teacher showed how cigarette smoke diffused through a room. With demonstrations, there may be little involvement of the learners. In this case learners had to smell the cigarette smoke. As pointed out earlier, if teachers are at the centre of an activity, and learners are doing nothing except listening, there is a possibility that some learners would not be listening at all. Teachers should make sure that all learners are engaged in learning when they (teachers) are demonstrating. For example, a worksheet could be used for learners to fill in what they have observed during the demonstration. However, there was a second activity done at this school where learners were required to make posters, which would have engaged them more actively.

- Although Teacher F1 claimed to have given his learners activities, his claims raised some doubts in my mind about whether the activities were done, because he seemed not to be sure of what happened, and the fact that he used present tense in his speech, suggesting he was generalising. His description of having done a role play with this class suggested that although he may at one time have done something like this, he may not have done it this time (although this may simply be a language problem with the way he explained it).

  > "*Actually **we design** our drama in such a way that, one, you know, I mean, get to look at what influence a person to smoke. **We design**, **we do have** characters and **factors**. We have characters **which display** factors which influence men, especially young men, and women to smoke. And then, also the end result of smoking **we do perform**. Actually **we just perform** some sort of activity.*" [Teacher F1, lines 81-84].

  The last sentence of the extract, besides being in the present tense, is vague. If the activity was done one would expect details on how it was done. The use of the present tense in English language suggests a generalisation (see Table 14). Activities done would probably have been described using the past tense (e.g. We designed our drama ... We had characters ...).

  For another activity, Teacher F1 initially stated that learners were given an activity, "... *in the form of an assignment ...*" [Teacher F1, lines 114-115], where they had to build a lung model, but later mentioned that "... ***it's optional**, but I always encourage them to do it at home so that everybody concentrate*" [Teacher F1, lines 122-123]. Based on the experience of what is happening in many schools I believe that many learners are unlikely to have done the activity.

- Learners at three of the seven schools (A, B, and C) (from what the teachers said) seemed to have been actively engaged in different activities (see Table 16), where learners had to go out to gather information either from their colleagues at school, people in their local communities or at their local clinic. One teacher at School C, when asked how she addressed the topic, explained that

  > "... *the learners had to design a questionnaire* [on why people smoke] ... *They had to go and ask people ten questions ... about age* [smoker's age] *when they started* [smoking], *reasons why they started, ...*" [Teacher C1, lines, 34-36].

  Learners were given a case study

  > "*...which they learned a lot of things* [from, for example] *the disease within smoking. And we gave them research work to go and visit their local doctor or local nurse or get or the clinic and learn more about what is bronchitis, pneumonia, tuberculosis and lung cancer.*" [Teacher B1, lines 53-56].

The purpose of the research work, as implied by Teacher B1, was to give learners the opportunity to get information, by themselves, on some of the diseases associated with smoking. However, from what Teacher B said in the interview session, this seemed not to have worked as some people at the clinic "*were not cooperative.*"

Based on the information gathered it is difficult to generalise findings about the extent of activity-based learning because some information did not come out clearly during the interview sessions.

Using meaningful activities

In order to have guidelines in differentiating between "meaningful" and "not meaningful" activities I used the following criteria (see Table 18 on the next page).

Table 18: Levels of meaningfulness of activities

Description of activities	Examples from interviews conducted during this study	Level
activities that are "minds-on" (that is activities that make learners think)	▸ case-study on diseases ▸ designing a poster to warn people about smoking ▸ building a lung model (with a purpose of explaining a theory) ▸ visits to clinics (to gather information on smoking)	meaningful
activities with no apparent educational purpose (to achieve outcomes), e.g. no content learned.	▸ cut-and-paste posters of smokers ▸ drawing smokers and non-smokers	not meaningful

- At least three of the seven schools (A, B, and C) seemed to have adopted a much more investigative approach (which is meaningful) to teaching and learning than the traditional one where the teacher is the source of information. One teacher at School A explained,

  > "*This year what we mainly did was a research on it. They had to do an investigation, a research and an investigation on it. It's a lot of information which they discovered themselves, which is different from two years ago when we just gave them all the information*" [Teacher A2, lines 36-38].

  This quote suggests that at School A learners were involved in a **meaningful** learning task. Teacher A2 mentioned that in their investigation learners were

  > "*... given a rubric and then they had to draw up their own questionnaires. That's what they had to do, and then draw ... eh ... their questionnaire, they had to draw up an aim and then draw up also, from the investigation, their own summary and things like that*" [Teacher A2, lines 57-60].

  This is an example of a situation where learners were engaged in a meaningful learning task where they had to do some thinking.

- Three of the 10 teachers included activities which did not seem to be meaningful. Perhaps this was because although they knew activities were required by the new curriculum they did not realise why activities are so valuable in the learning process. Activities need to be carefully planned to achieve specific outcomes for the learning area. At schools D and G some tasks (e.g. developing a poster) seemed to have been done more for the sake of doing an activity than for learning science.

  - For example, at School D an activity was done cutting and pasting pictures of smokers and non-smokers to make posters, with little apparent purpose. The teacher simply told learners to

    > "[c]*ome with the posters. When you see somebody smoking in a newspaper just cut the picture and paste it somewhere ... like that*" [Teacher D1, lines 122-123].

  This activity does not seem to have an educational purpose, and there is no science to be learned from it. Therefore it is not meaningful, as indicated in Table 18.

  - School G did a similar task, but the learners drew the smokers and non-smokers. When asked in which activities the learners were engaged other than the demonstration he did, Teacher G1 said,

    > "*... drawing sketches of a person smoking and the other one who is not smoking and showing the effects of smoke, ...*" [Teacher G1, lines 70-71].

    The activities at schools D and G seem to be "token" activities. It is not clear how drawing people would show the effects of smoke, or how effects of smoke could be shown in any drawing.

- At least three out of the seven schools (A, B, and C) actively engaged learners in activities that involved them mentally.

  For meaningful learning to take place learners must be mentally and not just physically engaged in activities (Carin and Sund, 1980; Mashalaba and Sanders, 2003).

  - The poster activity at School C is an example of a "meaningful activity", in contrast to the poster activity at School D. At School C learners were given the opportunity to plan and design posters to warn people about smoking, a theme that was reinforced across the curriculum in *Life Orientation* and *Natural Sciences*, at that school. The educational purpose that was to be achieved from the activity was for learners to be able to design strategies to encourage smokers to consider quitting smoking. This task gets learners thinking and is therefore meaningful and covered content. When explaining the task Teacher C2 said,

    > " ... *it was the project where they had to make a poster making the community aware of ... the effects of smoking*" [Teacher C2, lines 70-71].

  - At School B learners were given an investigative task (a case study) were they had to gather information about smoking-related diseases.

  - At School A learners had to process the data obtained in their investigation. They had to

    > "*give the questionnaire out. Get the responses, then tabulate the responses in table form and then a graph. So they would demonstrate what they have learned. There was scientific finding, then there was conclusion, summary ... eh ... scientific data ... what they have gained from their questionnaire*" [Teacher A1, lines 56-59].

  The above quote suggests that learners were engaged mentally. The fact that they had to " ... *compile a questionnaire. ...*" [Teacher A1, line 53], give it to the respondents, and then analyse the data and write a summary on the findings implies that the learners had to do some thinking.

Activity-based learning*: *Starting with activities before theory to promote construction of knowledge

Only three schools (A, B and C) used activities as a starting point in order to get the learners thinking so that the theoretical explanation of science emerges. In activity-based learning activities should be the **starting point** of a lesson before the theory (see Chapter 1, page 12, in section 1.2.3,) in order to assist learners in constructing their own ideas (Sanders and Kasalu, 2004), and not to be used as a means of verification after learners have been taught concepts (Phakisi, 2008). If the teacher starts a lesson with theory followed by an activity, then that is no long activity-**based** learning, but is"activity-**orientated**" learning (Phakisi, 2008).

- When I asked Teacher A2 how she dealt with the effects of smoking in class, she said

  > "[t]his *year what we mainly did was a research on it*" [Teacher A2, lines 36-37].

- At School B the teachers gave learners a case study on diseases associated with smoking as a starting point for the lessons on smoking.

Although school A and B appear to have applied the feature of the requirement, it is difficult to generalise, because not all information came out clearly from the interview sessions.

Using a variety of methods or strategies

According to Sanders and Kasalu (2004) using a variety of methods in teaching will promote the acquisition of a wider range of outcomes relating to knowledge, skills, and attitudes.
Three of the seven schools (A, B, and C) used a range of strategies to engage learners actively in the learning process (the fourth feature in Table 15). Whether they did that with the aim of achieving a range of outcomes or were just complying with the new curriculum did not come out clearly in the interview. Schools B and C perhaps were particularly successful in using a variety of teaching strategies.

- At School B, in addition to an investigation monitoring smoking habits in their school, learners were meant to gather information on smoking-related diseases at a local clinic; did an activity involving a case study on emphysema; and investigated the mechanism of breathing using a functioning model of the lungs.
- Besides an investigation and a visit to the school by the local clinic staff, School C engaged learners in developing posters to warn people about smoking, and invited a guest speaker to come and talk to the learners about smoking and smoking-related matters. There was also some traditional teaching at School C.

Although the three schools used a variety of methods it is difficult to tell whether they did that to achieve a wider range of outcomes relating to knowledge, skills and attitudes because it did not come out from the interview. In addition to lack of information from the interview, only Teacher A2 from the three schools submitted her lesson plan to me (as explained earlier in this chapter). Although School F seem to also have used a variety of strategies, it is difficult to conclude that the school really did that because some of the claims by Teacher F1 raised some doubts in my mind (as indicated in the earlier section on page 93).
It is difficult to tell whether the 10 teachers fully applied the features of activity-based learning and the reason for this has already been explained earlier.

Teachers should be *facilitators* of learning

The results of this study reveal that in spite of knowing that they were expected to facilitate, some of the teachers in the group were not implementing many of the practices expected of a good facilitator, as indicated in the list in Table 19 on the next page, which I used as a checklist. However, when analysing the information I did not strictly follow the order of the list as there is some overlap with some of the features. It should be noted that two features in the list of Sanders and Kasalu (2004) have been omitted. The feature on teachers specifically planning lessons to achieve the outcomes was omitted because only one teacher provided her lesson plan. The second feature that was omitted was on creating a favourable environment which allows for meaningful learning to happen. I did not ask teachers, for example, whether they had posters on smoking displayed on the walls of the classroom or other resources to create a favourable environment for teaching the topic on smoking. It should be noted that the feature of facilitation are not discussed in the order shown on to the list in Table 19 on the next page, but according to the frequency of ticks [✓].

Table 19: A summary of how the interviewed teachers said they facilitated learning (n = 10)

For teachers to be facilitators they have to make sure that they	Teachers									
	A 1	A 2	B 1	B 2	C 1	C 2	D 1	E 1	F 1	G 1
• "make easier" or "assist the progress" of learning and are not simply transmitters of knowledge. This involves a balance between explaining concepts and allowing learners to construct their own meaning / understanding.	✓	✓	✓	✓	✓	✓	×	×	✓	✓
• are 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 learners to discover things for themselves).	–	–	½	½	–	–	×	–	–	–
• monitor learners and deal with problems, as learning is happening.	✓	×	–	×	✓	✓	×	–	–	–
• consolidate lessons to ensure all learners have covered all necessary content, and that concepts developed are those currently accepted by scientists.	–	–	×	✓	×	×	×	×	×	–

Note ✓ means the feature was implemented
½ means the feature was partially implemented
× means the feature was not implemented
– means the feature did not come out from the interview session

The balance between explaining concepts and letting learners construct knowledge, to promote learning

Teachers should be aware that facilitation does not necessarily prevent them from teaching in order to explain concepts when appropriate, as long as learners are given the opportunity to construct their own knowledge where possible. However, some of the teachers in this study seemed to have missed the point.

- **Teachers who struck the balance between facilitating and explaining of concepts**
  - At School B, Teacher B1 claimed to facilitate, not to teach, which she saw as giving learners activities and then correcting things which needed correction,

    "*The teaching part? We don't actually teach these days, we just facilitate. Ja. We give them activities, what to do and correct some of the things which are not right with them.* ..." [Teacher B1, lines 37-38].

    However, she also did some "straight teaching" to

    "*... emphasise very important things because some of the things you have got to do them, like when you give them a drawing of respiration you have got to emphasise this is this, how it works and so on. They don't have an idea*" [Teacher B1, lines 39-41].
  - At School C, after a brief introduction on the breathing system and the effects of smoking, learners were given an investigation to do. What the two teachers (C1 and C2) did at this school shows the balance between explaining concepts and allowing learners to construct their own understanding. However, it did not come out from the interview whether teachers C1 and C2 consciously struck the balance between explaining concepts and letting learners construct knowledge, or it was just coincidence
- **Teachers who did not strike the balance**
  - With Teacher E1 there was no indication of facilitation from the interview. What she said when addressing the section on smoking in class

"... *it becomes a general talk, what do they know. Are there other people smoking at home*? ..." [Teacher E1, lines 69-72].

There is no indication in the interview whether she provided guidance to help learners in constructing concepts. She does not seem to "assist the progress of learning."

- At School D, although learners were given activities to do, the teacher (Teacher D1) did not teach them,

"*Ja, I never taught the learners*" [Teacher D1, line 80].

This is a sign of poor facilitation. This teacher seem to think that when you facilitate you are not supposed to teach. There is a crucial point that teacher D1 did not seem to understand, that facilitation is not about just letting learners do all the work on their own. There are problems that might arise, for example, time management. Learners may not be able to do things on time, they need to be guided. Learners may also lack skills to do certain activities. Therefore, it is unrealistic to expect learners to do everything on their own while teachers are busy with other things not related to what the learners are busy with at that particular moment.

Monitoring of lesson progress by the teachers

- **Teachers who monitored lesson progress**
  - Teachers A1, C1 and C2 realised the importance of appropriate intervention. For example, Teacher C1 explained,

"... *where they get stuck they just come to you and ask. ... They are not folding their arms, they are solely doing it. We are only there to guide them*" [Teacher C1, lines 156-160].

Both school C teachers showed excellent facilitation skills, reviewing the initial questions groups provided for the questionnaire being designed, and giving them feedback on how to clarify wording before they went out to interview people (using the questionnaire), so questions were not ambiguous,

"... *each group brought five questions and then we looked at them and decided on 10 questions*" [Teacher C1, lines108-109]. The teachers checked whether the "... *kids can ask questions that can be answered, that are straight to the point* ..." [Teacher C2, line 76].

Three teachers (A1, C1 and C2) showed good facilitation in terms of providing initial guidance with assignments and, providing rubrics to direct learners in their investigations.

- **Teachers who did not monitor lesson progress**
  - Three of the 10 teachers (A2, B2, D1) did not realise that a facilitator needs to monitor the learning process (see Table 18), and provide appropriate intervention when needed, hence they did not comply with the feature of the requirement of the new curriculum. For example, Teacher A2 when asked whether she assisted the learners when they designed their investigations said,

"*Not at all*" [Teacher A2, line 64]. "*They did it totally on their own*" [Teacher A2, line 66].

Surely teachers would not expect learners to design an investigation totally on their without being monitored by the teacher. Learners may not have all the necessary skills to do that, and when they encounter problems in the process they need to be helped onto the right path again.

- According to Teacher B2 learners at School B experienced some problems when trying to gather information from a local clinic. At this school learners were told to visit a local clinic (in groups) to find out about various diseases associated with smoking, and were simply left on their own to get on with it. The teachers did not monitor the situation to see whether all learners had access to such a clinic, to advise them about making appointments, to see that they did in fact make a visit, or to ask the clinics to co-operate. Consequently problems arose,

  > "*... But with the clinics, when they got there ... they don't get ... eh, positive attitude. The nurses there were very negative. They don't give them enough information*" [Teacher B2, lines 133-135] " *... and they would say 'you are troublesome* " [Teacher B2, line 142].

As Sanders and Kasalu (2004) suggest, teachers must monitor learners in their groups to see that everything is appropriately guided, and even assist learners where they need help.

Teachers' preparedness in terms of pedagogical content knowledge

One of the requirements of the new curriculum (Sanders and Kasalu, 2004), is for teachers to be well-prepared in terms of their content knowledge and suitable pedagogical approaches (suitable teaching and learning approaches) to achieve the outcomes. The literature reviewed in Chapter 4 reveals that lack of content knowledge and pedagogical approaches can hinder the implementation of a new curriculum. Content knowledge of the teachers is discussed later in more detail under research question 3.

Four of the 10 teachers (D1, E1, F1 and G1) interviewed seemed to be inadequately prepared in terms of their pedagogical content knowledge to teach about smoking in the way intended by the new curriculum, as revealed in the following discussions. Two teachers (E1 and G1) used only unprepared informal whole class discussions, based on learners' experiences, to teach this section. The "brainstorming" approach used by Teacher G1 resulted in a similar unstructured class discussion to that used by Teacher E1. When I asked Teacher G1 how he handled the topic "smoking and related matters" in class, he said,

> "*Like I indicated ukuthi* ***(that)*** *with the health issues, you know, like putting up the topic and then ... eh ... brainstorming it with the kids.*" [Teacher G1, lines 50-51].

When I asked what he meant by "brain-stormed", he said,

> "*What effects of smoking, how does it affect the person smoking and the other people around him, how does smoke affect the whole environment.*" [Teacher G1, lines 53-54].

If learners are to develop a scientific understanding, teachers cannot simply rely on general class discussions where they question learners about their experiences and prior knowledge, as this does not allow them to learn anything "new". The ideas of brainstorming or having a general discussion in class can be used, for example, to establish learners' prior knowledge in order to build on it, but this was not done by these two teachers.

Provision of necessary resources by teachers

Good facilitators provide their learners with the necessary resources to allow them to construct their knowledge (Sanders and Kasalu, 2004), and assist them (when need arises) in using the resources (Brodie and Pournara, 2005). If learners have to "discover information for themselves" teachers must ensure that the learners have the necessary resources to allow them to find the information (Bentley, 1994; Sanders and Kasalu, 2004), particularly in situations where books, internet availability, and access to experts might be difficult.

- **Schools where learners were provided with resources by teachers**
  - School B provides an example of an "information-seeking activity" where learners were helped with resources (the case study in which a comprehension exercise on emphysema was provided) and one where they were NOT adequately helped. The second activity, in which learners were told to visit a local clinic to find out about various diseases associated with smoking and were simply left to get on with it by Teacher B2, has already been mentioned earlier in this section under the heading, *"Monitoring of lesson progress by the teachers"*.

- **Schools where learners were not provided with resources by teachers**
  - Two teachers (Teachers D1 and F1) used activities where they did not provide the **necessary resources** for the activities.

    Teacher D1 provides an example of lack of provision of the resources learners needed to build knowledge or develop understanding. When asked about an activity on weight loss he said,

    > *"But with this one it was in the form of assumption, because the other group will say, this one lose weight because of this one, while the other group will say no, why are you saying so?"* [Teacher D1, lines 107-108].

    When I asked him whether learners went out to look for the correct answer he said

    > *"No! No! They didn't"* [Teacher D1, line 112].

    It would seem that the teacher wanted learners to realise that smoking affected a person's weight. However, nothing was done to"facilitate" understanding by providing the learners with the resources they needed in order to obtain evidence that smoking resulted in weight loss, although the Continuous Task Assessment activity provided by the Department of Education (which this teacher had), if properly done, would have provided this evidence.

    In as far as facilitation is concerned, Teachers D1 did not comply with the feature (provision of necessary resources) of the requirement of the new curriculum.

- **Schools where teachers did not mention in the interview whether they provided resources**

  Teacher F1 claimed to have engaged learners in activities but does not say in the interview whether he provided the necessary resources for the learners.

Consolidation of lessons by teachers

Consolidation is another important feature of facilitation identified by Sanders and Kasalu (2004). Consolidation needs to be done by a teacher at the end of a lesson to establish whether learners have

covered all the necessary content and that concepts developed are those currently accepted by scientists (Sanders and Kasalu, 2004).

- **Schools where teachers consolidated lessons**

  Only one teacher (B2) seemed to have consolidated her lessons, explaining (in response to my question about what happened if she sent learners out to find answers and they could not find them).

  > " ... *after presentation then I make a summary out of what they have*" [Teacher B2, line 101].

  It is possible that learners might miss some important information, and might develop erroneous ideas, if lessons are not consolidated. Facilitators have the responsibility of ensuring that all learners understand all the science they are learning about, so consolidation of lessons is important.

- **Schools where consolidation was not done**

  At School C, although learners did an investigation and poster creation activity they did not present their work. Teachers C2 mentioned that the learners

  > "... *were not told to present it in class. What they did, the data they recorded they had to ... Okay ... to analyse ... everything was on paper. They had no time for presentation.*" [Teacher C2, lines 61-62].

  By not having the presentations Teacher C2 did not check whether knowledge constructed by the learners was scientifically correct, or whether all learners knew everything they needed to know about smoking and its effects on the human body. In cases where different groups are doing different activities, such whole class presentations are sometimes the only way that all learners will get to learn about all the information they need, in order to fully understand the science in the lessons.

- **Schools where the idea of consolidation was not mentioned**

  Although the rest of the teachers engaged learners in activities it did not come out from the interview whether they made sure that learners had learned correctly all they were supposed to learn.

Discussion and conclusion on the findings regarding facilitation

Many of the teachers interviewed seemed to believe that to "facilitate" means simply ensuring that learners get on with some task, from some topic of interest to the teachers or learners. Firstly, there seemed to be little effort to ensure that all learners eventually developed a complete conceptual understanding of the topic. Secondly, many teachers seemed to be withdrawing from their role as educators, and were leaving learning up to the students. While this may work for some students, it leaves the weaker students floundering. Facilitation is not easily done, and requires a lot of effort on the teacher's part (Nourse, 1999; Sanders and Kasalu, 2004). Teachers cannot simply leave the learners to get on with their own learning. Teachers need to understand that facilitation involves a combination of activities done by learners, which allow them to construct their own scientific understanding (and which may involve them finding information for themselves) and "teaching" [imparting information] (Sanders and Kasalu, 2004). Learners should not have to discover everything for themselves.

Based on the information gathered from the interview some schools (A, B, and C) seemed to have done some facilitation to a certain extent, while with the other schools (D, E, F and G) it was not easy to conclude due to lack of evidence. Reasons for lack of evidence were mentioned at the beginning of the whole section on how teachers complied with the requirements of the new curriculum (see page 86).

Learning needs to be *learner-centred*

The information from the interview sessions with the participating teachers seemed to reveal that they (teachers) either did not understand what learner-centredness means, or did not know what to do. As discussed in Chapter 1, page 10, in section 1.2.3, learner-centredness focuses on recognising and accommodating differences between learners (McCombs and Whisler, 1997; Sanders and Kasalu, 2004).

According to Sanders and Kasalu (2004) learner-centredness focuses on two main features, (1) recognising and accommodating learners' differences and (2) involving learners in some decisions about their learning. The first feature did not come out from the interview sessions with the 10 teachers whether they recognised and accommodated learner differences. Therefore, the second feature will guide the discussion in this section on whether the 10 teachers complied with the requirement of the new curriculum.

- **Schools that allowed learners some choices about how they learn**
  - Two schools (Schools A and C) had an element of learner-centredness in their lessons, allowing the learners to decide what questions about smoking they wanted to find answers to, in their investigations. For example, this is what Teacher A1 had to say about the learners,

    > "*They had to have a question - what do they want to learn about smoking? What did they want to learn from the people they interviewed about smoking?*" [Teacher A1, lines 53-54].

    The teacher said

    > "*... some of them wanted to know whether people were aware of the dangers of smoking. Others were ... cost of smoking and wasting money ...*" [Teacher A1, line: 157].

  - School C had a similar investigation. Each group of students had to design five questions, based on their interests, for the questionnaire the class was constructing. School C also showed an element of learner-centredness in the poster learners had to construct to warn the community about smoking, because they did this

    > "*in different ways. It will depend on the creativeness of the learner.*" [Teacher C1, line 174].

    Learners at these two schools (A and C) were given the opportunity to make some choices about what they wanted to do, which is in accordance with the second feature learner-centred practice. However, I could not tell whether teachers at these schools did that consciously or it just happened by chance.

- **Schools that did not allow learners some choices about how they learn**

  At other schools, for example schools B and G, learners were not given the opportunity to choose how and what to do at any time during the topic on smoking.

  - At School B learners were engaged in at least five activities on the topic (see Table 15 in the section on activity-based approaches on page 91), but in none of them were the learners allowed to make any decisions. For example, in one activity they were told

    "*... to go and visit their local doctor or local nurse or get to the clinic and learn more about what is bronchitis, pneumonia, tuberculosis and lung cancer*" [Teacher B1, lines: 54-56].

  - Teacher G1 engaged learners in three activities (see Table 15) when addressing the topic on smoking, but learners were never given an opportunity to choose what they wanted to do. In one of the three activities learners were told to draw

    " *... sketches of a person smoking and the other one who is not smoking and showing the effects of smoke ...*" [Teacher G1, lines70-71].

  The teacher did a demonstration on diffusion using a burning cigarette while learners listened and watched.

- **Schools where the idea of allowing learners some choice did not come up in the interview**

  With schools E and F it was not apparent from the interview whether the teachers used any aspect of a learner-centred approach.

It is difficult to say whether teachers complied with the requirements of the new curriculum in as far as learner-centred approach is concerned because, for reasons already explained, the interview sessions did not give much data on the features of requirement. As for those teachers who allowed learners some element of choice, it was not apparent from the interviews whether they did that consciously or not.

Making *skills development* a focal part of the curriculum

The new school curriculum in South Africa encourages the achievement of skills by learners (Department of Education, 2002), but this does not necessarily mean that skills development must be done in every topic.

Before giving learners a research task I asked Teacher B2 whether she taught them how to do research. She stated that

> "*[b]efore ... maybe in January, I will be giving them some hints on how to research ... how to go about, you know, a project, maybe on Natural Sciences, I will be giving them some hints*" [Teacher B2, lines 111-113], adding [lines 130-131] "*When you research, maybe like ... eh ... interviewing a person, take note of important things. That is what I tell them*".

However, the teaching of skills requires more than this "supply the recipe" approach (Beyer and Charlton, 1986). Giving hints about a skill is not an effective way to teach a skill. Skills must be actively taught (Sanders and Kasalu, 2004), and teaching skills requires overt planning and active teaching and it is not always easy to do (Sanders, 2002).

Another important point for teachers to note is that developing skills is more than just getting learners to use the skill (Sanders and Kasaulu, 2004). Beyer and Charlton (1986, 207) claim that "*(t)oo often what we assume to be teaching of these skills consists instead only of making students attempt to use these skills*". Teacher C1 seemed to be confusing **using** a skill and **developing** it. She said they were trying to develop skills across learning areas.

> "*... we are not only looking at the information, like, we want our learners to* ***choose*** *different skills and integrate. For instance, the graphs and the tables, those are maths skills integrated in Natural Sciences.*" [Teacher C1, lines 147-152].

But there is no mention of actually teaching any skill.

None of the other teachers even mentioned skills development for this section of work, which could be due to the fact that during the interview I did not probe on skills development. In as far as the teaching and development of skills is concerned, it is difficult to conclude whether the 10 teachers complied or did not comply with the requirement of the new curriculum.

Promoting the use of *groupwork*

Seven of the ten teachers said they had used groupwork for at least one activity. According to the new curriculum policy, groupwork should "*feature prominently in their* [learners] *learning*" (Department of Education, 1997: 5), as discussed in Chapter 1 page 14.

Sanders and Kasalu (2004) emphasise six features of groupwork which teachers need to understand before they can successfully implement the new curriculum policy on groupwork. However, I will guide my discussion with three of the six features that I have data on.

- although groupwork must "feature prominently", not all learning has to involve groupwork.
- groupwork must involve purposeful, meaningful activities. Tasks should not be mindless activities done simply for the sake of working together.
- groupwork will probably require facilitation — monitoring and input from the teacher — if meaningful learning is to happen. The groups should not always simply be left to get on with tasks.

(Sanders and Kasalu, 2004)

Groupwork featuring prominently in learning

Seven of the ten teachers claimed to have used groupwork.

- At School C, Teacher C1, when asked how she involved learners when dealing with the section on smoking, said

  > "*... When you talk about a topic like smoking, you are not doing the talking. Most of the information comes from the learners. Our learners sit in groups, so it makes it easy for them to go into group discussions, and giving presentations - that is feedback to the rest of the class.*" [Teacher C1, lines 76-78]

  This quote suggests that teachers at School C promoted the use of groupwork.

- At School A Teacher A2 said learners were working in groups of five during the investigation, and were given the opportunity to "... *choose the group members themselves*" [Teacher A2, line 54]. This is another example where the school promoted groupwork.

Teacher D1 made learners work in groups because learners have to work "... *in groups because this is part of OBE ... must be a group thing always*" [Teacher D1, line 125]. According to literature (e.g. Davis, 2001; Rogan and Grayson, 2003; Brodie and Pournara, 2005) the policy on groupwork, which states that groupwork should feature prominently in learning, is one which seems to be misunderstood by many teachers. The quote above suggest that Teacher D1 thinks that all work should be done in groups. However, Sanders and Kasalu (2004) point out that not all learning has to involve groupwork.

Involving purposeful, meaningful activities in groupwork

Sanders and Kasalu (2004) emphasise that groupwork should involve purposeful and meaningful activities. Meaningful activities have already been discussed in this chapter on page 94, under the heading The following discussion cites an example of a school where a task given to learners seemed meaningless.

> At school D the group task that learners were told to do seemed to lack purpose and meaningfulness. Teacher D1 talked about the learners doing "research" but it was apparent that this involved no more than individuals in groups finding pictures (in newspapers) of people smoking and making posters. (D1 = the teacher, Rs = the researcher)
>
> D1: *It's a matter of going outside to do some research.*
>
> Rs: *Who is giving them all these instructions?*
>
> D1: *Myself.*
>
> Rs: *You tell them "okay go out and get information"?*
>
> D1: *Come with the posters. When you see somebody smoking in a newspaper just cut the picture and paste it somewhere ... like that.*
>
> Rs: *Okay. And how were they doing it? Were they doing it in groups or individually?*
>
> D1: *Ja! In groups because this part of OBE must be a group thing always.*
>
> Rs: *Okay. Now, once they got all this information, what do they do with it? Because they have collected all the information that you wanted to them to collect ... what did they do after that?*
>
> D1: *They submit it, may be in group A, B, C, D. In group A somebody maybe is a secretary, so they submit, not individually, maybe one for groups A, B, C and D. Then I evaluate. After that I put it in their* (learners) *files and I record it.* [Teacher D1, lines 118-130]
>
> In this task there is nothing educational or any content to be learned. There is no purpose of achieving any outcome. Not only does the task seem pointless, but simply filing the work and recording marks is not helpful in promoting learning.

Facilitating and monitoring groupwork

Sanders and Kasalu (2004) suggest that groupwork will probably require facilitation, monitoring and input from the teacher if meaningful learning is to happen.

- **Schools which facilitated and monitored groupwork**
  - The teachers at School C not only monitored learners' progress , but also gave input, reviewing the initial questions groups provided for the questionnaire being designed, and giving them feedback on how to clarify wording before they went out to interview people (using the questionnaire), so questions were not ambiguous (as discussed in the section on facilitation),

    "*... each group brought five questions and then we looked at them and decided on 10 questions*" [Teacher C1, lines:108-109].

    It is important to give learners feedback on the questions they are going to ask people to ensure the data they collect is of educational benefit to them.
- **Schools which did not facilitate and monitor groupwork**

  At School B learners were told to visit a local clinic (in groups) to find out about various diseases associated with smoking, and were simply left to get on with it (as explained in the section on facilitation on page 97).
- **Schools where teachers were not probed on facilitating and monitoring groupwork**

With three teachers (E1, F1, and G1) I did not probe them on groupwork, so I cannot conclude whether they promoted groupwork in their lessons or not when addressing the section on smoking.

Continuous assessment should be used

At least nine of the ten teachers who participated in this study said they assessed learners for the section of work on smoking. However, it did not come out during the interview sessions with the 10 teachers whether the assessment was continuous or not. The tenth teacher (Teacher E1) who dealt with smoking with her matric learners, did not assess the learners for this section.

> "*You know, with assessment, you only assess what you know is going to come in the exam*" [Teacher E1, line 101]. She further said "*No. There is no assessment whatsoever*" [Teacher E1, line 113].

According to what Teacher E1 said in the section of the transcript above, it would seem that she only assessed what she knew would be asked in the examination. However, the new curriculum requires teachers to assess learners continuously throughout the year (Department of Education, undated b; Sanders and Kasalu, 2004; Department of Education, 2006). Assessing continuously does not necessarily mean that each and every lesson must be assessed. Continuous assessment has to be done over a period of time and should be ongoing (Department of Education, 2002). According to the Department of Education assessment is an integral part of the new curriculum (Department of Education, undated b), and it serves a number of different purposes (as explained in Chapter 1, page 15 in section 1.2.3).

For some of the teachers, perhaps it would not have been possible to assess the section on smoking on an ongoing basis because the amount of time they spent on the topic was too short. Table 20 (on the next page) shows the amount of time that the 10 teachers said they spent teaching about smoking and associated topics (e.g. the respiratory system).

Table 20: Amount of time the 10 teachers said they spent on the section on smoking

	School A		School B		School C		School D	School E	School F	School G
Teacher	A1	A2	B1	B2	C1	C2	D1	E1	F1	G1
Time spent on the topic	2 periods		2 weeks		1 week	2 weeks	3 days	2 periods	2 weeks	2 periods

As indicated in Table 20 teachers A1, A2, E1 and G1 spent only two periods on the section on smoking, so would not have be realistic to expect the teachers to assess learners continuously. However, with the other teachers who spent more than two periods on the topic, data were available to report on. What follows is a report on how the teachers assessed learners.

- **Use of formal assessment**

  School C used two major activities (see Table 16 on page 91), an investigation and a project, both of which were assessed using rubrics. The two teachers at this school confirm that they did assess the learners.

- **Use of informal assessment**

  Six of the 10 teachers (B1, B2, C1, C2, F1 and G1) also appeared to be doing some ***informal*** assessment (assessment, e.g. by observation, not using standard methods of assessment), particularly for skills and attitudes.

  - Teacher B1, when asked to what extent her assessment tasks checked knowledge of facts said

    "*After going out to the doctors and the nurses* ***you can see*** *that they have learned a lot*" [Teacher B1, lines 202-203].

  Teachers should not rely solely on informal assessment because it does not give a clear picture of what every individual learner has learned from whatever activity they were given. However, it should be noted that the purpose of an assessment is important. If the assessment achieves the purpose it is set for, then it is worth it.

  - Teacher G1did some formal assessment (short class work), but when asked whether he assessed learners' attitudes responded,

    "*Mmmm ... No! No! Not much, not that much. But now* ***if you just observe,*** *there is always an excitement of some kind when you talk about smoking*" [Teacher G1, line 138-139].

  Assessing learners by observation serves little educational purpose if you objective is to find out whether learners have learned anything from a particular lesson. It might not be everyone who is excited about the section on smoking. Whereas if you assess every learner using standardised methods of assessment, one would get a clear picture as to what percentage of learners enjoyed the topic and what percentage did not. However, informal assessment cannot be ruled out completely, it has a purpose that it can serve, depending on what the teacher wants to assess.

  - Teacher C2, when asked what he did after learners have done the investigation and the project on the poster (warning about people about the dangers of smoking), said

    "*... eh message is sent ... eh ... to me, after I had a poster from each one of them. Then ... eh ... to them now it is knowledge and they know ... the effects of ... even if they*

would continue smoking, but they would know what is expected ... knowledge is there now" [Teacher C2, lines 96-99].

Having a poster does not necessarily mean that learners have learned all they need to learn about smoking and related matters by simply developing a poster and interviewing people about their smoking habits, particularly when Teacher C2 stated during the interview that learners "*had no time for presentation*" [Teacher C2, line 62]. Having learners present their work in class would have given the teacher an opportunity to correct whatever misconceptions learners might have developed after doing the tasks they were asked to do, and assisted with additional information where it was needed. However, the purpose of the poster was to warn people about the dangers of smoking. Hence, the assessment should be on whether the learners achieved the objective (that is warning people about dangers of smoking).

▸ **Pointless assessment**

Teachers should note that assessment done with no educational purpose or benefit is pointless. One of the benefits (to the learners) of assessment is to provide learners with feedback so that they can use it to improve their knowledge, skills or attitudes, depending on the feedback they have received. The quote (below) from the interview of Teacher D1 illustrates a case where assessment seemed to serve no educational purpose. Teacher D1 stated that after learners had finished the activity they were doing in groups,

"[t]*hey submit it, maybe group A, B, C, D ... Then I evaluate, after that I put it in their files and I record it. No one is wrong*" [Teacher D1, lines 127-129]. He continued to say "[t]*hat is part of OBE ...*" [Teacher D1, line 132].

In this case learners (in groups) had submitted a poster, and all the teacher did was to allocate a grade and then file the work. Learners were not given feedback on the work they had done. Teacher D1 claims that no one is wrong: Then what would be the point of assessing learners if no one is wrong? This verifies the point made above, that the assessment seemed to serve no educational purpose.

In summary, although all except one teacher (Teacher E1), claimed to have assessed their learners, for some teachers it did not come out clearly from the interview sessions whether they applied continuous assessment when assessing learners for reasons already mentioned earlier in this chapter.

5.2 TEACHERS' USE OF THE CURRICULUM SUPPORT MATERIALS

The information presented and discussed in this section tries to answer the research question 2.

Research question 2:	**What are the existing norms regarding teachers' use of support materials?**

Provided they contain relevant information and clear instructions on how to use them in a classroom situation, curriculum support materials can help teachers who are struggling to implement a new curriculum, acting as "*agents for instructional change*" (Ottevanger, 2001: 47). Curriculum materials can provide resources (such as lesson plans, activity-based worksheets, assessment tasks, rubrics for

assessment) which not only supply new ideas for teachers, but save them time and effort (Ottevanger, 2001). However, it is now widely realised that many teachers do not make use of curriculum materials, or do not use them as intended (Olson *et al.*, 1999; Hall and Hord, 2006). As already explained in Chapter 3, section 3.4.3 on "Factors affecting the use of curriculum materials" , there are several factors that may affect teachers' decision, to use or not to use curriculum support materials they are provided with.

Twenty-five teachers responded to the questionnaire on teachers' use of support materials. Out of the 25 teachers who responded to the questionnaire, only seven said they had previously had access to any form of support materials. All the seven teachers had made use of the materials, but **none** of them had used the materials exactly as suggested by the designers, four of them using less than half of the package. This is not surprising, as the literature on the use of curriculum materials shows that when teachers do utilise such materials they tend to be selective in their use, applying 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). As a consequence the package that I developed was made flexible in the sense that it has a number of alternative strategies suggested for achieving outcomes, from which teachers can choose.

Teachers were asked to give reasons why they did not use all that was in the packages they had. Their responses were clustered according to trends that emerged, as indicated in Table 21. One teacher gave a vague response which seemed to have nothing to do with curriculum materials, and was therefore excluded. Another teacher gave two responses.

Table 21: Teachers' responses on why they did not use curriculum materials they had (n = 6)

Cluster	Frequency	Teachers' responses
Clarity of the material	2	▸ *Some of the material is not clear for one to teach about or explain.* ▸ *I had no idea on using it.*
Resources demanding	2	▸ *It is demanding in terms of resources.* ▸ *In science chemicals and most equipment are to be bought.*
Time	1	[It is] *time consuming.*
Relevance of the material	1	*Some* [material is] *not relevant to the syllabus.*
Use of own documents	1	*Because I had my documents and some other prepared extra.*

- **Clarity of curriculum material**

  Curriculum materials meant for teachers to use in class should be user-friendly, that is, teachers should be able to use them with ease. It is therefore important that before the curriculum materials are issued, workshops are arranged to introduce them to the teachers to avoid statements by teachers such as "*some of the material is not clear for one to teach about or explain.*"; or "*I had no idea on using it correctly,*" which were the reasons given by two teachers for why they had not used the support materials they had.

- **Availability of resources**

  Cheap and locally available resources should accompany packages or be identified and recommended to teachers. One teacher complained that "*it* [the curriculum material] *was demanding in terms of resources ...*" I interpreted this to mean that the school did not provide resources to carry out activities in the package. Another teacher gave the same reason, explaining that although they had support materials the school was expected to have the necessary equipment and chemicals described in the resource packages.

- **Time**

  One teacher claimed that the reason for not using the curriculum package he had was that it was time consuming. In my opinion, some teachers use time as an excuse for not being interested in curriculum packages. Well developed curriculum materials that are in line with what teachers are doing in class (see the point on relevance below) should not be waste of time to use.

- **Relevance of the material**

  One teacher pointed out that "*some material was not relevant to the syllabus,*" which is the reason why he did not use the package he had. A good teaching and learning package should have a variety of activities from which teachers can choose those that are relevant to what they are teaching in class. It is therefore, important to do a needs analysis to get firsthand information from the teachers who will be using the package, on areas where they need assistance (which is what I did before developing the package). This will assist the developers of curriculum materials to develop materials that are in line with what teachers are doing in class. According to Zammit (1992) and Draper (1998) it is important to involve stakeholders during the development of curriculum materials because it means the materials are more likely to be responsive to their needs, and thus more likely to be used

- **Use of own documents**

  One of the six teachers mentioned that he did not use a teaching and learning package he had access to because he had already prepared his own materials (see Table 21). From my experience of more than six years in the teaching profession, teachers who have been in the teaching profession for a long time do not find it easy to change their ways of teaching. Issuing them with curriculum materials is like derailing them from the way they do their teaching.

The information gathered in this section assisted in the development of the teaching and learning package developed for teachers, for example, a variety of activities were developed for teachers to choose those that are relevant to what they are doing in class. Also, a section on resources was done to address the issue of resources.

5.3 NEEDS ANALYSIS

Most teachers who were at the workshop pointed out that smoking was a serious problem at their schools (as indicated in section 5.1.1 on pages 78-82). As a reminder to the reader, the total number of teachers

who participated in the workshop was 29. It was important to find out what kind of assistance teachers needed in order to address the problem in a classroom situation. One of the lessons learned from the literature reviewed in Chapter 3 is that it is crucial to involve teachers in an innovation rather than imposing a new curriculum on them (see Chapter 3,section 3.6)

One of the aims of this study was to obtain research-based data about what would be appropriate information to put in the teaching and learning package (which dealt with smoking-related matters) in order to assist teachers with content-based information. One way of obtaining such data was to ask the teachers what they needed to know about smoking and related matters. A second way of obtaining such data was to give teachers written tasks to do in order to establish their content knowledge on smoking-related matters. Teachers' views about what to be included in the package, and what the tasks showed assisted in the selection of content knowledge that was included in the package.

The data presented and discussed in this section attempts to answer the following research question.

Research question 3: What needs exist which could be addressed in the package?
3a) What do teachers say they want to be included in the package?

5.3.1 What teachers said they needed in order to teach the section on smoking and related matters

In order to generate this information questions were asked at different stages during the workshop. The reason for having two almost similar questions was to triangulate the data collected. Also, because information was given to the participants during the workshop and some discussions took place during the workshop, I thought that after teachers' reflections they might want to add more to the list of things they wanted to know more about, at the end of the workshop. Hence, the second question was included. The two questions asked were:

> ***What would you like to know more about, regarding smoking and smoking-related issues?***
>
> ***Tell us what you want: Please list the things you would like us to include in the package on "Smoking and related issues"***

An analysis of their answers to the first question about what they wanted to know more about revealed the categories of needs shown in Table 22 on the next page.

Table 22: What the teachers wanted to know more about, regarding smoking (n = 29)

What teachers wanted to know		n =	% of sample
Effects of smoking (42 comments) 59%	Diseases caused by smoking.	15	52
	What parts of the human body are affected by smoking.	10	31
	The effects of smoking on the unborn babies of pregnant women.	7	24
	What makes people addicted to smoking.	6	21
	Passive smoking and its effects.	4	14
How to deal with smoking (12 comments) 17%	How to quit smoking.	8	28
	How to discourage learners from smoking.	4	14
Content of cigarettes (6 comments) 8%	The harmful substances found in cigarettes.	6	21
Other (11 comments) 15%	How cigarettes are made.	5	17
	The cost of tobacco.	4	14
	Why people smoke.	2	7
Total number of requests		**71**	

It should be noted that the column with (n) in Table 22 represents the number of comments by the teachers, and the column on percentage sample (% of sample) indicates the percentage of the number of teachers out of the total (n=29) that presented that particular request.

Of the 71 requests by the teachers, 42 of them (59%) were on the effects of smoking, while 12 (17%) had to do with how to deal with the smoking problem. The average request per teacher was about two requests.

Among the four categories, the one on effects of smoking had the most common request (n = 15) which was for information on *diseases caused by smoking*. This means that in this category, 52% of the teachers who responded to the questionnaire wanted to know more about diseases associated with smoking.

The information in Table 22 indicates that most requests by the teachers were on the effects of smoking, which may suggest limited content knowledge on the effects of smoking by some of the teachers. This information was important for deciding what topics needed to be included in the package, as well as the background information needing to be provided.

Whereas the first question was only about content the second question, asked at the end of the workshop, was what they wanted to be included in the package.

Three categories of requests emerged from the teachers' answers: (1) content-related information, (2) information on pedagogical approaches for teaching the topic (i.e. pedagogical content knowledge), and (3) a need for resources (see Table 23 on the next page). It was not clear whether the teachers wanted resources to be included in the package or just wanted to know where they can find them. Anyway, the package developed provides teachers with some resources and also lists of places where they can find resources (see Chapter 6 section 6.3).

Table 23: Suggestions by teachers on what they would like to see included in the package (n = 29)

Teachers' suggestions		No. of comments	% of sample
Content-related information (23 comments) 33%	Different ways of smoking	4	14
	Why people (e.g. teenagers) smoke	3	10
	Information on how to counsel smokers	3	10
	South African statistics of people suffering and dying from smoking	3	10
	Drugs and drug abuse in schools	2	7
	Air pollution	2	7
	The diseases caused by smoking	2	7
	Advantages and disadvantages of smoking	2	7
	Difference between a smoker and a non-smoker	1	3
	Smoking and pregnancy	1	3
Pedagogical approaches (5 comments) 7%	Ways of doing assessment; suggested rubrics to see what exactly is needed	3	10
	Experiments involving smoking	1	3
	How can we prevent smoking as the community	1	3
Resources (42 comments) 60%	Posters on smoking-related diseases	15	52
	Models or instructions on how to construct and use models	15	52
	Pamphlets on smoking and smoking-related matters	5	17
	Educators' guide	2	7
	Questionnaires for research work on smoking	2	7
	Models to demonstrate to learners during experiments	2	7
	A video-tape that comes with the whole package	1	3
Total number of requests		**70**	

Of the three categories, the most common was a need for **resources**. Table 23 shows that 42 of the 70 requests (60%) were for resources. 52% of the teachers wanted to be assisted with posters on smoking-related diseases. Twenty-three of the requests (33%) were on content-related information, with the highest request being on different ways of smoking.

Teachers' requests were slightly different from the ones listed in Table 22. As already mentioned earlier, this questionnaire was administered at the end of the workshop after teachers had been involved in discussions on various things introduced at the workshop, and trialing some experiments using models (e.g. lung model, automatic smoker, and the spirometer). Most of the requests listed in the second questionnaire seemed to have been influenced by what teachers saw or engaged in at the workshop. For example, among teachers' requests were posters and pamphlets on smoking, instructions on how to construct and use models, models to demonstrate to learners during experiments, experiments on smoking, and others.

5.3.2 What the teachers knew about smoking

The information in this section attempts to answer sub-question 3b) on the following page.

Question 3: What needs exist which could be addressed in the package?
3b) What is the nature and extent of teachers' content knowledge about smoking and its effect on human body?

At the workshop teachers were asked: "**Do you think you know enough about smoking to teach about it**?" This question was asked in order to establish teachers' perceptions about the adequacy of their content knowledge on smoking and related matters.

Twenty-nine teachers responded, only seven of whom said "yes". Thus only 24% claimed they knew enough about smoking to teach the topic. Four (14%) said "no", and 19 (66%) indicated they were "not sure". This information suggests that most of the teachers probably lacked the content knowledge about smoking and related matters which they needed to teach it.

It was important for me to have these data in order to establish the validity of the teachers' responses about their levels of knowledge. However, South African research reveals that many teachers "*over-estimate the adequacy of their own knowledge*" (Sanders and Ngxola, 2009: 417). In my research participating teachers were asked four questions designed to assess their actual basic knowledge, which they would have to know about before they could teach the section on smoking [See Appendix D for the diagnostic questionnaire on content knowledge].

Parts of the body affected by smoking

Firstly, the teachers were given a diagram of a human body (showing the internal organs) and asked: **If cigarettes harm the body, which parts of the body do you think would be affected, and why?** They were asked to "show the answer by drawing an arrow to the body part you think is affected. Label the part with its name. Add a short explanation about how you think that part is harmed by smoking." Table 24 shows information collected from the 29 teachers who responded.

The data obtained from this activity were categorised according to the systems of the body (see Table 24 on the next page). The most striking consequences of smoking are lung cancer and chronic obstructive pulmonary disease (Annual Smoking-attributable mortality, 2005). According to medical reports, smoking causes about 90% of lung cancer in men and almost 80% of lung cancer in women. About 90% of all deaths from chronic obstructive lung diseases (e.g. chronic bronchitis and emphysema) are attributable to cigarette smoking (Annual Smoking-attributable mortality, 2005).

Not unexpectedly, the majority of the answers, 81 out of 133 (61%), related to parts of the gaseous-exchange system. However, only 44 out of 81 (54%) comments were accompanied by the requested explanations regarding how various parts of the gaseous exchange system are affected by smoking. This means that 46% of the answers did not have explanations, which raises questions about teachers' content knowledge. Of the 44 explanations provided only 10 (23%) were scientifically correct. Twenty-eight of the 44 answers (64%) were considered to be inadequate (usually because they were incomplete) and six (14%) were scientifically incorrect. Thus although teachers seemed to know some of the body parts of

the gaseous exchange system affected by smoking, only ten would be explained correctly, whereas 34 would probably be inadequately explained and six would probably be explained incorrectly if the teachers taught based on what they "knew".

Table 24: Body parts which the teachers thought are affected by smoking (n = 29)

Body part teachers thought is affected		No. of teachers listing body part	Explanation ...			
			provided	correct	incorrect	inadequate
Parts of the central nervous system	brain	21	9	0	2	7
	nerves	1	1	0	1	0
	eyes	4	2	2	0	0
Parts of the gaseous exchange system	nasal passages	11	4	0	0	4
	mouth	14	6	3	2	1
	throat	19	10	2	0	8
	trachea	7	3	0	0	3
	bronchi	1	1	0	0	1
	lungs	29	20	5	4	11
Parts of the cardio-vascular system	heart	3	2	1	1	0
	blood vessels	2	2	1	0	1
Extremities	fingers, feet etc.	6	2	2	0	0
Excretory system	bladder	1	0	0	0	0
	kidneys	4	3	1	0	2
Other body parts	stomach	2	1	0	0	1
	skin	1	0	0	0	1
	nails	2	0	0	0	0
	joints / bones	2	1	0	1	0
	fungus under feet*	1	0	0	0	0
	liver*	2	1	0	0	1
Totals		**133**	**68**	**17**	**11**	**41**

Note: Parts with * are incorrect

The other body system seriously affected by smoking is the cardio-vascular system. Coronary heart disease is one of the diseases of the heart associated with smoking, caused by the narrowing of the coronary arteries (blood vessels that supply the heart with blood and oxygen). This is likely to cause angina (chest pain) or heart attack (Royal College of Physicians, 2001). An estimated 437,902 Americans died each year during the period 1997 to 2001 due smoking-related illnesses, and 137,979 of the 437,902 (34.7%) deaths were because of cardiovascular-related diseases (Annual Smoking-attributable mortality, 2005).

Out of the 29 teachers only five (17%) were aware that smoking affects the cardio-vascular system, three mentioning the heart, and two that blood vessels are affected. Four of the five teachers provided explanations, and only two of the four explanations were scientifically correct. For the 24 teachers who did not know that the cardio-vascular system is affected by smoking (83% of the sample), this is a serious concern in as far as lack of content knowledge on smoking is concerned.

Another system affected by smoking is the nervous system. Smoking contributes to the hardening of the arteries supplying blood to the brain, causing them to constrict so that blood flowing to the brain is blocked. This process can cause a stroke (Solomon and Davis, 1986). Twenty-one teachers (72%) said the brain was affected by smoking. However, only nine gave an explanation of how it is affected, and none of these explanations were scientifically correct. Seven were incomplete and two were scientifically incorrect. It is possible that a number of teachers had simply "guessed" that the brain might be affected, rather than known this for a fact.

Health problems or diseases caused by smoking

The harmful substances found in cigarette smoke are capable of causing damage to parts of the body systems. The second of the four questions was as follows: **List any health problems or diseases that you think are caused by smoking**. Teachers were then asked to indicate how sure they were that their answer was correct ("sure", "think so", "guessing"). These "confidence levels" were used to check teachers' content knowledge as it is easy for one to guess the answers. Their answers are summarised in Table 25.

A number of problems associated with smoking were not mentioned by the teachers, including strokes and stomach ulcers, and in women early onset of menopause and osteoporosis. Babies born to mothers who smoke are more likely to be still born, born underweight or to die before the age of one (Crofton and Simpson, 2002). Only one teacher mentioned the effect of smoking during pregnancy. One serious consequence of smoking not mentioned by any of the teachers is that blocked blood vessels result in circulation problems which can cause pain in the legs during exercise and may eventually lead to amputation of limbs. Types of cancers teachers did not mention included cancer of the vocal cords, mouth, tongue, bladder, pancreas, kidney, stomach and cervix, all of which have been found to be more prevalent in smokers than non-smokers (Royal College of Physicians, 2001; Crofton and Simpson, 2002).

Table 25on the next page suggests that the knowledge of most the teachers exists at the level of "general knowledge". For example, although it is true that cigarette smoking affects the lungs (Crofton and Simpson, 2002), it is common knowledge that when you inhale cigarette smoke it goes to the lungs and affects them. My parents would always warn me that cigarette smoke would burn my lungs if I smoked. This could explain the high number of teachers (12 out of 13) who were sure that smoking caused lung cancer.

Another pointer that may suggest that the teachers' knowledge exists at the level of general knowledge is the fact that six teachers stated that smoking causes tuberculosis and five out the six were sure of their answer. The reason for these teachers claiming that tuberculosis is caused by smoking could be the way some people pronounce tuberculosis [tobbaco - losis], leading them to believe it is caused by tobacco smoking.

Naming the hair-like structures and explaining their purpose and function

The third question used to assess teachers' knowledge on the topic was phrased in this manner: The body parts indicated by arrows in this diagram are lined by tiny hair-like structures. **What are they called? What is their *purpose* and how do they *function*?**

This question was asked because the earlier interviews of teachers who were teaching about smoking suggested that many of them did not know about cilia, or teach about them. Yet the role of cilia is crucial in moving the particle-trapping mucous out of the passages of the breathing system, to keep them clear of harmful substances. The movement of the cilia is slowed down by smoke so that tar and other harmful particles are not cleared out of the lungs, which causes many of the so-called "respiratory" problems in smokers.

Only seven out of the 29 teachers (24% of them) were able to correctly name the cilia, although eight teachers were able to give a correct explanation of their purpose. Ten of the 29 teachers (34%) did not attempt to name the structures and 12 (41%) gave an incorrect name. No-one explained how they function. This could have been because the wording of the question was confusing as there were two questions in one sentence. A very large percentage (76%) of the teachers did not know the name of these tiny hair-like structures and their purpose. This raised doubts in my mind about aspects of the teachers' content knowledge about smoking and smoking.

Table 25: Health problems or diseases the teachers thought can be caused by smoking (n = 29)

			How sure they were that their answer was correct		
		n =	Sure	Think so	Guessing
Question not answered		5			
Cancer n = 31 (52%)	cancer of the lungs	13	12	1	0
	cancer of the throat	8	5	2	1
	cancer (unspecified)*	8	6	2	0
	cancer of the blood*	1	1	0	0
	cancer of the intestine*	1	1	0	0
Lung diseases n = 15 (25%)	tuberculosis*	6	5	1	0
	chronic bronchitis	3	2	1	0
	asthma	3	2	1	0
	emphysema	2	2	0	0
	pneumonia	1	1	0	0
Cardio-vascular problems n = 4 (7%)	cardio-vascular diseases	2	2	0	0
	heart attack	1	1	0	0
	high blood pressure	1	1	0	0
Nervous system n = 6 (10%)	brain damage	3	3	0	0
	cause foetus brain cells to die	1	1	0	0
	affects the eyes*	1	0	0	1
	addiction (not a disease or illness)*	1	1	0	0
Other body parts	many body diseases (unspecified)*	1	0	0	1
Other effects n = 3 (5%)	premature babies	1	1	0	0
	tooth decay*	1	1	0	0
	bad breath (not a disease)*	1	1	0	0
Totals		60	51	8	3

Note: The * indicates diseases or health problems not associated with smoking

Naming the harmful substances found in cigarette smoke

The fourth question about the effects of smoking on the body asked: "**What are the harmful substances found in cigarettes?** Show your answer by drawing an arrow to the relevant part of the cigarette and naming the harmful substance. Add a short explanation about what you think that substance does to the body."

Tobacco smoke contains more than four thousand identified substances, some of which are toxic, and 43 of which are carcinogens [cancer-causing substances] (Cigarette and Smoke Composition, 2001; Royal College of Physicians, 2001; Crofton and Simpson, 2002). All the harmful substances in cigarettes are actually found in the smoke of burning cigarettes. Although the majority of the teachers (26 of the 29) were aware of the main harmful agent in cigarettes (nicotine) only 11 of them (42%) were able to give a correct explanation of the harm done by nicotine. Far fewer teachers were able to name the other two most harmful substances, namely tar (n = 6) and carbon monoxide (n = 4), and only four and two teachers, respectively, could correctly explain their effect. One teacher named a substance which is not found in cigarette smoke (cocaine), and three teachers gave irrelevant answers (filter, vocal cords, emphysema). There is no way that one could find a filter, vocal cords or emphysema in cigarette smoke. This suggests some teachers may not have understood the question. Table 26 shows the harmful substances which teachers thought were found in cigarettes.

Analysis of the data from Table 26 (see on the next page) again suggests that the teachers' knowledge about smoking and related matters exists mainly at a level of general knowledge. This is shown by the obvious substances they named that are found in cigarettes (smoke, tobacco and ash). Obviously if you light a cigarette there will be smoke. Besides nicotine, smoke was the most frequently mentioned substance (n = 14).

The data collected from the four questions suggest that the majority of the teachers did NOT have sufficient content knowledge about the biological effects of smoking on the body to teach the topic adequately. This information prompted me to consider including content-information for the teachers in the package (as explained in Chapter 6, section 6.1).

The lack of content knowledge with regard to smoking and related matters was further evident in the interview sessions conducted with 10 teachers from seven schools. Because of the amount of information which can be elicited by questionnaires during a workshop, the ten teachers who were interviewed were also asked about smoking and related matters in order to get more in-depth information about their knowledge on smoking, although the main purpose of the interviews was to find out how they taught the topic in class prior to using the package designed for this research. Some comments from the interviews can be used to triangulate what had been found in the questionnaires. As discussed below, the information that emerged during interview sessions with the participants revealed (1) gaps in the teachers' knowledge about smoking and related matters and (2) some scientifically incorrect claims which suggested that some teachers may have misconceptions about certain science concepts they have to teach.

Table 26: Harmful substances which the teachers thought are found in cigarettes (n = 29)

Categories	Substance named by teachers	How the substance actually affects the body	No. of responses	Explanation		
				None given	Correct	Incorrect
The major harmful substances	nicotine	An addictive "drug" which acts on the brain and narrows the blood vessels, affecting circulation (especially in the fingers and toes) and raising the blood pressure.	26	7	11	8
	tar	Reduces the flexibility of the alveoli, causing smoker's cough and shortness of breath. Hot microscopic particles of tar irritate the inner linings of the mouth, increasing the chances of cancers of the mouth and throat.	6	1	4	1
	carbon monoxide	An odourless, colourless and very poisonous gas which lowers the capacity of the blood to carry oxygen. It increases the risk of developing circulation problems, such as hardening of the arteries and coronary disease.	4	1	2	1
Other harmful substances	carcinogens	Cancer-causing agents, such as hydrogen cyanide, cadmium and benzopyrene.	2	0	2	0
	carbon dioxide	Normally a by-product of respiration, which the body excretes (gets rid of).	4	2	1	1
	cyanide	Chemical compound that contains the cyano group with the carbon atom triple bonded to the nitrogen atom. Not all cyanides are toxic, but those that release the cyanide ion are highly toxic.	1	0	0	1
Parts of the cigarette	smoke	Tobacco smoke is harmful because it contains nicotine, tar, carbon monoxide and carcinogens	14	1	9	4
	tobacco	There is no harm if tobacco is not lit, unless it is chewed.	2	2	0	0
	filter	No detrimental effect to body	1	0	0	0
Irrelevant answers	vocal cords*	No effect to body	1	0	0	0
	emphysema*	No effect to body	1	0	0	0
	ash*	No effect to body	1	0	0	0

Note: The * indicates incorrect answers

Gaps in teachers' knowledge about smoking and related matters

Four of the 10 teachers (B1, B2, C2 and D1) showed evidence of lacking knowledge which they should have known about in order to teach this section of work. Teacher B1 acknowledged

> "*You know, we never taught them, really, the smoking part. For instance, if we got into smoking, we were supposed to tell them how the cigarette is made ... things that are there in a cigarette. We never did that because we were never sure what's going on with a cigarette itself.*" [Teacher B1, lines 169-173].

Teachers B2 and C2 revealed, throughout the interviews, uncertainty about the content as they explained what they had taught. For example, Teacher C2, when asked what was in a poster he had used, said,

> "*Showing a human structure whereby parts that can be infected ... eh ... you see ... eh ... lungs being a major diagram there ... windpipes, such things.*" [Teacher C2, lines 299-301].

At one point in the interview Teacher D1 tried to explain the lung model as follows.

> "*Let me remember the experiment. You see ... like a bell-jar ... Inside the bell-jar there are two balloons and there are some things going up there. So ... and then how important the experiment is, is that ... eh ... I was just showing them how if you smoke, what is happening to your ... what do you call ...?*" The interviewer asked "*lungs?*" and the teacher agreed "*to your lungs.*" [Teacher D1, lines 167-172].

The teacher not only was unsure what the model looked like, but claimed it showed what happens to the lungs when you smoke, when in fact it illustrates volume and pressure changes during the normal breathing process (to explain inhalation and exhalation) and has nothing to do with smoking.

Teachers' misconceptions about smoking-related matters

Scientifically incorrect claims suggest that some teachers may have misconceptions about the topic. Five teachers (A1, A2, B1, B2, and C1) mistakenly referred to the *"breathing system"* as the *"respiratory system"*, a fairly common error made by South African matric students (Sanders and Cramer, 1992) and teachers (Sanders, 1993). Respiration is a chemical process occurring in all body cells, and not the gaseous exchange process occurring in the lungs or the tissues.

Two teachers made erroneous claims about what the lung model showed. As explained above, Teacher D1 thought it showed what happened to your lungs when you smoke. Teacher F1 claimed that the model showed how diffusion of a gas takes place, when it does not.

> "*... We do perform an exercise on that. We show the learners how diffusion of a gas takes place. And then what remains in the alveolus, in the long run if one take smoke, what will the alveolus look like.*" [Teacher F1, lines 104-105].

He also said the balloon in the model represented the alveoli (rather than the lungs) [lines 180-183] and compared the movement of the ribs and intercostal muscles with the plastic bottle (which is in fact inert), saying,

> "*... the ribs, also the muscles of the ribs also react. You know, and in that case they become the very same ... eh ... plastic bottle that they had.*" [Teacher F1, lines 182-184].

In order to facilitate learning using models teachers need to know how the model (that they are planning to use in class) functions and also understand its purpose in assisting learners understand the concept being illustrated.

Three teachers made erroneous claims about diseases which they claimed were caused by smoking. Teacher F1, incorrectly attributing AIDS to smoking, said that cancer had the same effect as AIDS, affecting the blood circulation. He initially incorrectly said that smoking can cause HIV.

> "*...We also have our own members of the school who have attended courses such as HIV, also discuss causes of HIV of which smoking, according to our findings, can lead to HIV.*" [Teacher F1, lines 205-207].

However, he later corrected this statement, saying smoking is not a cause of HIV but a factor which can make it difficult for AIDS to be curable. Two teachers said smoking contributes to tuberculosis [Teacher C2 and Teacher G1].

> "*... and the person who is smoking will, after some time, be affected with some diseases, e.g. TB.*" [Teacher G1, lines 71-72].

A number of other errors were made. Teacher E1 inaccurately claimed that lungs are heated by tar,

> "*... it's just when I need an example, how the lungs are heated by the tar*" [Teacher E1, line 81].

Teacher G1 made an erroneous claim that the digestive system is affected by smoking. Teacher F1 incorrectly thought haemoglobin is a cell, while Teacher B1 inaccurately referred to emphysema as "*emphysia*".

Conclusion about teachers' knowledge on the topic

Data from both the workshop and interview sessions showed evidence that content knowledge of a large number of the teachers is problematic. They either lack the knowledge they have to teach, or they have erroneous ideas. This raises some doubts about the kind of information (about smoking and related matters) they impart to learners. It is crucial that teachers understand and master the content they are required to teach.

5.4 CONCLUDING REMARKS ABOUT THE DIAGNOSTIC PHASE OF THE STUDY

The situational analysis and the needs analysis described in this chapter provided valuable information which influenced the way in which the curriculum materials were developed to assist teachers in the topic, "smoking and related matters", as described in the next chapter. Interviews with the teachers about how they were currently teaching provided in-depth information which generally was useful data because to a certain extent it portrayed how the teachers were applying the new curriculum requirements. Whilst it was encouraging to note that many teachers were changing the way they taught, a number of points of concern were noted which education department officials need to be aware of, and which in-service training providers needed to know in order to address them in future.