

CHAPTER 3

RESEARCH DESIGN AND METHODS USED IN THE STUDY

3.1 OVERVIEW OF CHAPTER

This chapter provides details of what approaches and data-gathering techniques have been used in the study to answer the research questions, and justification for why certain methods and instruments were used.

3.2 RESEARCH DESIGN

Research designs serve as the “*architectural blueprint*” (Bickman *et al.*, 1997, 11) of research, as they involve consideration of the research approach to be used, and the best methods of collecting and analyzing the data (Bickman *et al.*, 1997; and Opie, 2004). Research designs link data collection and analysis activities to the research questions and ensure that all research aspects will be addressed (Bickman *et al.*, 1997). These authors claim that the “*credibility of the research, and its usefulness rests with the design implemented*” (Bickman *et al.*, 1997). The research design used for this study is outlined in Figure 1 on page 32.

3.3 RESEARCH PARADIGM

Opie (2004, 18) defines paradigm as “*a basic set of beliefs that guides action*”, and suggests that historically two main paradigms have influenced educational research, the qualitative and quantitative research paradigms. Both Gall *et al.* (1996) and Opie (2004) claim that researchers who subscribe to the quantitative research paradigm believe that natural phenomena have causes that can be found by observation and measurable criteria, and can be verified. People with such a belief system see social reality as free from personal feelings and therefore unbiased (Gall *et al.*, 1996). What researchers believe affects the methods they select for their research. Quantitative research is perceived typically to involve an “*inquiry into a social or human problem based on testing a theory composed of variables, measured with numbers and analysed with statistical procedures...*” (Leedy, 1997, 105). Quantitative researchers tend to start by formulating an hypothesis to be tested and to collect data and analyse it so as to see if the original hypothesis is supported or not (Leedy, 1997; Opie, 2004). Researchers involved in qualitative research, on the other hand, believe that individuals consciously construct their own understanding of the world through experience. Leedy (1997) sees qualitative research as an “*inquiry process of understanding a social or human problem, based on building a complex, holistic picture, formed with words...*” (Leedy, 1997, 105). Qualitative researchers tend to start their work by asking general questions, then collecting large amounts of data and usually presenting their findings in words (Leedy, 1997).

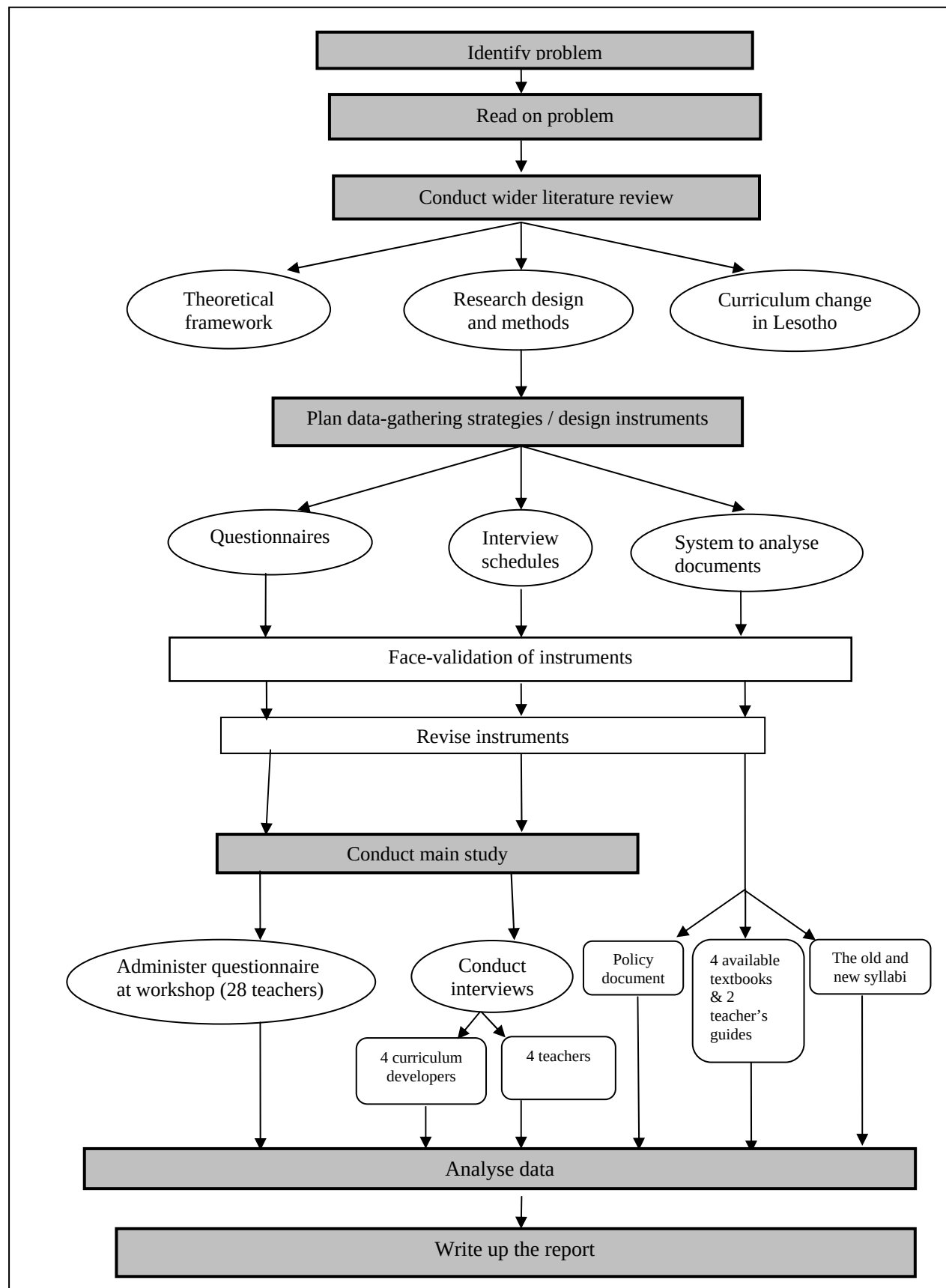


Figure 3: Flowchart of the research design for the study

These two paradigms both have their strengths and weaknesses. As a result a third research paradigm, referred to by Reeves and Hedberg (2003) as the mixed methods – eclectic – pragmatic paradigm has gained recognition. This paradigm reflects the belief system of researchers that research methods should be determined by the problems the researcher has to investigate or the questions to be answered and the best methods to do so, and not by first deciding about whether the research is qualitative or quantitative (Johnson and Onwuegbuzie, 2004). Because the methods chosen should be those best able to answer the questions, such researchers often combine typically quantitative and qualitative research techniques so that *“the resulting mixture or combination is likely to result in complementary strengths and non-overlapping weaknesses”* (Johnson & Onwuegbuzie, 2004: 16). Other researchers, e.g. Johnson and Onwuegbuzie (2004), use a shorter name – “the mixed-methods paradigm”, and they see the mixed-methods paradigm as a middle-man meant to bridge the disagreement between qualitative and quantitative researchers. However, this shorter name seems inappropriate, as it gives the impression that one starts by deciding to mix the research techniques which is not the case, as shown above.

The pragmatic paradigm was used for this study because it provides the best possible opportunity for answering the research questions.

3.4 GENERAL RESEARCH APPROACH

The general research approach that was used for this study was a survey. A “survey” is defined as an *“investigation of the behaviour, opinion etc of a group of people usually by questioning them”* (Oxford dictionary, 1995). In a research context surveys usually involve finding opinions from a large group of people about an issue of interest (Fraenkel and Wallen, 1990). The information is usually gathered by asking people questions, either through face-to-face interviews or through questionnaires, but can involve an analysis of written or visual documents as a way of gathering data to answer the research questions. The purpose of surveys is to describe some characteristics (such as opinions, attitudes, beliefs or knowledge) of a population at a particular point in time (Fraenkel and Wallen, 1993). The information is generally collected from a carefully selected sample instead of the whole population, with the goal of generalizing findings to the bigger population (Fraenkel and Wallen, 1993). In this study a survey was used because the researcher wanted to find answers to the research questions in relation to teachers’ understanding of the requirements of the new curriculum. Both face-to-face interviews and questionnaires were used to optimize the benefits of each strategy and minimize their weaknesses.

3.5 SAMPLING

Sampling involves the selection of a small group of people from the larger population to be studied. The logic behind this is that information collected from the smaller group of people possessing the information the researcher wants will be representative of the larger population from which they were drawn (Schumacher and McMillan, 1993). Random sampling is generally considered desirable, as all members

of the population will have the same chance of being selected, so results are less likely to be biased and can be generalized to the larger population of individuals (Schumacher and McMillan, 1993). However, in educational settings random sampling is often not feasible, so an accessible group may be used – what researchers call “convenience sampling” (Schumacher and McMillan, 1993; Fraenkel and Wallen, 1993; Gall *et al.*, 1996). Convenience sampling is often used in educational research because of its practical benefits, as it is seldom feasible to get access to the theoretically ideal sample, so researchers “*often need to select a convenience sample or face the possibility that they will be unable to do the study*” (Gall *et al.*, 1996, 228). Convenience sampling can involve, for example, an available class of students or a group of people gathered for a meeting. The problem, however, is that such samples are often biased, as the group may have features that are not representative of the target population, like being more motivated or enthusiastic. Convenience sampling makes no claim that the sample is representative of the population, and therefore has limitations in terms of generalization of the results from the sample to the population it represents (Schumacher and McMillan, 1993).

Convenience sampling was used in this study because I conducted the study in Lesotho while still having courses to attend at the university in Johannesburg and could not spend a lot of time in Lesotho. In the case of the teachers, collecting data at a workshop meant I had all teachers attending the workshop as my sample which ensured 100% returns the same day. This was because I was there to administer and collect questionnaires after every activity. For the interviews, both teachers and *Science* panel members involved were those who agreed to be interviewed and were therefore also a convenience samples.

In this study there were three sources of data: teachers, *National Curriculum Development Centre* staff, and curriculum support materials. The following paragraphs discuss these sources.

Teachers: The teachers participating in my study were Lesotho *Junior Secondary Science* teachers from one district in Lesotho, who meet on a monthly basis to discuss their experiences, and the successes and problems they encounter as they try to implement the new curriculum. About 30 *Junior Secondary Science* teachers attend each workshop, organized by the district *Science* resource personnel of the *Ministry of Education*, and they made up my “convenience sample” of teachers.

The invitation letter asking the teachers to attend my workshop was sent through the district *Resource Centre* of the *Ministry of Education*. It might have been worthwhile to get a bigger sample, as it could have provided a more representative picture of the situation in the country as a whole and would have made the results more generalisable, but it was not possible to invite more teachers to attend the workshop because of geographic distances. One limitation of this sample is that the group could be different from other science teachers in Lesotho as they have been working with the new syllabus extensively and may have come to grips with its needs. As volunteers they may also be more professional and more enthusiastic than teachers who do not voluntarily give their time to attend professional development workshops.

Twenty-eight teachers completed the questionnaires at the workshop. Four teachers who had not attended

the workshop were later interviewed. Originally I had thought of interviewing some of the teachers who had attended the workshop to get in-depth data. However, I realized that the workshop discussions might somehow influence the way they responded.

Curriculum development staff: The *Ministry of Education* in Lesotho had mandated the *National Curriculum Development Centre* with the task of reviewing and revising the syllabus. Different subject panels were developed involving members of different sectors of the *Ministry of Education*, such as the *Examination Council of Lesotho*, and teacher education institutions, to mention just few. All panels were supposed to have subject specialists who were expected to have sound knowledge of curriculum development and content of their specific field. These panels were working under the supervision of the curriculum specialist. My sample consisted of four accessible *Science* panel members, one from the science inspectorate office, one teacher educator, one district resource personnel member and a *Science* subject specialist.

Support materials: Available support materials to be analysed consisted of syllabi, textbooks, and teacher's guides, as shown in the table below. I had originally intended to get a policy document referred to by another researcher, that would give me more information regarding the new syllabus. However, I could not get hold of the curriculum document, and during my discussion with some members of the *Science* panel it transpired that there are no such curriculum documents. When I talked to the researcher who had referred to this document in a paper it turned out that he had been referring to the syllabus (although the information he had quoted is not in the syllabus document). The only official document I could get was the syllabus document.

Table 3. A summary of available support materials analysed for the study

Type of document	Publisher	Form
Syllabi (old and new)	-	-
Student textbooks	Heinemann Lesotho Longman Lesotho	B and C B and C
Teacher's guides	Longman Lesotho	B and C

Textbooks: The sample of books consisted of four textbooks, two for each form from two publishers. Because the books had too many content chapters to review only chapters on breathing and respiration in these books were used as samples for analysis, in addition to the introductory section in each book.

3.6 DATA-GATHERING INSTRUMENTS OR STRATEGIES

In this study three data-collecting techniques were used: questionnaires, interviews, and document analysis. Questionnaires and interviews were both administered to teachers to allow the researcher to triangulate the results of one technique with the other to see if the same pattern of results was obtained, so as to enhance reliability and hence validity of the interpreted results, as recommended by Schumacher and McMillan (1993).

3.6.1 Questionnaires

To find information concerning teachers' understanding of the requirements of the new *Junior Secondary Science* syllabus, 28 *Junior Secondary Science* teachers attending a workshop in one district in Lesotho completed questionnaires. Questionnaires are “*data-gathering instruments used to obtain factual data, opinions and attitudes in such a way that the respondents and the data-gatherer need not come into contact with each other*” (Galfo, cited by Sanders, 1995: 712).

Advantages of questionnaires

Questionnaires are considered useful instruments for collecting information. They have a number of advantages,

- They are a relatively inexpensive way of getting information quickly from large samples, as they can be administered by a single researcher on a single occasion, which cuts down on traveling expenses (Oppenheim, 1966; Schumacher and McMillan, 1993; Neuman, 1994).
- Mailed questionnaires can be used to reach geographically difficult-to-reach areas (Neuman, 1994).
- Anonymity is possible because they do not involve face-to-face interaction with the researcher as is the case with interviews, and as a result they can encourage greater truthfulness from the respondents (Opie, 2004).
- Respondents can usually complete the questionnaire at their own pace, for mailed interviews (Gall *et al.*, 1996).

Limitations of questionnaires

As with all instruments, questionnaires have some limitations, the most common being poor returns when they are mailed which leads to biased answers which should not be generalized (Oppenheim, 1966). In this study the issue of poor returns did not apply as the questionnaires were administered and collected during the workshop. A further problem with questionnaires is that they do not allow for probing, so the researcher cannot explore any of the answers in more detail. This denies researchers the type of data that gives research its richness and value (Gall *et al.*, 1996; Opie, 2004). Furthermore, because researchers are usually not present when the questionnaire is completed they cannot clarify questions or instructions not understood by the respondents. This did not apply to my study, because I administered the questionnaire myself so everything was clarified during the workshop. Another shortcoming of using questionnaires is that some respondents may not be keen or confident in expressing their views, thoughts or feelings in writing, especially if they are to answer the questionnaire in a language which is not their first language (Neuman, 1994; Opie, 2004).

Constructing the questionnaires

According to Schumacher and McMillan (1993) and Opie (2004) questionnaires are one of the most commonly used means of obtaining research information, but constructing good questionnaires is not easy. To overcome this limitation, a thorough literature review was conducted to obtain information about designing good questionnaires and this advice (see Table 4) was considered when designing the questionnaire.

Table 4. How to design effective questionnaires

Planning stage		
What to do	Reasons	Authors
Make a list of specific objectives that one expects to achieve by the questionnaire.	• Gives one clear focus on what information one hopes to get. • Helps one to decide on an appropriate form of questions to use.	Schumacher and McMillan (1993); Gall <i>et al.</i> (1996)
• If possible locate an existing questionnaire. • If one develops new questionnaires they must justify the use.	• Reliability and validity have already been established, which saves time. • It is not easy to develop a good questionnaire and to ensure rigour, and this needs energy and time.	Schumacher and McMillan (1993)
Design stage		
Use a mix of both open-ended and closed-ended questions.	The disadvantage of each form of question is reduced, and benefits of each are maximized.	Neuman (1994)
Start with simple items and put sensitive or threatening items near the end of the questionnaire.	Difficult questions may unsettle the respondents and they may abandon the questionnaires as a result.	Oppenheim (1966); Gall <i>et al.</i> (1996); Opie (2004)
Include brief, clear, conspicuous instructions.	Ensures that respondents are clear on what they must do and how the questionnaire should be completed.	Opie (2004)
• Ensure suitable spacing between questions. • Allow sufficient spacing for open-ended questions to be answered.	Enhances readability and gives an indication of how much information one expects for open-ended questions.	Gall <i>et al.</i> (1996); Opie (2004)
Use simple language, avoiding the use of technical terms or jargon.	Target the vocabulary of the respondents, using the language they will understand.	Neuman (1994); Gall <i>et al.</i> (1996)
Format and layout of questionnaire should be attractive.	Gives a good impression and encourages respondents to take the questionnaire seriously.	Schumacher and McMillan (1993); Opie (2004)
Make questionnaires attractive.	Attractive questionnaires invite the respondents to want to read and answer.	Oppenheim (1966); Gall <i>et al.</i> (1996); Opie (2004)
Use call-outs or cartoons where appropriate.	Captures attention of respondents and encourages them to answer.	Sanders (1995)
Things to avoid when writing questions		
Avoid ambiguous and vague questions.	Ambiguity causes inconsistencies in terms of the meanings different respondents assign to the questions, and thus affects the validity of their answers	Neuman (1990)
Avoid asking questions that are beyond respondents' capabilities.	They frustrate respondents and lead to poor quality responses.	Tuckman (1978); Neuman (1990)
Avoid biased or leading questions, and make respondents feel that all responses are legitimate.	Leading questions influence respondent's tendency to give the responses they think researchers want.	Tuckman (1978); Neuman (1990); Gall <i>et al.</i> (1996)
Avoid double-barreled items. Make each question about one topic.	Respondents may agree with one and not the other, but they are forced to respond to two questions with one answer, leading to validity problems.	McMillan and Schumacher (1993); Neuman (1994); Gall <i>et al.</i> (1996)

It is important to decide on the structure of the questions, as different types of questions have their advantages and disadvantages. Opie (2004) gives two general types of questions, closed questions and open questions. Closed questions ask a question and usually give predetermined responses from which respondents must choose. Thus they are particularly quick to answer, and are easy to code and statistically analyse (Neuman, 1994). These advantages make them popular for large-scale surveys. However, they have disadvantages such as restricting the respondents, preventing them from providing their own views. As a result a lot of important information can be lost as respondents feelings and beliefs are squeezed into categories formed by the researcher (Oppenheim, 1966; Neuman, 1994; Opie, 2004).

Open questions, on the other hand, ask questions in a format which allows the respondents to give their own answer. They are therefore useful “[t]o learn how a respondent thinks, to discover what is really important to him or her, or to get an answer to a question with many possible answers ... open questions may be best (Neuman, 1994, 234). However, open questions have the following disadvantages: firstly, different respondents may give different amounts of detail in their answers, and as a result responses are difficult to analyse and code (Neuman, 1994; Opie, 2004). Secondly, they take up a greater amount of time and thought for respondents to answer, which can lead to respondents’ loss of interest and willingness to respond (Neuman, 1994; Gall *et al.*, 1996).

In this study both open and closed questions were used in the questionnaires. This is because mixing the two forms reduces the disadvantages of each form and optimizes the benefits of both (Neuman, 1994).

The appearance of the questionnaires is an important aspect that needs to be considered when constructing questionnaires, as better looking questionnaires are more likely to be answered (Opie, 2004). In this study different coloured paper was used for each questionnaire: Different colours also made the questionnaires more attractive, so as to motivate teachers to respond and also helped during administration as I could refer to them as the “pink” or “blue” paper. Callouts⁴ were used where possible as they capture the attention of respondents and motivate them to fill in the questionnaire (see Appendix B for the questionnaires).

Activity-based questionnaires

Despite their limitations questionnaires were used in this study to gather information from teachers, because if they are well constructed, they are still considered the best way to collect data quickly from a large sample. A special type of questionnaire, called “activity-based questionnaires” by Mashalaba and Sanders (2003), was used in this study. These questionnaires are used during interactive teachers’ workshops to serve a dual purpose. Firstly, they are used as reflective tasks to get teachers thinking about their practices (as part of the workshop) and secondly, the written records from these activities can be collected as data by the researcher.

⁴ Callouts are speech bubbles, usually next to graphics of a person speaking. These are left blank so the respondents can fill in their point of view.

Face validation of the questionnaires

Validity (see section 3.8) for an explanation of validity and why it is important) of the results is important in research. Face validity was used during the development of the questionnaires. This involves asking an expert to judge whether the developed instrument is likely to measure what it is intended to measure (Sanders and Mokuku, 1994). This allows for problems to be corrected before the main study. The purpose of face validity is to check for clarity of the meaning of the questions, so as to make sure they are clear and unambiguous (Gall *et al.*, 1996). The validity of the questionnaires was improved as they were developed, by obtaining opinions and advice from an experienced researcher, regarding wording and sequencing of the questions, as well as appropriateness of the language and content. The comments from the expert were incorporated when revising and refining the questions, so as to improve the chances of gathering the required information.

Administering the questionnaires

The questionnaires were administered during a teachers' workshop, and were sequenced in such a way that the four requirements of the new curriculum surfaced as the activities unfolded logically one after the other during the workshop (for workshop programme see Appendix A). Four separate activity-based questionnaires linked to specific tasks in the workshop were used, one focusing on what teachers believed the new curriculum required them to do; the second focusing on learner-centred approaches and teachers' beliefs and practices in this regard; the third focusing on activity-based learning; and the fourth on teachers' practices as they taught the section of work on breathing and respiration (see Appendix B for the four activity-based questionnaires).

3.6.2 Interviews

Interviews involve collection of data from direct verbal interaction between the researcher and the respondents (Cohen and Manion, 1997). Interviews, if well designed and well conducted, provide in-depth information which reflects what people believe and do. "*By providing access to what is inside a person's head*" (Tuckman, 1978, 197), interviews make it possible to find out "*what a person knows (knowledge or information), what a person likes or dislikes (values and preferences), and what a person thinks (attitudes and beliefs)*" (Tuckman, 1978, 197).

Advantages of interviews

Interviews have a number of advantages when compared with other survey instruments such as questionnaires. Unlike questionnaires, interviews, when well conducted, provide in-depth data, and, because they allow both the respondents and the researcher to ask for clarification, increase the chance of obtaining valid information from the respondents (Cohen and Manion, 1997). Fraenkel and Wallen (1990) consider interviews as the most effective means of eliciting cooperation from respondents, as rapport can be established between the researcher and the interviewee. In this way it may be possible to get sensitive information that would not be easy to get otherwise (Gall *et al.*, 1996).

Limitations of interviews

However, interviews do have some potential disadvantages. Because of the face-to-face interaction the interviewer's tone of voice or facial expressions may influence respondents' answers so that they give the response they feel will be acceptable to the interviewer (Cohen and Manion, 1997). Interviews are also prone to "*subjectivity and bias on the part of the interviewer*" (Cohen and Manion, 1997, 300). For instance, interviewers may have the tendency to get answers to support their own preconceived views, or interviewers may interpret what the respondents say in a way which supports the interviewer's preconceived ideas (Cohen and Manion, 1997; Opie, 2004). As a result, validity of answers from interviews relies on the skills of the interviewer. Furthermore, the presence of a tape-recorder may change the interview as respondents may be reluctant to express their feelings concerning sensitive issues if they know their responses are recorded (Gall *et al.*, 1996). Despite all these limitations, interviews, if well done, provide detailed, in-depth information which cannot be found using other instrument like questionnaires.

There are different types of interviews; structured, semi-structured and unstructured interviews. According to Gall *et al.* (1996) and Opie (2004) structured interviews involve a series of fixed questions that do not allow the researcher to follow up on a question and obtain information of greater depth (Gall *et al.*, 1996). Semi-structured interviews involve a pre-existing set of questions, but allow the interviewer the flexibility to deviate and probe further if the need arises. In unstructured interviews there are few prepared questions, usually with no set order, and the interviewer will phrase questions during the interview according to the responses of the interviewee. The problem of unstructured interviews is that they make it difficult for the researcher to focus the respondent on the issue, and as a result a lot of unusable data may be collected (Gall *et al.*, 1996). Semi-structured interviews were used in this study because they allow for carefully prepared questions which ensure that all the areas of interest are covered, and nothing is left out. Furthermore, they allow the interviewer to deviate and probe further, and in this way more detailed information can be obtained as interviewee's responses can be expanded (Gall *et al.*, 1996; Opie, 2004).

Designing the interview schedules

Interview schedules are well structured lists of questions that will be asked during an interview, to ensure that interview goes well (Opie, 2004). The interview schedule was constructed after an extensive literature review on how to design and conduct interviews, and what steps should be taken to improve on the rigour of the research. The interview schedules were designed using these guidelines from the literature (see Table 5 on page 41) on how to design and conduct effective interviews.

Table 5. Advice on how to design and conduct interviews

Advice	Reasons	Author(s)
Designing the interview schedule		
Review the research questions to see what information is required.	To avoid redundant interview questions which do not contribute to the research.	Coleman & Briggs (2003)
Decide on the structure of the interviews, i.e. if it will be structured, semi-structured or unstructured.	So that the interview format is carefully considered and matched to what one wants to achieve.	Opie (2004)
Translate research questions into specific questions and probes to be asked in the interview.	Questions should cover all the information one wants to get.	Cohen & Manion (1997); Coleman & Briggs (2003); Opie (2004)
Determine the order in which questions will be asked.	It would be easier to conduct interviews if you have a schedule and questions can flow naturally one after the other, in a logical sequence.	Thompson (1978) Opie (2004)
Word questions so that they will encourage respondents to say with “greater richness and spontaneity” (what they think and do).	To avoid questions that will give non-committal answers with little or no detail.	Coleman & Briggs (2003); Opie (2004)
Language is important and researchers must avoid using language the interviewee is not familiar with (e.g. professional jargon should be avoided).	To ensure that questions are clearly understood by the interviewees.	Coleman & Briggs (2003)
Do not ask leading questions that are suggestive and direct interviewee’s response.	Respondents may give you the answers they think you would like to hear, thus decreasing validity of the responses.	Tuckman (1978); Posner & Gertzog (1982); Opie (2004)
Do not use double-barreled questions	They may cause confusion, and the respondent will find it difficult to answer.	Gall <i>et al.</i> (1996); Opie (2004)
Pilot the schedule.	To detect ambiguous and confusing questions, so these can be reworded.	Opie (2004)
Conducting the interviews		
Be appropriately dressed	Appearance is important, so you don’t offend or intimidate the interviewee	Coleman & Briggs (2003)
Establish rapport by greeting respondents and engaging in small talk to put the respondent at ease. Find a balance between friendliness and objectivity.	Makes respondents comfortable and encourages honest answers later in the interview.	Schumacher & McMillan (1993); Coleman & Briggs (2003)
Inform the respondent of the purpose of the interview at the start.	So that respondents are aware of the kind of information they have to give and how that information will be used.	Schumacher & McMillan (1993); Cohen & Manion (1997); Opie (2004)
Assure respondents of confidentiality before starting the interview.	To gain their trust and encourage them to give truthful answers.	Gall <i>et al.</i> (1996)
Use clear language meaningful to respondents.	Asking complex questions may lead to questions not being answered.	Thompson (1978) Coleman and Briggs (2003)
Aim to talk less and allow the respondent to talk more.	To get rich, detailed answers.	Posner & Gertzog (2003)
A good interviewer must provide concentrated attention, be a good listener.	One needs to gain information from the respondents, and listening attentively promotes further information from the interviewee.	Thompson (1978) Posner & Gertzog (2003)
Don’t interrupt the respondent’s story.	You may cut off important information.	Thompson (1978)
Don’t appear to be cross-examining the respondents. If they feel threatened by some questions skip these and move on to others.	You need to be sensitive and sympathetic to respondents’ standpoints. Your attitude may stop them answering (if they feel threatened).	Coleman & Briggs (2003)
Know when to probe, and when you do probe you must probe to elicit responses.	Probes must never favour a particular answer. They must be neutral.	Fraenkel & Wallen (1990)
Stick to the wording of the planned questions where possible.	Changing the question wording may change a question you spent a lot of time designing to achieve your research goals.	Schumacher & McMillan (1993); Babbie (2005)
At the end of the interview ask if there is anything the respondent would like to ask, and thank them.		Coleman & Briggs (2003)

Face validation of interview schedules

Designing the interview schedule was followed by face validation by a science education expert to see if the questions were appropriate for answering the research questions, if they were worded clearly using language respondents would understand, and to check that they were sequenced in a logical way.

Conducting the interviews

Four people from the *National Curriculum Development Centre* were interviewed, so that the researcher could find out what changes the new curriculum expects teachers to make in the classroom, and what they think is meant by the “learner-centred” and “activity-based” approaches. Interviews with teachers were used to supplement data collected from the questionnaires, so as to get more in-depth information. Four teachers who had not attended the workshop were interviewed to find out what they believed the new curriculum requires them to do, and if they thought they are practicing the new approach. I also wanted to find out if they were coping with the new approach, and to identify their needs for assistance.

The interviews were tape-recorded, with permission of the respondents, to make sure that all the information was accurately captured, and so that the flow of the interview was not interrupted by the researcher taking notes, a problem which Fraenkel and Wallen (1990) warn about. The research literature also advises that tape-recording reduces the interviewers’ bias or tendency to make an unconscious selection of data that favour them, if they are taking notes. Transcribing the recordings allows a second person to check the accuracy of the transcription, thus increasing validity (Fraenkel and Wallen, 1990; Gall *et al.*, 1996).

3.6.3 Document analysis

According to Schumacher and McMillan (1993) document analysis involves the analysis of the written or visual content of a document. Written materials can include “*textbooks, students’ completed homework assignments, tests, computer print outs of school data ...*” (Gall *et al.*, 1996, 356), and visual materials can include “*photographs, posters, and drawings*” (Gall *et al.*, 1996, 356). Document analysis involves

“defining as precisely as possible those aspects of a document’s contents that the researcher wants to investigate and then formulating relevant categories that are so explicit that another researcher who uses them to examine the same material would find essentially the same proportion of topics emphasized or ignored”. (Fraenkel and Wallen, 1993: 388)

Steps involved in doing document analysis

It is important that researchers first identify relevant documents and records which contain appropriate content for the study as a source of their data. The literature recommends that researchers identify a population of documents that can be used, and decide whether to use the whole population or to select a sample of the population (Gall *et al.*, 1996).

For this study, three types of documents were analysed, the old and new *Junior Secondary Science* syllabus documents, four available Lesotho Junior Secondary Science textbooks, and two teacher’s guides.

- *Junior Secondary Science* syllabi: The old and the new syllabi were compared to see if the approaches given in the new syllabus are new or if they have always been there. I reviewed the new syllabus document firstly to see what requirements were spelled out, and secondly to look at how it explains “learner-centred” and “activity-based” approaches, and if it spells out how teachers are intended to implement these approaches. I also checked if the document gives teachers guidance on what skill and attitudes had to be developed, and guidance on how to develop skills and favourable attitudes. I looked at the old syllabus firstly to see what it required teachers to do, and secondly to compare the requirements in the old syllabus with those of the new syllabus to deduce what was old, new and what was reviewed.
- Teacher’s guides: A teacher’s guide checklist (see Appendix E) was developed and used to check the nature and extent of guidelines about the meaning of “learner-centredness” and “activity-based”, and to see whether the guide explicitly guides teachers on how to make their lessons activity-based and learner-centred. The checklist was also used to see if the guides provide guidelines on what skills and attitudes to teach in each Form and how to teach them.
- Textbooks: A checklist (see Appendix F) was developed from categories emerging from the requirements of the curriculum as deduced from the syllabus document. Four prominent features that make up the categories were learner-centredness, activity-based learning, the development of skills, and development of appropriate attitudes. This checklist was used to analyse first the general comments in the introductory sections of the textbooks to see if they provide any information regarding learner-centred and activity-based approaches, and on the development of skills and attitudes. Then a thorough page-by-page check was made on chapters dealing with breathing and respiration, to find out the extent to which the chapters made provision for learner-centredness, activity-based learning, and the development of skills and attitudes.

In both teacher’s guides and textbooks checklists a slot was given for evaluator’s qualitative comments.

3.7 DATA ANALYSIS

Data analysis involves a systematic search for meaning from the collected data, so that what is learned can be communicated to others (Hatch, 2002). Different types of data often require different analysis strategies. Two types of coding were used for analyzing the data in this study, closed coding and open coding

- Closed coding: This was used where instruments had pre-identified categories, as was the case with the textbook checklist and some closed-ended questions from the questionnaire. Frequency counts of teachers giving certain responses were made, changed into percentages and recorded.
- Open coding: Open coding involves reading through the data, picking up the patterns or trends arising from the results, categorizing and naming the trends (Cohen and Manion, 1997). Open

coding was used for coding answers from the interviews; from the open-ended questions from the questionnaires; and for the evaluator's comments in the checklists of the old and the new syllabi, textbooks and teacher's guides. The researcher read through the data and looked for emerging patterns and trends. Using the curriculum requirements as a basis, a list of features was drawn up, and features that fell under each requirement were grouped into categories and sub-categories where these emerged. The categories were then allocated abbreviated codes to distinguish them from each other for easy analysis. Categorising and coding helped in extracting information relevant to the study, with the purpose of answering the research questions. The codes were only used during analysis and not for reporting data. A science education expert was asked to face-validate the coding system developed, by checking if the categories covered all the data collected, and that the categories developed were logical and mutually exclusive.

3.8 RIGOUR IN THE RESEARCH

“The quality of the instruments used in research is very important, for the conclusions researchers draw are based on the information they obtain using these instruments” (Fraenkel and Wallen, 1993: 138). This implies the need to ensure that the research provides trustworthy results, by checking on the validity and reliability of the instruments. Reliability refers to the extent to which research instruments can give consistent results if used by different researchers or if used more than once by the same researcher (Opie, 2004). Validity has two dimensions: it refers to the degree to which the research instruments measure what they claim to measure, and the appropriateness and meaningfulness of the inferences researchers make based on the data collected (Fraenkel and Wallen, 1990; Opie, 2004).

Improving on validity and reliability of the results involves taking precautions at different stages of the research, for example when designing the questionnaires and the interview schedules. The questionnaires and interview schedules were designed following the advice given by different authors. The instruments were face validated. The purpose of the face validation was to check whether the instruments were likely to get the data they are intended to get, as advised by (Gall *et al.*, 1996).

3.9 ETHICAL ISSUES

“Educational research is also advocacy research. A set of values, and hence a moral and ideological position of some kind informs all research” (Adler and Lerman, 2003: 452). Researchers should strive to avoid doing harm to individuals involved in their study, as well as avoiding harming the educational system. Researchers must be able to care for and care about the respondents.

My responsibility as a researcher was to endeavour to adhere to ethical principles and standards guiding research. I applied for permission from the Human Research Ethics Committee (non-medical) of the

University of the Witwatersrand for clearance of research involving human subjects, adhering to all their guidelines about doing research involving humans, and permission was granted. I was open to, and honest with, the teachers and disclosed fully the purpose of my research. I also solicited informed consent of the teachers to participate in the study and guaranteed their anonymity, as recommended by Schumacher and McMillan (1993), and asked for permission to use their responses in my study.

3.10 CONCLUDING REMARKS

The chapter described the research design and methods used in this study. It gives an explanation of where the study was carried out and how the samples were selected. It also provides a description of the instruments and strategies used to collect data, why and how they were used, and steps taken to improve validity of the results obtained using the instruments.