

CHAPTER 1

INTRODUCTION

1.1. Introduction.

This chapter outlines the problem to be investigated in this study and the background and context in which it occurs, taking into consideration that the study is carried out outside South Africa.

It also gives the aims and questions to be answered at the end of the study, the ethical issues considered during the study, and the limitations, delimitations and benefits of the study.

1.2. Statement of the Problem.

The main problem to be investigated in this research is the lack of practical work in chemistry teaching in most Mozambican secondary schools. This problem is so critical that quite often learners finish the three years of junior secondary school without performing even one experiment.

In an analysis of the situation of science education in Mozambique, the Ministry of Education of Mozambique, through the Strategic Plan for education in Mozambique 1999-2003, states:

“the lack of laboratories and/or poorly equipped laboratories is a nationwide problem which negatively affects the quality of science education in particular and education in general.” (Ministry of Education, 1998, p. 12).

They also acknowledge that the problem of lack of practical work is a nationwide one and its magnitude and extent varies from one province to another and from one school to another within the province. They also found that the common trend within the majority of schools was that practical work was not done on a

regular basis, irrespective of a school having an equipped laboratory, having a poorly equipped laboratory or even no laboratory at all.

This research takes this problem into consideration and investigates an alternative way to contribute to changing the situation. For this purpose, microchemistry kits are used experimentally to do practical work in two Grade 9 classes from two different schools in Beira city (second largest city of Mozambique). Another two Grade 9 classes from two other schools within the same city were used as a comparison group. The main purpose for this is to find out whether the microchemistry kits have any effect on the chemistry teaching and learning that occurs, and find out teachers' and learners' opinions about the kits after using them for the very first time.

This purpose lines up with the priority given to practical work in chemistry programs for junior secondary school (Grade 8 to 10) by the Ministry of Education when it is stated:

“In each lesson the teacher must do as many as possible of the experiments recommended in the program and others which the teacher decides to do. This will allow deep and solid acquisition of the content and at the same time can awaken learners’ interest for chemistry.” (Ministry of Education, 2004, p. 5).

Despite the flexibility of the Ministry's program for doing practical work and attributing to it a key role in chemistry teaching, this effort is hindered by the acknowledgement that the government, through the Ministry of Education, does not have enough funds and resources to run schools accordingly.

In view of this, the microchemistry kits, of which the materials are relatively cheap and which use significantly less chemicals compared to the traditional large scale chemistry equipment, can be used as an alternative solution to the lack of practical work in Mozambique. Two problems can hence be solved with the use of the microchemistry kits – (1) for schools with laboratories, the lack of funding

to buy chemicals is solved by the relatively small amounts of reagents used in the microchemistry experiments and (2) for schools without laboratories, the lack of facilities is solved by the use of the kits in a normal classroom.

1.3. Background to the Problem.

The field study for this research was carried out in Mozambique. Because of the peculiarities of the country, its educational system as well as the context in which the learning process takes place, it is important to give an overview about the country and the area in which the study took place. Particular emphasis will be placed the educational sector, because the problem and research occur in this area.

1.3.1. General information about Mozambique.

Mozambique is a country situated in the south-east of the African continent. It shares its borders with six different countries, all of them former English colonies and members of the Southern African Development Community (SADC). These are: Tanzania in the north, Zambia and Malawi in the north-west, Zimbabwe in the west, South Africa in the south-west and Swaziland in the south. The entire east border of the country lies along the Indian Ocean. From north to the south the country is approximately 2800 km long, with about 2000 miles of sea coast. Appendix A contains a map of Africa with the position of Mozambique in it.

The country occupies an area of 799.380 km² and is populated by about 17 million people, distributed in 10 provinces and 21 linguistic groups. Portuguese is the only official language used as medium of instruction, and considered the language of unification of the different ethnic and linguistic groups (Knauder, 2001). A map of Mozambique with its ten provinces and capital cities appears in Appendix B.

After 13 years of liberation struggle against Portugal and subsequently its political independence on 25 June 1975, the country became independent for the first time since the fifteenth century. However, the peaceful environment in the country did not last more than two years. In 1977 the country was involved in a civil war, which ended in 1992 with the signing of a peace agreement between the government and the rebel movement.

Since the silencing of the guns in 1992, the country has encountered peaceful times under a multiparty constitution approved in 1990, amended in 1992 after the peace agreement. Mozambique is ruled by democratic society with the realization of three successive multi-party presidential and parliamentary elections in 1994, 1999 and 2004.

After more than twelve years of peace, the country is still recovering from the 16 years of war and the destruction of the socio-economic infrastructures and social backbone of the country. The major priority of the country and government has shifted from emergency relief to reconstruction, which is currently in progress.

It is good to see that as a result of the reconstruction phase some socio-economic indicators are improving. For example, according to Knauder (2001), citing different official documents about the country, the literacy rate has risen from 7% in 1975, to 28% in 1980 and 40% in 1997. The estimated level of poverty moved from more than 80% in 1975 to about 62% by 1999. The enrolment rate was estimated at 63% in 1991 from about 45% of schools destroyed during the period 1983-1987. (For more details about facts and numbers of the country see Appendix C).

Despite these signs of progress in different sectors, Mozambique is one of the Heavily Indebted Poor Countries (HIPC), it lack resources and/or money to drive many of its programs, plans and needs in order to maintain a healthy economy. Though the indicators are improving in vital sectors of society such as education

and health, they are far from reaching the ideal level and the expectations of the public at large.

1.3.2. Educational System and Curriculum of Mozambique.

The national education plan of Mozambique, approved in 1983 and still in progress, defines three main levels of education (Ministry of Education, 1983):

First level: *Primary education*: This ranges from Grade 1 to Grade 7, divided into two sub-levels or cycles. The first cycle is from Grade 1 to 5, and the second cycle comprises Grades 6 and 7.

Second level: *Secondary education*: This spans from Grade 8 to Grade 12, and includes two cycles. The first cycle is from Grade 8 to Grade 10 called junior secondary school, and the second comprising Grades 11 and 12, called pre-university level or senior secondary school.

Third level: *tertiary education*: This includes post-matric courses for Grade 12 or equivalent graduates. Different university courses and degrees can range from 4-7 years.

Each one of the three levels has its own characteristics. But the philosophy and pedagogical principles guiding the teaching and learning processes are the same, especially for the primary and secondary levels. Therefore, what can be said about one level is valid to some extent to the other. The tertiary level, because of its professional character has many of its own features.

A nationwide study conducted in 1997 by INDE (National Institute for Education Development), an institution of the Ministry of Education, identified (among other issues of curriculum and programs development for different Grades within

primary and secondary schools) five main characteristics of the Mozambican curriculum (Ministry of Education, 1997):

- 1. Centralized model:** All decisions about the curriculum and its implementation are defined centrally by the Ministry of Education. What ever is decided and prescribed must be implemented by all schools irrespective of their conditions.

The centralized model of the curriculum goes to the extent of giving specific instructions about teaching strategies and methods to employ in a unit of contents and sometimes in a single lesson (practical work lessons, for example).

The main disadvantage of this model is that it does not take into consideration local factors or the context from which the learner comes. Thus, learning is abstract and not relevant to the learner, because he or she cannot relate to what was learned at school to his or her everyday life.

- 2. Based on annual Grades:** The subject matter and learning outcomes are organized into a system of annual Grades. During the academic year all learners must attain the expected instructional and educational outcomes.

The main disadvantage of this model is that learners can be punished for some aspects beyond their control and beyond the control of the teacher (by a fail).

- 3. Based on academic levels:** Both primary and secondary levels have two cycles, and an exam must be passed to complete each cycle and to be admitted into the upper cycle or a level.

The main disadvantage of this model is that levels and cycles are constructs of the curriculum developers with little or no meaning to learners' developmental process or to someone outside the system.

- 4. Centralized in disciplines:** The subject matter and the syllabi are based on disciplines, most of them separated. Important attention is given to the selection, structure and sequence of the contents of each discipline, which in turn determines the strategies and experiences of the learning process.

The main disadvantage of this model is that learners see each discipline as a closed body of knowledge not related to others, and they struggle to use different disciplines in an integrated form to analyze or interpret a practical situation faced in day-to-day life.

- 5. Monolingual medium of instruction:** Mozambique has about 21 Bantu linguistic groups. Despite that, the only medium of instruction is Portuguese, which is considered the language of union of all Mozambicans.

In a country where more than 60% of the population live in rural areas with one or more Bantu languages as their first or second language, the use of Portuguese as medium of instruction in earlier Grades can affect their school progression to higher Grades.

Recognizing that this curriculum is inadequate to meet the needs of the current national, regional and international situation, the government has launched a nationwide debate and discussion for public hearing and suggestions regarding the model and content of curriculum for the country.

As a result of this exercise the Strategic Plan for Education in Mozambique was launched in 1998. The blue-print document contains the philosophy, pedagogical

principles and structure of the whole educational system in the country. This document is updated every four years after a number of assessment meetings every two years, and the latest edition of the document is the 2004–2008 version. Appendix D₁ and D₂ show the front cover of the two first editions of the Strategic Plan for Education in Mozambique.

1.3.3. Current Context of Education in Mozambique.

Inspired by and based on the principles of the Strategic Plan for Education the Strategic Plan for Secondary Schools was launched in 2003. This document is used as the foundation to elaborate programs of different disciplines at a secondary school level.

The rationale for implementing the new curriculum is stated in the Strategic Plan for Secondary School but it is basically “...to adequate the national standard of the education to the regional and international tendencies of the education reform.” (Ministry of Education, 2003, p. 18).

The statement above reflects the inadequacy of the former curriculum in meeting the needs and expectations of the population in the new socio-economic and political context.

In order to show a shift in the teaching and learning approach the document states that in the new curriculum,

“...learning and teaching process should be supported by a realistic and relevant curriculum, using adequate means and materials of instruction with active methodologies of teaching, learner-centred and focused on problem-solving.” (Ministry of Education, 2003, p. 11).

From this statement it can be inferred that the new curriculum incorporates a constructivist view of teaching and learning, which is a learner-centred view of teaching which further incorporates an inquiry-based approach. Both elements

were not clearly stated in the former curriculum, and hence most teaching strategies observed in the large majority of science classes were the traditional style of teaching (i. e. a chalk and talk teacher's explanation of the content). Sadly enough this condition continues to this day in most classes.

1.4. Aims and Purposes of the Study.

There are three main purposes or aims for doing this research:

1. To find out teachers' and learners' opinions about the role and importance of practical work;
2. To verify how microchemistry kits can influence chemistry teaching and learning, and
3. To find out teachers' and learners' opinions about the microchemistry kits as chemistry teaching and learning tools.

1.5. Research Questions.

Taking into consideration the purposes of the study, this research defined three main questions. Below each question are the reasons behind their formulation, as well as a description of the instruments used to gather data.

1. What are teachers' and learners' opinions about the aims of practical work? And what are teachers' and learners' opinions about microchemistry kits?

This question is two sided. On the one hand, there are teachers, who did practical work during their training at tertiary level who are aware of the relevance of practical work in teaching chemistry, but where most of them did not encounter practical work at school. On the other hand, there are learners who never did practical work, and quite often have never been in a chemistry laboratory.

For both of these groups it is important to establish whether they acknowledge the lack of practical work as a problem in teaching and learning chemistry, and what role and importance they ascribe to practical work.

The second part of the question is for those learners and teachers who used the microchemistry kits before. It is important to obtain their opinions with regard to the tools that they used, and for the teacher to explain whether or not they attained the aims of practical work. It is also important to know whether or not the learners enjoyed practical work and the use of microchemistry kits.

The instruments used to collect the data were different questionnaires, one for teachers and another one for learners.

2. How does practical work contribute to the conceptual understanding of chemistry content?

First, a pretest of the knowledge and understanding of 2 groups of learners in the selected chemistry topic was conducted. Then after eight weeks of intervention learning chemistry by means of practical work using microchemistry kits in one group, and having normal classes in another group, the same test was administered again. The purpose was to ascertain whether or not the knowledge and understanding of the topics in questions had changed and how it changed in the two groups.

The instrument used to collect data to answer this question was a content-based diagnostic test.

3. How does practical work contribute towards improving students' interest towards chemistry?

This question was directed specifically towards learners who used microchemistry kits during the eight weeks intervention. After the initial excitement from doing practical work for the first time, and from experimenting

with the new tools, learners got to use the tools and assume them to be part of the chemistry teaching. Based here on, they would be in a position to say whether or not they liked using them and what their opinions about the tools are.

Two different questionnaires were used to obtain the answer to this question, one for teachers and another for learners.

In addition to that, field notes and informal interviews with teachers and some learners provided more details about the environment in which the study was conducted.

1.6. Ethical Considerations.

This research was conducted respecting the privacy and autonomy of people and institutions directly involved in the study. Prior to the study a written letter requesting authorization to carry out the research which outlined the purpose and duration of the study was sent to educational authorities at both provincial and district levels. (See Appendix E, for a Portuguese version of the letter).

After the approval of these two bodies which passed the information to the schools, the second stage was to meet the principals and give them details about how the research would be conducted and the implications for the lessons. With the approval of the principals, chemistry teachers were first asked to answer the questionnaire. Then, one Grade 9 teacher from each of the four schools involved in the study was asked to choose one class to participate in the study.

All teachers and learners who participated in the study did it voluntarily and showed willingness to do so. Personal identification of the teachers and learners are confidential, and the results of the findings of the research are used only for educational purposes.

1.7. Delineations and Limitation of the Study.

This study was conducted in Beira city, the second largest city of Mozambique after Maputo, the capital. Beira is one of the ten capital cities of the ten provinces of the country.

The study involved four out of five public schools in the city all of which were secondary schools. In the four schools 18 out of 20 junior secondary school chemistry teachers were asked to answer 'teachers questionnaire' before starting the research, and about 175 learners from four different schools were asked to answer the Pre-test and Post-test and a questionnaire for learners before intervention. After intervention only half of this number was available to answer the questionnaire for learners.

Despite this relatively large sample size, chosen for statistical analysis, the findings of the study could not be generalized to include the entire population of learners in the whole country. For example, the relatively high number of qualified teachers is peculiar to Beira and Maputo, because they are the biggest cities and they have a pedagogical teachers-training university. In other provinces the number of qualified teachers is very low.

Nevertheless, taking into consideration that educational problems are the same nationwide, with few exceptions, and considering the attitudes and motivation towards school work, it can be speculated that the cognitive patterns and attitudes towards the content is likely to be the same countrywide. Therefore, teachers' and learners' responses to the questionnaires can be considered to represent the opinions of a significant portion of the Mozambicans who are probably under the same conditions. Thus, the result probably can be generalized to the whole province, and with some extrapolation the whole country.

Due to time constraints it was possible to observe only three of the eight weeks of intervention. The first two at the beginning and one at the end of intervention.

As a consequence, it was not possible to provide much more detail than was given about the classroom where teachers were using microchemistry kits. This would allow the researcher to collect more information about the intervention as it evolved. To overcome this problem, field notes were taken during the three weeks in the field, and occasional interviews were conducted with teachers and some learners.

Due to external pressures to start in time with the field work, the diagnostic test (designed to test learners' knowledge and understanding of the topic in question) was only given to two university chemistry lecturers for a face and content validity check. The comments and recommendations made were used to design the final version which was piloted and administered without going back to them for further comments and corrections.

An effort was made to ascertain that the content and questions were based on the demands of Grade 8 and Grade 9 chemistry programs. Therefore, within the scope of this research the instrument can be considered reliable enough to collect information regarding learners' knowledge and understanding in the selected topics.

1.8. Research Report Outline.

This research report comprises six chapters, including this introductory chapter. The content of each chapter is briefly described below.

Chapter 1 states the problem to be investigated and the background of the country and educational context in which the research was carried out. It also gives the aims, the research questions as well as the ethical considerations and delineations and limitations of the study.

Chapter 2 reviews different literature directly or indirectly related to the problem to be investigated. The literature surveyed forms the theoretical framework to judge or give insights into the findings of the study.

Chapter 3 outlines the approach; instruments and procedures used to collect data, answer the research questions and attain the aims of the study.

Chapter 4 presents and analyzes the data gathered from the questionnaires administered to teachers and learners before and after the eight weeks of intervention. The data is presented in tables and descriptive statistics are used to discuss and analyze the results.

Chapter 5 presents and analyzes the information collected from the diagnostic test administered before and after the intervention (i.e. the pre- and post-test). The data is presented in tables and bar graphs, and both descriptive and inferential statistics are used to discuss and analyze the results.

Chapter 6 is the final chapter of the research report. It summarizes the main findings of the research and, based on the theoretical framework, judgments are made in order to answer the research questions and decide on the extent to which the aims of the study were attained.

Based on the findings of the study some recommendations are addressed to the educational authorities of Mozambique, the main target of the study.

The following chapter gives the theoretical framework in which this research report is based. It is the summary of the literature survey in the topics directly or indirectly related to the problem investigated.