University of Venda
Creating Future Leaders

THE PROVISION AND UTILIZATION OF LEARNING AND TEACHING SUPPORT MATERIALS IN PHYSICAL SCIENCE: A CASE OF LIMPOPO PROVINCE

by

MOSES NDWAKHULU RATHANDO

UNIVERSITY OF VENDA
LIBRARY

A Thesis

Submitted to

University of Venda

In fulfillment of the requirements

For the degree of

DOCTOR OF EDUCATION

Department of Curriculum Studi

SUPERVISOR: Prof. ELM Bayona

CO-SUPERVISOR: Prof. TS Tshivhase- Phendla

February 2010

© University of Venda

University of Venda
Creating Future Leaders

APPROVAL

This thesis has been examined and is approved as meeting the required standards of scholarship for partial fulfillment of the degree of Doctor of Philosophy in Curriculum Studies.

---------- ----------

Supervisor Date

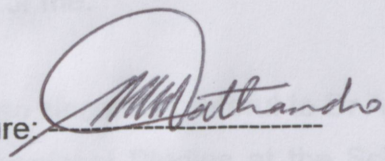
© University of Venda

University of Venda
Creating Future Leaders

DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any University for a degree.

I further declare that all sources noted throughout the thesis have been acknowledged by a complete list of bibliography.

Signature: 

© University of Venda

University of Venda
Creating Future Leaders

ACKNOWLEDGEMENTS

I would like to start by expressing my sincere appreciation and gratitude to all who rendered assistance and showed interest in the completion of this study.

I am greatly indebted to my supervisor, Professor E.L.M. Bayona, and Professor T.S Tshivhase- Phendla, my co-supervisor for their enthusiasm, support and professional guidance during the important stages of my work. Their knowledge, experience and expertise in research have made the completion of this task easier for me.

I am also sincerely grateful to Dr A.P. Kutame, Senior Lecturer in the Department of Professional Studies at the School of Education of the University of Venda, who assisted me with final typing of the document, computation and statistical analysis of the results. His unceasing words of encouragement are greatly appreciated.

I further wish to express my gratitude to Dr T. Wrightson for proof reading and language- editing of the document.

My appreciation also goes to Mrs X. Ragau for her initial typing of the document, Mr M.R. Mathivha, District Senior Manager of Vhembe District, for granting me permission to carry out the survey in schools under his jurisdiction, and to the Provincial Department of Education in Limpopo Province for granting me permission to have access to policy documents on the provision of Learning and Teaching Support Materials (LTSM).

The support of my family has been invaluable throughout the study. The patience and persistence of my wife, Mashudu and my children is deeply appreciated. In particular I wish to single out my last born child, Mashudu, for her aptness in typing some portions of the final revised document. My last born son, Thendo,

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

University of Venda
Creating Future Leaders

should be highly commended for his technological know-how which became very useful towards setting-up of the final document.

Many thanks to the principals of the various participating schools chosen, for their help during the administration of the questionnaires. My thanks also to the educators, learners and curriculum officers who responded to questionnaires and interviews respectively.

Finally, I thank God Almighty for granting me the health, strength and will power to complete this study.

© University of Venda

University of Venda
Creating Future Leaders

ABSTRACT

THE PROVISION AND UTILIZATION OF LEARNING AND TEACHING SUPPORT MATERIALS IN PHYSICAL SCIENCE: A CASE OF LIMPOPO PROVINCE

By

MOSES NDWAKHULU RATHANDO

This dissertation examines the provision and utilization of learning and teaching support materials (LTSM) in the teaching and learning of Physical Science in Limpopo Province schools. Schools that participated in the study were selected from Vhembe District. Data, consisting of a survey of Grade 12 Physical Science learners and educators from the selected schools, together with interview responses from curriculum officers at both district and provincial levels, were collected and analyzed. The study combined both qualitative and quantitative sources to complement the responses.

Currently in Limpopo Province, as is the case in other Provinces, only a few DINALEDI schools (schools of science excellence) are receiving science LTSM from the Department of Education (DOE). The current Limpopo Department of Education (LDOE) policy on provision of LTSM does not specifically provide for science LTSM to all the schools which are offering Physical Science, thus creating a gap between theory and practice when teaching and learning Physical Science. It is this gap that this study is focusing on.

The current policy, however, makes provision for science textbooks but this is not sufficient since effective teaching and learning of science require practical work where both educators and learners have hands-on experience. Utilization of the available science LTSM at schools also faces the challenge of educators lacking appropriate skills in applying them. Also, there is the shortage of Physical

© University of Venda

University of Venda
Creating Future Leaders

Science curriculum advisers who would assist in training educators on utilization of science LTSM.

In this study I addressed five objectives. First, carrying out a review of literature in order to establish the theoretical base for this study. In the second objective I conducted a review of the Limpopo Department of Education Policy on provision of LTSM. Thirdly, I conducted an overview of actual provision of equipment and physical facilities at school, with a view to establish the level of practical work in the teaching and learning of Physical Science in the province. Fourthly, I conducted a field study in order to examine the utilization of existing science LTSM by both learners and educators. Fifthly, I made recommendations on improvement of the policy on provision of LTSM in the Province to include outstanding science LTSM. Lastly I made recommendations on improvement of the utilization of the available science LTSM and other appropriate science facilities.

The study is concluded by making recommendations aimed at solving the identified problem of inequitable provision and utilization of science LTSM in Limpopo Province schools.

© University of Venda

University of Venda
Creating Future Leaders

TABLE OF CONTENTS

LIST OF TABLES xv

LIST OF FIGURES xvii

LIST OF ACRONYMS xviii

LIST OF APPENDICES xx

CHAPTER ONE: THE PROBLEM AND ITS BACKGROUND 1

1.1 Introduction 1
1.2 Statement of the Problem 6
1.3 Objectives of the Study 7
1.4 Research or Critical Questions 7
1.5 Significance of the Study 8
1.6 Research Methodology 9
1.7 Delimitations and Limitations of the Study 11
1.7.1 Delimitations of the study 11
1.7.2 Limitations of the study 11
1.8 Ethical Considerations 12
1.8.1 Permission 12
1.8.2 Appointments 12
1.8.3 Confidentiality 13
1.8.4 Data anonymity 13
1.8.5 Accessibility of the research report 13
1.9 Presentation plan 13

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER TWO: REVIEW OF RELATED LITERATURE 15

2.1 INTRODUCTION 15

2.2 PRACTICAL WORK IN PHYSICAL SCIENCE AND THE USE OF LTSM 18

2.2.1 The context of the use of LTSM in Physical Science Learning 18
2.2.1.1 Defining LTSM materials 18
2.2.1.2 Role of LTSM 19
2.2.1.3 Provision of LTSM 27
2.2.1.4 Utilization of LTSM 32
2.2.1.5 Funding of LTSM 40

2.2.2 Historical use of LTSM in practical learning of Physical Science 44
2.2.2.1 In the developed world 44
2.2.2.2 In the developing world 46
2.2.2.3 In the current South African context 47
2.2.2.4 In the current Limpopo Province context 50

2.2.3 Curriculum models in Physical Science learning and the place of LTSM 51

2.3 THEORETICAL BASIS FOR LTSM IN PRACTICAL LEARNING OF PHYSICAL SCIENCE 55

2.3.1 A theoretical review of practical learning of physical science and the place of LTSM 55
2.3.1.1 LTSM facilitating practical learning 57
2.3.1.2 Value of LTSM in facilitating hands-on learning 57
2.3.1.3 Value of LTSM in empirical work in practicals 58
2.3.1.4 Value of LTSM in practicals that rely upon discovery approach. 58

2.3.2 The place of LTSM in facilitating theoretical models of practical learning of Physical Science 59
2.3.2.1 The use of LTSM in directed activity and reception 60
2.3.2.2 The use of LTSM in demonstration practicals 60
2.3.2.3 The use of LTSM in skill development practicals 61
2.3.2.4 The use of LTSM in laboratory practicals 61
2.3.2.5 The use of LTSM in undirected activity practicals 62
2.3.2.6 The use of LTSM in inquiry-problem solving practicals 62
2.3.2.7 The use of LTSM in directed inquiry-problem solving 63

© University of Venda

University of Venda
Creating Future Leaders

2.3.2.8 The use of LTSM in creating feedback 63

2.4 THE GAP IN PROVISION AND UTILIZATION OF LTSM IN LEARNING PHYSICAL SCIENCE: 64

2.5 CONCLUSION 65

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY 67

3.1 Introduction 67
3.2 Population of Study 68
3.3 Sample and Sampling Procedure 69
3.3.1 The Sample 69
3.3.2 Sampling procedure 70
3.4 Instrumentation 71
3.5 Validity and reliability 72
3.6 Data Collection Procedure 72
3.7 Data Capturing Procedures 73
3.8 Data Analysis Procedure 74
3.9 Delimitation and limitation of the study 75
3.9.1 Delimitation of the study 75
3.9.2 Limitation of the study 75
3.10 Ethical considerations 76
3.10.1 Permission 76
3.10.2 Appointments 76
3.10.3 Confidentiality 76
3.10.4 Data anonymity 77
3.10.5 Accessing research report 77
3.11 Conclusion 77

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER FOUR 78

DATA ANALYSIS AND INTERPRETATION 78

4.1 INTRODUCTION 78

4.2 SECTION A: EDUCATOR'S RESPONSES 79

4.2.1 Educators' personal data 79

4.2.1.1 Educators' age and gender 80

4.2.1.2 Educators' highest academic qualifications 81

4.2.1.3 Educators' highest professional qualifications 82

4.2.1.4 Educator's experience of teaching Physical Science at Grade 12 level. 83

4.2.2 Policy on provision of LTSM 84

4.2.3 Development of science LTSM 85

4.2.4 Provision of equipment to perform experiments 87

4.2.5 Provision of chemicals for performing experiments 88

4.2.6 Provision of physical structures for Physical Science teaching and Learning 89

4.2.6.1 Provision of Physical Science laboratories 89

4.2.6.2 Provision of audio-visual rooms 91

4.2.6.3 Provision of library centres 92

4.2.6.4 Provision of computer laboratories at schools 92

4.2.7 Fittings in Physical Science laboratories 93

4.2.8 Educator's in-service training workshops on utilization of Physical Science LTSM 95

4.2.9 Improvisation of science LTSM by educators 96

4.2.10 Conducting experiments as required by Grade 12 Physical Science CASS Policy 97

© University of Venda

University of Venda
Creating Future Leaders

4.3 SECTION B: LEARNER'S RESPONSES 99

4.3.1 Learners' personal data 99

4.3.1.1 Learners' ages 100

4.3.1.2 Learners' age and gender 101

4.3.1.3 Home language and medium of instruction 102

4.3.2 Contribution of electricity in learning Physical Science at learners Homes 103

4.3.3 Contribution of electricity in utilizing science LTSM at school 105

4.3.4 Shortage of Physical Science textbooks 106

4.3.5 Equipment for performing experiments 107

4.3.6 Chemicals for performing experiments 107

4.3.7 Participation in conducting experiments by learners themselves 108

4.4 SECTION C: CURRICULUM OFFICER'S RESPONSES 109

4.4.1 Policy on provision and utilization of Physical Science LTSM 109

4.4.2 Provision of Physical Science LTSM at schools 111

4.4.3 Utilization of available Physical Science LTSM 112

4.4.4 Improvisation of simple Physical Science LTSM by educators 113

4.4.5 Educator's training on utilization of LTSM 115

4.4.6 Availability of Physical Science laboratories 116

4.5 CONCLUSION 117

CHAPTER FIVE 119

WHAT MIGHT WE LEARN FROM THIS STUDY 119

5.1 INTRODUCTION 119

5.2 AN OVERVIEW OF QUESTIONS 119

5.2.1 Research question one 119

© University of Venda

University of Venda
Creating Future Leaders

5.2.2 Research question two 120
5.2.3 Research question three 120
5.2.4 Research question four 120
5.2.5 Research question five 121

5.3 RESPONSES TO RESEARCH QUESTION 121
5.3.1 Research question one 121
5.3.2 Research question two 122
5.3.3 Research question three 123
5.3,4 Research question four 124
5.3.5 Research question five 126

5.4 CONCLUSION 127

CHAPTER SIX 128

SUMMARY, MAJOR CONCLUSIONS AND RECOMMENDATIONS 128

6.1 SUMMARY 128

6.2 MAJOR FINDINGS AND CONCLUSIONS 131

6.2.1 Findings and conclusions pertaining to the LDOE Policy on Provision of LTSM 131
6.2.2 Findings and conclusions pertaining to provision of science LTSM 132
6.2.3 Findings and conclusions pertaining to utilization of LTSM 133

6.3 RECOMMENDATIONS 134

6.3.1 Recommendations pertaining to provision of Physical Science LTSM 135

© University of Venda

University of Venda
Creating Future Leaders

6.3.2 Recommendations pertaining to utilization of Physical Science LTSM 137

6.3.3 Practical work by both learners and educators 139

6.3.4 Recommendations for further studies 139

BIBLIOGRAPHY **140**

APPENDICES **162**

© University of Venda

University of Venda
Creating Future Leaders

LIST OF TABLES

TABLE	PAGE
Table 2.1 Provincial budgets structured in terms of expenditure per Learner	43
Table 3.1 The sample	70
Table 4.1 Age and gender of participating educators	80
Table 4.2 Educators' highest academic qualifications	81
Table 4.3 Educators' highest professional qualifications	82
Table 4.4 Educators' experience in teaching Physical Science at Grade 12 level	83
Table 4.5 Communication of policy on provision of science LTSM	84
Table 4.6 Reasons for local development of science LTSM	86
Table 4.7 Reasons for centrally developed LTSM	86
Table 4.8 Equipments for performing experiments	87
Table 4.9 Availability of chemicals for performing experiments	88
Table 4.10 Availability of Physical Science laboratories	89
Table 4.11 Provision and utilization of audio-visual room	91
Table 4.12 Provision and Utilization of media and library centres	92
Table 4.13 Utilization of computer centres	93
Table 4.14 Availability of laboratory fittings	94
Table 4.15 In-service training workshops	95
Table 4.16 Efforts for improvisation of Physical Science LTSM	96
Table 4.17 Experiments according to CASS policy	98
Table 4.18 Reasons for failing to conduct experiments	99
Table 4.19 Age of participating learners	100
Table 4.20 Age and gender of participating learners	101
Table 4.21 Home language of participating learners	102
Table 4.22 Availability of electricity in learning Physical Science at learner's homes	103

© University of Venda

University of Venda
Creating Future Leaders

Table 4.23 Availability of electricity at school 105
Table 4.24 Shortage of Physical Science textbooks 106
Table 4.25 Equipment for performing experiments 107
Table 4.26 Availability of chemicals for performing experiments 107
Table 4.27 Participation in conducting experiments by Learners 108

© University of Venda

University of Venda
Creating Future Leaders

LIST OF FIGURES

FIGURE	PAGE
Figure 2.1 The Australian Science Curriculum Model (Bradley 2005)	53
Figure 2.2 Instruction sequences for "hands science" courses.	54
Figure 2.3 The interrelationship between experiments, laboratory, practicals and didactics of science education.	56
Figure 2.4 The Theoretical Model for Science Practicals, after Ausbel(1963), Novak(1978) and Elton(1987).	59
Figure 2.5 Recommended Model for the provision and utilization of Physical Science in Likpopo Province schools	195

© University of Venda

University of Venda
Creating Future Leaders

LIST OF ACRONYMS

ANC	:	African National Congress
ASEP	:	Australian Science Education Project
C2005	:	Curriculum 2005
CASS	:	Continuous Assessment
CONASTA	:	Conference of the Australian Science Teachers Association
CPD	:	Continuing Proportional Development
DET	:	Department of Education and Training
DOE	:	Department of Education
EC	:	Eastern Cape Province
EPC	:	Education Policy Consortium
EPU	:	Education Policy Unit
ESCOM	:	Electricity supply commission
FDE	:	Further Diploma in Education
FEMSA	:	Female Education in Mathematics and Science in Africa
FET	:	Further Education and Training
FRD	:	Foundation for Research Development
FS	:	Free State Province
G	:	Gauteng Province
HOD	:	House of Delegates
HOR	:	House of Representatives
HSRC	:	Human Science Research Council
KZN	:	KwaZulu Natal Province
L	:	Limpopo Province
LDOE	:	Limpopo Department of Education
LTSM	:	Learning and Teaching Support Materials
M	:	Mpumalanga Province
NC	:	Northern Cape Province
NCS	:	National Curriculum Statement

© University of Venda

NGO	:	Non Governmental Organization
NRF	:	National Research Foundation
NW	:	North West Province
OBE	:	Outcomes-based Education
RSA	:	Republic of South Africa
SAASTA	:	South African Agency for Science and Technology Advancement
SAIDE	:	South African Institute for Distance Education
SASA	:	South African Schools Act
SEP	:	Science Education Project
SNC	:	Science National Curriculum
SPSS	:	Scientific Package for Social Science
TIMSS-R	:	Third International Mathematics and Science Study Repeat
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
WC	:	Western Cape Province

© University of Venda

University of Venda
Creating Future Leaders

LIST OF APPENDICES

		PAGE
APPENDIX A	Application to conduct research in Vhembe District of Education	162
APPENDIX B	Approval letter from the District Senior Manager	163
APPENDIX C	Letter to principals of selected schools	164
APPENDIX D	Limpopo Department of Education Policy on provision of Learner Support Materials	165
APPENDIX E	Questionnaire for learners	179
APPENDIX F	Questionnaire for educators	185
APPENDIX G	Interview schedule for Curriculum Officers	191
APPENDIX H	Northern Province map with the Vhembe district	194
APPENDIX I	Recommended Model for provision and utilization of Science LTSM in Limpopo Province schools	195

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER ONE

THE PROBLEM AND ITS BACKGROUND

1.1. INTRODUCTION

The education system in apartheid South Africa was largely 'content based' and teacher- centred. The traditional approach to learning and teaching promoted convergent thinking, was driven by examinations, chiefly required rote-learning and was characterised by a syllabus that encouraged minimal cross-fertilisation because of the compartmentalisation of knowledge into distinct subjects. The system was characterised by rigid division between 'academic' and 'applied', between 'theory' and 'practice' and between 'knowledge' and 'skills'. There was always a huge gap between education and training.

After the ushering of democracy in South Africa in 1994, provisions began for the transformation and restructuring of the education system so as to reflect the needs of all citizens. The apartheid system of education became a thing of the past. The focus of Education is now aimed at lifelong learning and equipping learners with skills, values and critical understanding, which requires them to confidently and creatively respond to the challenges of a changing social, political and economic environment (Department of Education 2000).

Furthermore, the Department of Education (2000) acknowledges that we are living in a rapidly changing world, where old skills are no longer relevant and new skills are required to adapt to rapidly changing demands. Today's workplace is characterized by global competition, cultural diversity, and technological and management processes that require workers to think critically, solve problems and communicate effectively. It is therefore imperative that learners be exposed to a curriculum that concentrates broadly on all aspects of career provision.

© University of Venda

University of Venda
Creating Future Leaders

The new curriculum thus needs to move towards a balanced learning experience that will provide flexible access to further education, lifelong learning and higher education, and to productive employment in a range of occupational contexts. The Education White Paper 4 (1998), indicates that this new curriculum will overcome the outdated divisions between 'academic' and 'vocational' education, and between education and training, and will be characterised not by the 'vocationalisation' of education, but by a sound foundation of general knowledge, combined with practical relevance. It is a curriculum that will offer the learner flexibility and choice, whilst ensuring that all programmes and qualifications offer a coherent and meaningful learning experience.

It is on the basis of the background stated above that the Ministry of Education decided to commit itself to an Outcomes-Based Education (OBE) approach to learning and teaching. This move was also made due to growing concern about the ineffectiveness, non-productivity and wastefulness of the previous education system. The OBE approach to Education is founded on the belief that all learners can learn and achieve, and that the role of the learning institution is to create the conditions that will enable them to do so. In this context, the learner is the focus of learning activities and the teacher is a facilitator. The focus is on learning by doing, learning how to learn, learning through experience and using critical contextual information for analysis.

In this system, learners gradually become responsible for their own learning and progress, and are constantly motivated by feedback and positive comment on the value of their efforts. Above all, the system is designed to encourage and promote a thirst for knowledge and a love of learning (Department of Education 2000).

The Ministry of Education has committed itself to a fully participatory process of curriculum provision and training, in which teacher educators, subject advisors and other learning practitioners play a leading role, along with academic subject specialists and researchers.

© University of Venda

University of Venda
Creating Future Leaders

The process must be open and transparent, with proposals and critique being requested from any persons or bodies with interests in the learning process and learning outcomes (Department of Education 1997). Bayona (1995) also indicates that successful curriculum provision is synonymous with adequate availability and utilization of materials, equipment, information, personnel, time and space. He further indicates that educators as well as other curriculum experts need an adequate resources support base in order to carry out their curriculum tasks.

The President's Education Initiative study reports that educators who participated in the University of the Witwatersrand Further Diploma in Education (FDE) seem to be aware of the importance of materials in learning. They also expressed an understanding of these in learning and they were keen to make their own materials. But despite this awareness and expressed desire to make materials, few educators did so. A number said they lacked the creativity to identify resources that could be turned into learning materials (Taylor and Vinjevold 1999). Lack of secure storage, support resources like libraries and duplicating facilities were also given as reasons for not developing materials.

According to Taylor and Vinjevold (1999) the Department of Education (DOE) includes a wide range of texts, resources and equipment in its definition of learning support materials. Learning support materials encompass 'more than just textbooks' and may be created from a variety of sources. They may also be 'print-based, electronic, physical, combinative, human and organisational'. The list of materials under each source is extensive. For example, print sources include notes, documents, published textbooks, workbooks, reading schemes, newspapers, magazines, supplementary readers, teacher guides and reference books, while electronic resources include transparency series, slide or sound presentations, filmstrips, video and audiotapes and computer software.

Presently, the Limpopo Provincial Department of Education is concentrating on the purchase and dissemination of textbooks, language prescribed books and

© University of Venda

University of Venda
Creating Future Leaders

stationery. The department is so far not focussing on science learning and teaching support materials (LTSM) such as apparatus, equipment, chemicals, electronic resources and computer software. It is also not focussing on provision of infrastructure such as science laboratories, computer laboratories and libraries which are useful in practical teaching of science. However, the dissemination of the said textbooks, language prescribed books and stationery is inadequate most of the time, belated or at times not done at all due to provisioning and financial constraints faced by the Provincial Department of Education. Failure to provide the said LTSM by the Provincial Department of Education causes a very acute problem in rural schools where economic conditions are such that schools cannot afford to improvise most of the required materials on their own.

Provision of learning and teaching support materials is not sufficient on its own. Educators require sufficient training in the use of these materials. Presently, although most educators have received some form of training in OBE, the training is generally regarded as insufficient and at times inappropriate. Most educators express a need for training that is less theoretical but more practical (DOE 2000).

The current scenario of science teaching and learning in the entire country of South Africa, but with special reference to Limpopo Province leaves much to be desired. According to Howie (2001) half of the 225 schools tested in South Africa indicated that instruction in Mathematics and Science was seriously hampered by a shortage of materials, equipment and facilities. The results further highlight this shortage of materials, equipment and facilities as one of the reasons for this poor achievement. The report also mentioned the fact that the South African results for science are significantly below the mean scores of all other participating countries (Howie 2001). Out of the nine provinces of South Africa, Limpopo obtained the lowest average score (169) in science, which was approximately half the score achieved by the learners from Western Cape (393).

In global terms, South Africa is severely under-represented in science, engineering and technology. An insufficient number of students are studying, completing or opting for science and engineering at school and higher education levels. Recent

© University of Venda

University of Venda
Creating Future Leaders

figures provided by the National Research Foundation (NRF 2000) estimate that there are 3.3 per 1000 scientists and engineers in the South African population. This is in comparison with 71.1 per 1000 in the Japanese population (Onwu 2000).

In South Africa, as in most African countries, provisioning of OBE learning and teaching support materials is located both at National and Provincial levels. This approach, results in educators becoming too dependent on externally provided materials, equipment and other teaching and learning supplies. The ideal situation is one in which educators are encouraged and trained to develop their own low-cost materials and equipment , or funds are made available to them in order to purchase science kits which they may be unable, for some reason, to develop.

Despite the good intentions of the new curriculum, it is likely to fail if the problem of provision and implementation of learning and teaching support materials is not attended to, particularly in the teaching and learning of science. In order to attempt to address these problems, this study aims to investigate the provision, and utilization of science LTSM in Limpopo Province with special focus to the practical teaching and learning of Physical Science at Further Education and Training (FET) level. As a point of departure the study pays attention to provisions of the Departmental Policy on supply of LTSM to schools.

This study was undertaken in the Vhembe District. The Vhembe District of Education forms the northern part of the province and is predominantly rural, with few schools found in semi-urban and urban areas. The greater part of this district was declared the 'Independent Republic of Venda' for a period of about fifteen years. This so-called independence had a negative impact on the provision of education resources. Physical Science in particular suffered great setbacks in areas such as provision of laboratories, services, equipment, material resources and skilled human resources. The rest of the district comprised largely of what was previously known as 'self-governing' territories which equally lacked adequate science educational resources. The district consists of six areas and twenty-seven circuits, covering the whole area that was formerly known as Venda, parts of Gazankulu and Lebowa.

© University of Venda

University of Venda
Creating Future Leaders

1.2. STATEMENT OF THE PROBLEM

The Ministry of Education seeks to adopt a more integrated approach to education and training, thereby transforming the separate and distinct areas of learning in schools and colleges. The new approach will stimulate and empower learners to acquire and apply knowledge, skills, and values and to confidently and creatively respond to the challenges of the changing social, political and economic environment through lifelong learning. For this ideal situation to be achieved, learning areas such as the natural sciences, which require a significant amount of practical work, need to be provided with relevant materials, equipment and facilities.

However, the provision of fully-fledged laboratories, together with sufficient apparatus, equipment, services and material resources at best, or alternatives such as science kits, and mobile laboratories to all the FET schools in Limpopo Province, is an enormous task. With the exception of ex-model C schools, almost all FET schools in South Africa are without resources for laboratory-based science teaching and learning. In addition to equipment, adequate provision of services (gas, water and electricity), and an adequate supply of well-qualified educators is needed to provide a quality teaching and learning environment. This is certainly a tall order – well-equipped laboratories are costly, and well-qualified science educators are few. Qualified laboratory assistants are also very important, but usually not available and yet they are needed for the efficient running of the science laboratories.

Clearly, there is a gap between the intentions of the new curriculum, and how it is being implemented, in view of constraints in the provision and utilization of science LTSM in the Limpopo Province. In other words, the gap is between theory and practice of knowledge and skills acquired during the process of teaching and learning of science – most often, it is not possible to link theory to practice. The current LDOE policy on provision of LTSM makes provision for supply of text books, excluding equipment and chemicals for practical work. This result in lack or inadequate practical work in the teaching of science. The gap, in actual fact, is

© University of Venda

between LTSM Policy provisions and expectations of teaching science practically. It is this gap that this study focuses on. This study explored the provision and utilization of learning and teaching support materials in Physical Science which obtains in Limpopo Province schools.

1.3. OBJECTIVES OF THE STUDY

The researcher set out to achieve the following objectives:

- To carry out a review of literature in order to establish the theoretical base for this study, and examine scholarly views on the significance of practical work, together with the role of the required science LTSM, in the teaching and learning of Physical Science at school level.
- To conduct a review of the Limpopo Department of Education Policy on the provision of LTSM.
- To conduct an overview of actual provision of equipment and physical facilities at schools, with a view to establish the level of practical work in the teaching and learning of Physical Science in the province.
- To conduct a field study in order to examine the utilization of existing Physical Science LTSM by both learners and educators.
- To make recommendations on improvement of the policy on provision of LTSM to include outstanding science LTSM. Further recommendations will be on improvement of the utilization of available science LTSM and other appropriate facilities.

1.4. RESEARCH OR CRITICAL QUESTION

The main question of this study was: "*How is provision and utilization of learning and teaching support materials in Physical Science implemented in Limpopo Province schools?*".

© University of Venda

University of Venda
Creating Future Leaders

In order to achieve the objectives and expectations of this question, the following sub- questions were taken into consideration:

1. What is the view of scholars on the significance of practical work, including the role of LTSM, when learning Physical Science?
2. How does the LDOE Policy on provision of LTSM meet the requirement of conducting practical work when teaching and learning Physical Science?
3. How are equipment for practical work and basic physical facilities such as gas, water, and electricity supplied to schools offering Physical Science?
4. How are educators trained or at least orientated to effectively utilize the available LTSM?
5. How is science educators encouraged to improvise simple LTSM, where possible, for their lessons?

1.5 SIGNIFICANCE OF THE STUDY

Firstly, Education Policy makers will benefit from the results of this study. The study makes several recommendations on how to effectively provide and utilize LTSM in the practical teaching and learning of Physical Science. An analysis of views from literature and of opinions by educators, learners and curriculum officers who participated in this study should influence curriculum developers in the provision of LTSM for use in schools. The results of the study can also become a source of evaluation of the system of provision, and utilization of LTSM by curriculum developers and other educational evaluators.

Secondly, Learners will benefit directly from the results of this study since effective utilization of learning and teaching support materials enhance learner participation in the classroom.

© University of Venda

UNIVERSITY OF VENDA
LIBRARY

University of Venda
Creating Future Leaders

Thirdly, other beneficiaries of this study are educators who teach Physical Science or natural sciences. Learning and teaching support materials have been proved to enhance the teaching and learning process to a great extent if utilized effectively.

Fourthly, those who offer in-service guidance and training of educators, such as curriculum advisors, will also benefit from the findings and recommendations of this study. They will be able to demonstrate the significance of science LTSM to educators and how to make use of them in learning and teaching of Physical Science.

Lastly, the outcome of this study will form a basis for future research in the same or related fields of study.

1.6 RESEARCH METHODOLOGY

In order to achieve the objectives stated above, an empirical investigation through survey method of the provision and utilization of Physical Science LTSM at selected schools in Vhembe District in Limpopo Province was conducted. The results obtained from questionnaires responded to by educators and learners were further enriched by responses from interviews conducted with curriculum officers.

The survey is a descriptive method in educational research in which the researcher gathers data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationship that exist between specific events. Thus, surveys may vary in their levels of complexity from those which provide simple frequency counts to those which represent relational analysis (Cohen and Warior 1986).

Bell (1993) describes a survey as a method of research which will aim to obtain information from a representative selection of the population and from that sample the researcher will then be able to present the findings as being representative of

© University of Venda

University of Venda
Creating Future Leaders

the population as a whole. The aim of a survey is to obtain information which can be analysed and patterns extracted and comparisons made.

Fraentel and Wallen outline the major characteristics that all surveys posses as follows:

- Information collected from a group of people in order to describe some aspects or characteristics (such as abilities, opinions, attitudes, beliefs, and/or knowledge) of the population of which that group constitutes the data of the study
- Information is collected from a sample rather than from every member of the population (1993: 343).

In this survey in which both quantitative and qualitative methods were used the targeted population consisted of all Grade 12 learners doing Physical Science at all secondary schools in Vhembe District together with all their respective educators. For reasons of feasibility, a random sample of 55 schools was selected. Both learners and educators from these schools responded to questionnaires appropriately designed for them by the researcher. The main purpose of the questionnaires was to establish the status of provision and utilization of Physical Science learning and teaching materials in schools in the District.

Interviews, which are applicable in qualitative approach, were conducted with a sample of curriculum officers based at provincial and district office levels. This was done in order to extract views, ideas, issues and guiding principles which may be helpful in improving the provision and utilization of Physical Science learning and teaching support materials in Limpopo Province schools. This view is supported by Henning *et al.* (2004) who maintains that, through qualitative research, the researcher finds out what happens, how it happens and why it happens the way it does. In qualitative approach participants have a more open-ended way of giving their views and demonstrating their actions.

© University of Venda

University of Venda
Creating Future Leaders

On the basis of data collected through the above stated procedure, the researcher made several recommendations aimed at solving the current problem of the gap which exists between LDOE Policy on provision of LTSM and practice in the teaching and learning of Physical Science in Limpopo Province schools, as well as anywhere else where similar conditions exist.

1.7 DELIMITATIONS AND LIMITATIONS OF THE STUDY

1.7.1 Delimitations of the study

The problem of adequate provision and effective utilization of Physical Science LTSM runs across the entire country of South Africa and in essence it is a problem of all developing countries of the world. For reasons of feasibility this study was conducted in the Vhembe District of Education in Limpopo Province. Specifically the target was FET institutions with Grade 12 learners doing Physical Science as a learning area.

1.7.2. Limitations of the study

The following are the identified limitations of this study:

- After piloting, every care has been exercised for all questions to be understood by all the respondents in the same context, however, it is possible that ambiguity in questions may not have been completely eradicated. The questionnaires used were in English, which is a second language to most of the learners and educators who took part in the survey. The reason why the questionnaires were only in English, whereas the majority of learners and educators were not speakers of this language, was that English happened to be the medium of instruction to the majority of those who took part in the study. Only a small number of learners who took part in the study were taught Physical Science in Afrikaans. It is possible, that both learners and educators may have misunderstood some of the questions as some answers to the contingency questions showed.

© University of Venda

- The other limitation is that the study is confined to Grade 12 Physical Science learners and educators and does not include those from lower grades. However, it is envisaged that factors that affect provision and utilization of LTSM in Grade 12 Physical Science learners and educators will also apply to learners and educators in lower grades.

The researcher believes that in spite of delimitations and limitations shown, objectives of the study were achieved.

1.8 ETHICAL CONSIDERATIONS

When conducting research, ethical considerations are of utmost importance, particularly when one is conducting a research involving human participants (Goddard and Melville, 2001). According to Kutame (2004) ethical principles include, but not limited to, informed consent, deception, confidentiality, anonymity, harm to subjects, and privacy. In order to comply with ethical considerations as explained, the researcher observed the following: issues such as permission, appointments, confidentiality, data anonymity and accessing research report after completion of the study.

1.8.1 Permission

The researcher sought permission to conduct research in some of the Vhembe District schools (A letter requesting permission from the Regional Director of Vhembe District and his reply granting permission can be found in Appendices A and B, respectively)

1.8.2 Appointments

Principals of selected schools were written letters of making appointments for visiting their schools in order to conduct research.(A copy of such letters can be found in Appendix C)

© University of Venda

University of Venda
Creating Future Leaders

1.8.3 Confidentiality

All respondents of the questionnaires and participants of interviews were assured both in written form and verbally that their responses will be treated confidentially and that they will be used for the purposes of this study only (refer to the beginning of each questionnaire in Appendices E and F respectively)

1.8.4 Data anonymity

All respondents were requested not to write their names or that of their schools on the questionnaires in order to ensure data anonymity. The assurances were given both in writing and verbally at the beginning of each responding session (see both Appendices E and F)

1.8.5 Access to research results

Respondents and participants were assured that research report will be made available to the Special Collection Section of the University of Venda library. Those interested could access it from there.

1.9 PRESENTATION PLAN

This thesis is divided into six chapters which are briefly explained below:

Chapter One focuses on the background of this study in terms of its problem, objectives, research questions, significance, delimitations and limitations.

Chapter Two is a critique of the relevant literature, focussing on views of scholars on the significance of Physical Science learning and teaching support materials. The major focus of this chapter is to relate the findings of this study with other related studies done in the field of provision and utilization of Physical Science learning and teaching support materials.

© University of Venda

University of Venda
Creating Future Leaders

Chapter Three focuses on the methodology followed in this study including the targeted population, sampling procedure, instruments designed for collecting data, actual data collection and data analysis procedures.

Chapter Four focuses on the actual analysis and interpretation of data collected. Data on provision, dissemination and utilization of science LTSM, collected through questionnaires and interviews, is analysed and interpreted in this chapter.

Chapter Five focuses on responses to research question and lessons learnt through the study.

Chapter Six outlines the summary of the study. Major findings of the study, conclusions of the study and a model summarising recommendations for provision and utilization of science LTSM in Limpopo Province schools based on the results of the study are discussed.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER TWO

LITERATURE REVIEW

2.1. INTRODUCTION

The review of literature in this chapter focuses on the role of LTSM for practical work in Physical Science teaching and learning. For the purpose of this study, the definition of a practical follows that of Hodson(1988) and Kirschner(1991) . A practical is a didactic method of learning and practicing all the activities involved in science. Experiments are considered a subset of laboratory work. Laboratory work is a subset of practicals, which is, in turn, a subset of the didactics of science education. This definition includes investigations and task- orientated problem solving. In terms of this definition, practical work ensures understanding of theory as well as providing opportunities to apply the theory in a practical sense. Hodson (1990) also defines practical work as tasks in which learners observe or manipulate real objects or materials – for themselves (individually or in small groups) or by witnessing educator demonstrations. According to him practical work can: motivate learners, by stimulating interest and enjoyment; teach laboratory skills; enhance the learning of scientific knowledge; give insight into scientific method and develop expertise in using it; and develop scientific attitudes, such as open-mindedness and objectivity.

Practical work, as defined above, cannot take place without provision and utilization of the necessary learning and teaching support materials (LTSM). This chapter will therefore pay attention to the role played by both practical work and LTSM in Physical Science teaching and learning.

An integrated approach towards education and training is now a major international trend in curricula (DOE 1997). It is therefore very important that the approach to education should aim at integrating the theory with practice, and the academic knowledge with vocational skills. Effective utilization of learning and teaching support materials is very critical in ensuring integration of theory with practice. The

© University of Venda

University of Venda
Creating Future Leaders

use of LTSM according to Khosa and Mbokota (2002) provides learners with opportunities for practical learning instead of relying on lecturing by educators. Studies show that there has always been a gap between theory and practice in the teaching and learning of natural sciences in many schools in South Africa. This is partly due to limited availability and utilization of a variety of LTSM.

Descy (1992) makes a claim that learners learn more information in less time in a properly mediated presentation when compared to a non-mediated presentation. The proper use of media in learning science gives all learners the opportunity to think and learn and develop an interest in and curiosity about the world around them through explanatory and investigative experiences and activities. Good educators become better educators when they use appropriate instructional materials in their lessons. Learning what materials to use, and how to use them, comes with experience (Ornstein and Lasley II 2000).

The researcher is of the opinion that it is essential that educators should learn to use instructional practices that positively apply a variety of learning materials and methods instead of relying solely upon the use of textbooks. This is endorsed by many studies in Science Education, according to Charlene and Chiarelott (1990), which demonstrated the significance of inquiry, open-ended experimentation, learner-directed activities and hands-on activities in the teaching of science.

Methods employed by educators to teach Physical Science in secondary schools are to a large extent influenced by the kind of resources and facilities available in the school. The teaching methods, in turn, influence the level and quality of participation and performance in Physical Science by learners. In general, where resources and facilities are inadequate; the teaching approach tends to be teacher-centred. This type of approach is heavily dominated by the educator as he or she lectures on the subject, gives notes and demonstrates the practical aspects of the lesson. The learners remain passive participants expected to listen and observe only. The educator, therefore, is the sole source of knowledge for the learners. A teaching approach that centres on the educator is bad for Physical Science teaching and learning and soon kills the interest of learners in the subject.

© University of Venda

University of Venda
Creating Future Leaders

Traditional chalk- and- talk teaching, copying notes and cookbook practical lessons offer little challenge or excitement to learners. Areas of research have indicated a link between learner retention levels and teaching method employed in science. One such research work in Australia document declining numbers of learners who take science courses in the post compulsory years of schooling and this reflect their disenchantment with science (Fensham 2005; Goodrum, Hackling, and Rennie 2001). Educators are concerned that science lessons are less fun and that learners can be left under-prepared for tertiary study (Hutchinson 2003). Practical work and hands-on experience is the answer to this concern.

The researcher asserts that for many science educators, it would be hard to imagine lessons which did not involve practical work. The prominence of practical work in the school science curricula of many countries suggests that there is clear commitment on the part of both educators and others involved in science education to the contribution that practical work makes to science lessons (Bennett 2003). In fact practical work of some form in Physical Science learning has been part of the school science learning and has been part of the school curriculum for well over a century, and its origins have been well documented (Gee and Clackson 1992; Lock 1988; Jenkins 1998)

In some respects, the development of practical work can be likened to a pendulum swinging between approaches which emphasize 'facts about science' and approaches which emphasize 'methods of science'. Practical work has been changing from time to time as methods and approaches changed. But, in all these dispensations of change, LTSM were always required to facilitate the teaching and learning process (Bradley 2005).

Although recent policy has been to give prominence to investigations, the general consensus is that a school Physical Science curriculum should contain a variety of different types of practical work. Several authors have attempted to clarify different types of practical activities according to their aims (Woolnough and Allsop 1985).

© University of Venda

University of Venda
Creating Future Leaders

Practical work in school Physical Science has been the focus of considerable research activity, as is evident from the number of books published in the last decade or so on various aspect of practical work (e.g. Hegarty-Hazel 1990; Woolnough 1991; Gott and Duggan 1995; Wellington 1998; and Leach and Paulsen 1999). All this is an indication of the important role played by practical work in the learning of Physical Science. The relevant LTSM also assume the same importance.

In this chapter the researcher further explores the context of the use of LTSM in Physical Science practical work; historical use of LTSM in practical work; curriculum models in Physical Science learning and place of LTSM in these; theoretical basis for LTSM in practical science learning; theoretical models of practical learning in Physical Science which includes the place of LTSM in facilitating this; and establishing the gap in provision and utilization of LTSM which require to be filled.

UNIVERSITY OF VENDA
LIBRARY

2.2 PRACTICAL WORK IN PHYSICAL SCIENCE AND THE USE OF LTSM.

2.2.1 The context of the use of LTSM in Physical Science learning.

2.2.1.1 Defining LTSM materials.

Learning and teaching support materials (LTSM) refers to both human and physical resources, also including facilities which offer support to the process of teaching and learning. According to this definition the following is a list which comprises what is referred to as LTSM in this study: educators, textbooks, libraries, laboratories, chemicals, tools and equipment, teaching aids, classrooms, stores, and offices.

© University of Venda

University of Venda
Creating Future Leaders

The department of education (DOE) provides a list of some LTSM which are required in the teaching-learning process as follows:

- Notes/ documents that can be distributed
- Published textbooks
- Work books
- Video tapes, radio tapes, multi-media packs and computer software
- Educators guides
- Supplementary books (additional books that an educator may choose to use in addition to the core textbooks)
- Models
- Apparatus
- Experimental learning strategies (field work) (1997:48-49).

The above list, according to the researcher, is not comprehensive enough since it left out both human and physical resources, without which utilization of LTSM is not going to be possible.

2.2.1.2 Role of LTSM

The DOE regards adequate learning and teaching support materials 'as essential to the effective running of an education system and asserts that these materials are an integral part of curriculum provision and a means of promoting both good teaching and learning (DOE 2000). As such curriculum implementation cannot take place effectively and efficiently without provision of the requisite learning and teaching support materials.

The OBE curriculum accordingly demands well-resourced classrooms that ideally should include LTSM, such as textbooks for each learning programme and other print-based materials, stationery, teaching equipment such as charts, globes, as well as equipment and consumable materials. In addition, the DOE policy requires that educators are not only able to use new textbooks effectively but also prepare learning materials themselves as well as make use of old materials in new and appropriate ways (DOE 2000).The new curriculum emphasizes hands-on

© University of Venda

University of Venda
Creating Future Leaders

experience, particularly by learners. Thus provision and dissemination of LTSM for practical work by learners themselves is a critical challenge for the DOE nationally and provincially.

Without availability of the required materials and equipment, curriculum implementation cannot take place. It is for the same reason that Ntombela (1994) indicated that the discrepancy between the demands of the syllabus and the reality found in schools with regard to the availability of learning materials is immense. Ntombela goes on to explain that the availability of learning materials influences what goes on in the classroom because educators make the final choice of learning activities in terms of the characteristics of the learners, the availability of resources, and the exigencies or the ongoing instructional process (Ntombela 1994). The problem of lack of facilities and resources to enhance effective learning and teaching of Physical Science was also raised by the Deputy Minister of Education in 2001, Mr Mangena, when he said:

> Our current situation is that few learners who graduate in Mathematics and Science choose Mathematics and Science teaching as a career. Consequently, we are caught up in a vicious cycle of under-dissemination of educators in these fields of study. Because of this most secondary schools do not offer Mathematics and Science. In schools where these subjects are offered, the majority of the educators are under qualified. This situation is exacerbated by the lack of facilities and resources to enhance effective learning and teaching. The majority of schools that offer Mathematics and Science do not have facilities and equipment to promote effective learning and teaching. The teaching of Science remains at a theoretical level without any experiments to enhance understanding and application of knowledge (2001:3).

Practical work will not be possible without equipment and material resources. It is for this reason that Nemudzivhadi (2003) when accepting a donation from both Electricity Supply Commission (ESCOM) and South African Agency for Science and Technology Advancement (SAASTA) stated that for the first time in the history

© University of Venda

University of Venda
Creating Future Leaders

of that school they had apparatus and chemicals which learners in their groups were able to handle in conducting experiments. That made learners to get a feel of how scientists work for example, perseverance, cause and effect relationship; opinion based on evidence, the complementary between theory and practice and verification of scientific laws and principles.

When material resources and equipment are not provided, the tension between the 'official' and the 'operational' curricula remains a big challenge. Whilst the former gives valuable insight into the attitudes, values and 'platform' of the authors, it is not subjected to the constraining realities of the classroom that shape the 'operational' curriculum. Ntombela explains the difference between 'official' and the 'operational' curricula by means of the following example:

> In the introduction of the Standard 6 and 7 DET General Science syllabi, for example, there is a statement that reads: "Sections indicated as practical work should be done by the learners themselves, while demonstrations should preferably be done by the educator" (1994:49).

Such a statement expresses the good intention of the 'official' curriculum or plan, but the unavailability of resources in many schools ensures that it remains at the level of intention and, for most classrooms, it is impossible to operationalise. Another worrying scenario is the one where resources are made available but they are not fully utilized. To this end Bellamy et al. blame the combination of technophobia and laziness:

> ... the majority of educators are afraid of media equipment, are unaware of resources available, and are unwilling to expand the extra resources, plan for the use of such resources in a presentation, or make arrangements for set-up and operation of necessary equipment (1978:7).

Smeltzer (1988:222) also observes that "educators have preferred to rely on the traditional classroom pedagogy than to incorporate mediated instruction in their lessons". One possible reason for this behaviour may be lack of adequate

© University of Venda

University of Venda
Creating Future Leaders

exposure during their pre-service training. Webb and Raubenheimer endorse this conclusion when they state:

> A good educator will use a range of methods to achieve the purpose of a lesson. However, the problem in South Africa is that educators have generally not been exposed to alternative methods of teaching during their own learning experiences. Furthermore, when they studied didactics at College it is likely that this was taught theoretically. Hence educators tend to model their teaching on that with which they are familiar, the chalk and talk method (1994:84).

During their pre-service training, educators should be assisted to develop skills which will enable them in developing their own materials which would be relevant to their contexts. Educators also need to know how to use the formal scientific apparatus that may be provided by education departments or by non-governmental agencies like the Science Education Project (SEP).

Webb and Raubenheimer (1994) further argue that because much of the educator training is theoretical, educators often do not know the basics, such as how to heat a ball and ring for an experiment on expansion. In-service training for educators is needed on a mass scale so that all educators have access to the requisite practical skills. Associated with this is the need for educators to be aware of safety precautions for handling equipment and chemicals. Educators should further ensure that these basic precautions are used by learners.

Physical resources such as laboratories underpin requirements for practical work in school science teaching. They are not learning and teaching support materials per se but they play a very significant role when some of the experiments are conducted. Ausubel has shown the significance of laboratories and made the following observation:

> ...the laboratory has always been the most distinctive feature of science instruction... with the advent of the new curricula; important changes have

© University of Venda

University of Venda
Creating Future Leaders

> taken place in the role assigned to the laboratory... The laboratory acquired a control role not as a means for demonstration, but rather as the core of the science learning process... it should typically carry the burden of conveying the methods and spirit of science... given the new roles, how effectively are these being carried out? (1989:59).

From this observation, the feature of a laboratory is very prominent in science instruction. Thus, its absence affects science instruction adversely and consequently scholastic achievement will also be affected negatively. Lemlech (1994) argues that although the textbook takes precedence, educators use many types of media and instructional technology particularly in the teaching and learning of Physical Science. For Physical Science concepts to be well understood, they require demonstrations and/or hands-on experience by educators and learners respectively. In essence, learner participation is essential to science teaching and learning.

Doidge sums up the laboratory situation in South African schools most appropriately in the following paragraph:

> In some older schools there are no laboratories. Many schools do however have a Physical Science and a Biology laboratory, but these laboratories are sometimes used only by the head of the department and/or senior educator in that subject. In a number of schools, the laboratory is used by one class as their classrooms (because of a shortage of classrooms); or it acts as a storeroom or staffroom; or it is kept locked for fear of vandalism. In the laboratory, there may be no electricity or gas. Apparatus varies from very little to an adequate dissemination. Apparatus may never have been supplied. If supplied, it may have been stolen, or never ever unpacked (the inexperienced educator's fear of the unknown!). Practical work is further hindered because some material is not easily available, for example, Hydra, tapeworm and ferns. Vandalism and destruction particularly during 1986, ruined many adequately supplied laboratories. The relatively low

© University of Venda

University of Venda
Creating Future Leaders

government funding for Black schools has resulted in a lack of money for repairs, equipment, etc. (1994:12).

This observation by Doidge dramatically describes the situation as it obtains in most schools for blacks in the Limpopo Province. The backlog is huge and unless it is confronted by the government as well as by NGOs, the situation will remain unchanged even in the new curriculum.

For practical work to be done on an efficient and effective basis, the researcher is of the opinion that adequate numbers of well-equipped laboratories have to be provided. This also implies adequate provision of services such as gas, water and electricity, and an adequate dissemination of well-qualified educators (Naik1994).

In considering the provision of laboratories, services and other physical resources for the high schools under the various education authorities, Naik (1994) concluded that the strengthening and upgrading of practical work needs to be carried out in each school, but most attention must be given to black schools in the country. Both the number and the size of laboratories in black rural schools remains a big challenge for education authorities. A good example is the case of Thengwe High school, a school situated in the far-north of Vhembe District of Education in Limpopo Province. The principal of the school, Mr Nemudzivhadi(2003), on the occasion of celebrating a donation from both Electricity Supply Commission(ESCOM) and South African Agency for Science and Technology Advancement(SAASTA) indicated that their old science laboratory which was meant for not more than thirty learners is now forced to cope with approximately 85 learners , which is definitely not conducive for proper science learning.

It must be emphasized that formal functional laboratories, if constructed justifiably, need to be provided with devices, equipment and material resources to offer a full range of typical high school experiments (Manana 1994). It should, however, be pointed out that the alternative to functional laboratories is to use low-cost equipment and experimental kits. The use of science kits requires quite a different

© University of Venda

University of Venda
Creating Future Leaders

approach in that they need only a work surface. They are independent of services and are low-cost in terms of demands on consumables. A good example is the Science Education Project (SEP) kits, which meet such criteria.

Micro science approach seems to be the solution in providing a practical science experience for learners. On the one hand traditional equipment is prohibitively expensive, both in terms of its costs and in terms of safety and storage requirements which implicate full science laboratories (Caillods, Gottelman- Duret and Lewin 1997). For many educators acquiring micro science equipment means enabling them for the first time to provide hands-on practical experiences for their learners. For many educators, furthermore, this is to a greater or lesser degree, the first time that learner- centred methodologies are used in their classroom to any significant extent.

The significance of physical resources in the teaching and learning of science cannot be overemphasized. Ironically, a newspaper article with the headline: "Matric triumph against the odds". The paper illustrates an argument that although the syllabus appears to encourage practical work, the examination makes it possible to do well without engaging in meaningful practical work during the year. Congratulating a successful township candidate, The Editor of Rand Daily Mail states:

> Remarkably, Nkosinathi managed to get an A for Mathematics and a B for Physical Science in a school where the 'laboratory' has almost no equipment and many of the experiment' procedures and results have to be imagined. There is no water dissemination or toilets at the school, windows are broken and classes are made up of between 70 and 80 learners...We established that they (learners) had only three months of extensive and full tuition last year (1994:2).

The above illustration does not discredit the significant role played by resources, both human and physical in the teaching and learning of science. It is most likely that the question paper in Physical Science had very little or nothing to do with

© University of Venda

University of Venda
Creating Future Leaders

equipment and materials as quickly, cheaply and conveniently as possible. If this is not done, Spargo(1994) concludes that the very substantial sums of money which are spent on aspects such as educator training and provision of laboratories will be largely wasted. Thus the researcher concludes that provision of LTSM is very critical to the teaching and learning of Physical Science.

2.2.1.3 Provision of LTSM.

Since provision of the required LTSM for the teaching and learning of Physical Science is expensive, provision of low-cost equipment becomes the best option. Provision of low-cost equipment uses local technical knowledge and local materials from the environment, and can easily be suited to local needs. Educators can participate in the design and provision of the items, thus, more closely relating the proper use of the apparatus to the curriculum. In fact, educators and learners can both be involved in the provision of apparatus. Such an involvement could provide an effective foundation for science and technology in the curriculum.

It has been observed by Warren (1983) that educators in most developing countries do not make full use of the apparatus purchased from international suppliers because they either fear breaking it or do not know how to use it. Following up to this observation it is significant for educators to undergo in-service training on the use of the purchased apparatus. Provision of appropriate learning and teaching support materials is an integral part of the curriculum provision process because without appropriate learning and teaching support materials objectives of any curriculum cannot be realized. Lewy (1977) supports this view when he states that curriculum provision entails a series of activities:

- The preparation of the syllabus
- The provision of instructional materials, and
- The implementation of the curriculum in the system.

Many educational authorities satisfy themselves with the formulation of syllabi and leave the task of the provision of instructional materials to private initiative (Lewy

© University of Venda

University of Venda
Creating Future Leaders

1977). This practice, unfortunately, does not always yield appropriate and expected results. Provision of instructional materials should form part of the curriculum provision process. Haves (in Lewy 1977) supports this view when he indicates that in contemporary education there has been an increasing tendency to have teams creating syllabi and also work on the provision of instructional materials.

It is also important to note that the producer of learning support materials should have clarity for purpose of the materials, the target users, the way in which the materials are going to be used, and the competencies that the users of the materials have to achieve (DOE 1997) On the same understanding, locally produced learning and teaching support materials are often appropriate and easy to utilize. The same view is supported by Lemlech (1994) who comments that quite frequently educators discover that the learning materials they make themselves are more popular with the learners and achieve better results than commercially produced materials.

Provision of learning and teaching support materials can either be done locally or by a central institute for a large population. The advantage of producing materials locally, as Lewy (1977) indicates, is not only for economic reasons, but also for pedagogical and psychological reasons, since materials produced in such a way may better fit the needs of the particular learners. If educators are encouraged and trained to make their own low-cost equipment they can do the repairs by themselves. Repairs and maintenance of imported items are not only expensive, but also delays between placing orders and delivery for replacement parts are often unacceptably long. Local provision of LTSM helps to ease the problem of dissemination of LTSM from a central provision unit.

Advantages in provision of low-cost equipment lie in the fact that those can be produced in large quantities such that there are ample items for learner's practical work, rather than only the educator's demonstration set. This might go a long way in solving that educators will use low-cost equipment, particularly if they are introduced to this equipment during their training courses. Maduemezia (1994)

© University of Venda

University of Venda
Creating Future Leaders

considers that low-cost science teaching equipment in developing counties has, in the long run, a superior pedagogical value over sophisticated equipment as it is developed at the level of the people.

United Nations Educational, Scientific and Cultural Organisation(UNESCO) (1973) also supports provision of low-cost equipment by indicating that the only possible partial solution to the problem of dissemination and maintenance of science equipment is to manufacture and disseminate relatively inexpensive pieces of apparatus using local talent and sources of raw materials (Manana 1994). This latter argument applies to both key individual pieces of apparatus and to organized collections called kits. What is largely needed is a clear policy related to this issue and the co-ordination of such activities both at provincial and national levels.

Provision of science LTSM has to do with storage facilities, the absence of which poses serious challenges to the school offering science subjects. It is for the same reason that Ntombela (1994) states that if storage facilities are poor then equipment will not be used properly and breakages will easily occur. It is therefore an unfortunate situation in which dissemination of equipment does not take into consideration the context where that apparatus is stored.

In the absence of properly built laboratories, mobile laboratories are a more viable alternative. They are able to provide the most needed storage facilities for LTSM. According to Naik (1994) the advantage of mobile laboratories is that they can serve three or four schools in a particular area. These may be used in the interim period while proper laboratories are being constructed at the different schools.

Provision of physical resources such as well equipped laboratories and adequate availability of services like gas, water and electricity remains a big challenge for schools in South Africa. The situation is even worse when we consider deep rural schools in poor provinces such as Limpopo. As Naik (1994) indicates, the provision of laboratories, services, equipment and material resources in the schools under the then authority of the Department of Education and Training (DET) was worse than those of the other educational authorities, particularly in rural areas. These

© University of Venda

University of Venda
Creating Future Leaders

deficiencies were deeply rooted in the politics of this country in the past. Thus provision of physical resources as well as science LTSM was deliberately not done or poorly done in black schools, particularly in rural areas.

In South Africa, dissemination of science learning and teaching support materials in the form of kits was largely done by non-government organizations such as the Science Education Project (SEP) (Manana 1994). The project provided worksheet books and equipment for educators and learners which were specially designed to take into account limited classroom and storage space. The key words in the SEP science kits were 'flexibility' and 'adaptation to local situations'. The kits came in sturdy wooden boxes, which facilitated storage and distribution as the unit boxes were categorised by a specific topic on the outside. Therefore, the appropriate kits were easily accessible to educators and learners.

The provision of LTSM is an integral part of the teaching and learning of Physical Science. It is on the same understanding that Spargo states:

> Science as practiced at school level is essentially no different to professional science in requiring for its successful prosecution equipment appropriate to the investigations which are undertaken and especially some items of measuring equipment. Science taught as a 'chalk-and-talk' operation with little or no investigative activity by learners is in effect any science at all and the procurement and maintenance of equipment is therefore a most important feature of the teaching of science at school (1994:20).

Without provision of appropriate and adequate LTSM no meaningful learning of Physical Science can take place as argued by Spargo (1994).Provisioning of textbooks and stationery is a complex process. Once curriculum policies and guidelines are available, publishers require approximately two years producing quality textbooks. Publishers require enough time for the trial and provision of quality materials (LDOE 2003).

© University of Venda

University of Venda
Creating Future Leaders

Submission of new curriculum materials, evaluation and selection, preparing catalogues, ordering books, awarding tenders to suppliers and dissemination of textbooks to schools cannot be done in less than one year. This process involves virtually all the directorates within provincial department as well as the schools, circuit, district and regional offices, and a number of external bodies such as the Tender Boards, publishers and suppliers (LDOE 2003).

The process differs quite substantially from province to province. The main objective is always to make sure that LTSM are delivered to schools, on or before the beginning of the school year. The provisioning process in LDOE is improved by purchasing directly from publishers and distribution to schools from warehouses.

Historically disadvantaged schools do not have resources, such as reference and textbooks, stationery, photocopying facilities and other technologies of teaching to implement Curriculum two thousand and five (C2005) effectively (DOE 2000). As far as science LTSM is concerned, availability differs from school to school. In the main, this difference is as a result of previous historical inequalities.

In describing the situation obtained from the apartheid era, Naik states:

> In reality, a substantial number of schools under the various education departments have fairly well-equipped laboratories for laboratory-based science teaching. However, these schools are mainly under the various white education departments, under the administration of the House of Representatives (HOR), and under the administration of the House of Delegates (HOD). Whereas, in most of the schools under the Department of Education and Training (DET) and what are presently self-governing territories, which cater for the education of the majority of the black African learners, the provision of laboratories, services, equipment and material resources, on average, is sadly lacking (1994:1).

© University of Venda

University of Venda
Creating Future Leaders

The new Outcomes Based Education system is introduced under circumstances as described above. Naik (1994) continues to indicate that the backlog is big and requires serious intervention by the current government. The impact of historical inequalities is huge and may take some time to eradicate. As Naik (1994) points out, black schools were poorly resourced, whereas white, coloureds and Indian schools were better resourced during the apartheid era. The challenge now is for the national DOE to address the inequities.

2.2.1.4. Utilization of LTSM

For the majority of educators, textbooks are crucial to effective implementation of the curriculum. The availability of sufficient textbooks and stationery is one of the most important factors of improving learning (DOE 2000). The significance of textbooks is also indicated by Collette (1973) who said that the textbook is the most widely used of all teaching instruments, not excepting the educator's own oral presentations. Indeed, the textbook is almost synonymous with schooling. Few educators attempt a program without one, and many administrators require that one be used.

Another study conducted by DOE(2000) cautions that dissemination of adequate amounts of textbooks is not enough in itself, such dissemination has to be accompanied by professional provision that enables educators to understand the pedagogical approaches underpinning the textbooks they use (DOE 2000). Lemlech (1994) argues that although the textbook takes precedence, educators use many types of media and instructional technology particularly in teaching and learning of Physical Science.

When utilizing LTSM, it should be taken into consideration that no two learners are the same. LTSM should cater for different groups of learners according to their capability of attainment. Learners with special education needs should be

© University of Venda

University of Venda
Creating Future Leaders

accommodated in the learning process and this can be made possible by specialized learning and teaching support materials.

Utilization of LTSM is a function of educator training. Although most educators received some form of training, the training was generally regarded as insufficient and at times, inappropriate. This has a negative impact on the level of confidence of the educators. Most educators expressed a need for training that was less theoretical and more sustainable (DOE 2000). Educators who are adequately trained have no problem in utilizing available LTSM. A major problem of utilization of LTSM is a lack of proper training.

Petje (2002) further argues that the key challenge is to improve the utilization of resources and to improve the conditions for effective teaching and learning through improving the internal efficiencies of the system. He also indicates that the education system needs to provide better services by emphasizing teaching quality, as well as efficient use of resources.

Since learners are predominantly different from each other, developers of learning and teaching support materials should ensure that LTSM offer all learners opportunities for processes such as observation, classification, organization, prediction, formulation and testing of hypotheses, interpretation of data, measurement, mapping and communication (DOE 1997).

The view of the researcher is that the essence of science teaching emphasises learner participation. Learners learn from their experiences and from interacting with each other and this is well documented by researchers such as Piaget(1950) and Vygotsky(1978). According to Lemlech (1994), mainstream learners need a hands-on approach to learning and a great deal of individualization. Lemlech (1994) writes further that this approach makes science ideal for facilitating their acceptance, both personal and by peers, into the regular classroom. Since most science activities are group-orientated, the mainstream learner can work in a

© University of Venda

University of Venda
Creating Future Leaders

carefully selected small group or be programmed to work individually. Thus the materials supplied should be both for demonstrations by the educator as well as utilization by learners themselves as individuals or as a group.

The issue of resource availability and quality of its use by teaching staff in schools is also crucial for effective learning and teaching of Physical Science (Onwu 2000). Onwu examines the availability and use of science materials in Grade 12 Physical Science classes in the Limpopo Province, and his findings show that the availability and quality of use of the learning and teaching support materials varied almost exactly according to the school's performance categories, thus confirming the link between resource availability and quality of use and learner performance in science.

The researcher ascribes to the view that effective instruction and learning of Physical Sciences entails practical participation of learners in performing experiments, and this demands the use of a variety of LTSM. As stated by Van der Stoep and Van der Stoep (1973), in practical work learners participate actively in the learning situation as a discovering activity which, to a large extent, ensures permanent success at the end of the learning activity. In a research conducted by Garnett and Tobin (1988) on the teaching of Chemistry course by two educators, both educators regarded laboratory activities as an essential and integral part of the course. Experiments sometimes were used to introduce new material and on other occasions to illustrate material that had been covered previously. Laboratory work was seen as providing learners with concrete experiences that enabled them to better understand concepts and principles developed during the course. In addition, both educators and learners considered that laboratory work played a critical role in the development of learners' process and manipulative skills.

Practical work faces learners with problems of living reality and helps them to seek a solution for those problems. Therefore, learners must be given the opportunity of handling LTSM themselves. It is for that reason that Garnett and Tobin (1988) had to indicate that among the things science educators are often exhorted to do, is to allow learners to construct their own knowledge, to attain higher cognitive level

© University of Venda

University of Venda
Creating Future Leaders

outcomes, to work at their own pace, and to provide all learners with opportunities to engage in learning tasks. However, research in high school science classrooms has indicated that these things seldom occur (Gallagher and Tobin 1987a; Mitman, Mergendoller, Packer, and Marchman 1984; Stake and Easley 1978).The main reason for this not happening is usually lack of appropriate resources and incompetence of educators to utilize the available resources.

Utilization of LTSM by learners themselves is also supported by Tobin and Fraser (1989) when they say that if learners do something for themselves, they remember it better because the way to learn better is by doing, writing in their own words and discussing with another person. Macdonald and Rogan (1987) also state that practical work in science lessons improves learner's performance. The same argument is supported by Odubunmi and Balogun (1991) who indicate that learners learn better in situations where they experiment, manipulate, collect data and classify and analyse subject matter than in situations where they simply memorise facts.

Learning and teaching support materials in the form of real objects, models or specimens provide concrete experiences for learners during instruction. When those real things are available, they should be used to demonstrate concepts or enhance learner's experiences. These learning and teaching support materials should be used in conjunction with reading materials or other learning experiences such as field trips or pictures. For example, using a prism to separate colours in sunlight is a more effective lesson than simply reading about the sun's rays (Lemlech 1994). In the teaching of science, a major objective is to develop learner's problem solving capacities. In order to achieve this objective, Lemlech states:

> Learning experiences must be structured to provide learners with opportunities to participate in processes of discovery. What is of significance with discovery learning is that it motivates learners' curiosity and interest in scientific subject matter and provides opportunities to practice the skills of observing, measuring, classifying, comparing,

© University of Venda

University of Venda
Creating Future Leaders

> generalizing and theorizing. Learning science enlarges the learner's perspective of the world and its environment. Science experiences are varied and appealing to the natural interests and curiosity of most learners (1994:326).

Utilization of LTSM by educators, like learners, is equally important since they do more than implement the curriculum; they also interpret it. Stressing the significance of the educator's role in shaping the 'operational' curricula, Baird (1988:70) maintains: "The future of science education does not lie primarily in curricula or in technology. It lies in the educator of science." It is clear that the educator is, and will remain the pivot on which the realization of the teaching and learning process hinges. The educator remains the initiator of learning through communication and interaction. The educator is further expected to create an atmosphere in the classroom which is conducive to maximum instruction and learning process and this is possible with the utilization of LTSM. According to De Wet, Monteith, deK, and Van Der Westhuizen (1981) the quality of the instruction process is determined by the following factors:

- The nature of the learning content
- The ability of the learner
- The characteristics of the educator.

Of the three factors mentioned above, the educator remains the most important in the instruction process and should have the necessary skills and knowledge to utilize the available LTSM in order to make the process a success. Gordon makes the following important statement about the provision of scientific knowledge:

> Learning about science should reflect participatory and collaborative ways in which knowledge is generated. Thus, science and technology education should be a participatory activity in which educators and learners share responsibility for learning (1995:116).

© University of Venda

University of Venda
Creating Future Leaders

Educators are thus expected to monitor their own behaviours and those of their learners to ensure that everyone is engaged in quality educational experiences. In particular, educators must help their learners to learn to work in groups and conduct meaningful conversations and practical work.

Educators are an indispensable resource in teaching and learning of Physical Science, however, they can be rendered ineffective by any one or a combination of the following factors:

- Large classes that overburden and overload the educator
- Poor training, poor qualifications or inadequate in- service programs
- Lack of visual aids, textbooks, chemicals or needed teaching and learning material (FEMSA 1997)

For educators to be able to utilize available learning and teaching support materials effectively, much depends upon their training, both pre-service and in-service. It is for this reason that Bradley states:

> A feasibility study into the upgrading and strengthening of practical work in South African high schools would be incomplete without considering what pre-service training science educators are receiving. It is all very well upgrading science educators in service, but unless educators coming into service are properly prepared, the present situation will not be permanently improved (1994:95).

The preparation of competent science educators, on the other hand, requires lecturers who are able to perform and supervise experimental work satisfactorily and requires them to have a sound knowledge of science. One would expect college or university students to leave their institution with good hands-on experience of utilizing LTSM. An educator who is well trained must be able to organize practical work; perform demonstrations in an interesting and thought-provoking manner; be able to rectify a mishap or unexpected result; explain why a particular experiment does no give the expected results; and have the necessary

© University of Venda

University of Venda
Creating Future Leaders

background knowledge to give meaningful explanations free from misconceptions (Bradley 1994).

With the influx of learning resources, educators need a number of new skills, particularly when they are requested to select and procure suitable equipment. The challenge is not only to select them but to be able to utilize them with learners. For example, with the diversity and quantity of materials available, educators need to be able to identify the most appropriate materials for their learners by utilizing information related to geographic factors, cultural factors and skill levels (Lemlech 1994).

Traditionally, according to Ornstein and Lasley II (2000), the textbook has been the most frequently used instructional material at all levels beyond the primary grades, and in some cases, it is the only one used by the educator. This happens to be true in most of the rural schools in Limpopo Province. McNeil (1999) also argues that without educators supplementing textbooks by introducing hands-on activities, projects, serious questions about the learner's environment and the like, the science curriculum is likely to be disconnected from real life. The use of textbooks is not good enough; hands-on experiences remain a serious requirement for effective teaching and learning of science.

Research has shown that learners learn more information in less time in a properly mediated presentation when compared to a non-mediated presentation. Research has also shown that the proper use of media may also be beneficial to the well being of the educator using the media. Molstad (1974) found that instructional media, when properly employed, can play a significant positive role in the overall achievement of the learner. Instructional media, if properly incorporated into the lesson, can make truly individualized learning possible. Research has also shown that learners prefer learning activities in which a variety of media is used (Descy 1992).

A practical approach to the teaching of science, according to Ntombela (1994), whether it involves learners' hands-on activities or educators' demonstration, is

© University of Venda

University of Venda
Creating Future Leaders

more time-consuming than textbook-based educator-talk approaches. Ntombela (1994) claims that educators using the practical approach have to:

- Prepare the materials and the room beforehand;
- Make sure that the experience is meaningful to all the learners in the mixed-ability class;
- Deal with unpredictable results that may necessitate a repeat of the experiment; and
- Clean or supervise the cleaning and tidying-up after the lesson.

Since all of these activities happen in the absence of a laboratory assistant or technician in most schools, it is not surprising that the majority of educators choose not to 'overburden' themselves with practical work. For most educators and learners, the priority is to finish the syllabus; as a result, that which may be pedagogically desirable but time-consuming, will naturally fall by the wayside. Despite all this, educators of science should be encouraged to appreciate the significance of practical work and continue doing them if the necessary learning and teaching support materials are available.

Webb and Raubenheimer sum up the issue of utilization of LTSM by educators:

> With respect to resources, the current status is that educators tend to mostly make use of the chalkboard and this often becomes the only resource that is used. Skills of improvisation are needed and should form part of the curriculum for educators at educator training level. Thus educators should have skills in developing their own materials which would be relevant to their contexts (1994:85).

In-service training for educators is therefore needed on a mass scale so that all educators have access to the requisite practical skills.

In concluding this sub-section, the researcher considered the important role that should be played by parents of learners who are learning Physical Science at school. Learners should be made aware that the science they learn at school is

© University of Venda

University of Venda
Creating Future Leaders

not confined to school. At home there are a lot of learning and teaching support materials which they can utilize to enhance their understanding of science concepts as they where taught at school. The role of parents in the education of their children is very critical and important However, according to Myeko (2000), and Heystek and Louw(1999) many South African parents, particularly in previously disadvantaged communities, are reluctant and unwilling to be involved and participate in their children's school activities.

Parental involvement is a process through which parents meaningfully participate in the various educational activities of their children, ranging from occasional attendance of school functions to intensive efforts to help parents become better educators of their children (Dekker and Lemmer 1994; Myeko 2000). Despite the obvious importance of parental involvement in education, some parents still do not participate in school activities. There are factors that hinder parental involvement, such as illiteracy. According to Dekker and Lemmer (1994) and Heystek and Louw (1999), parents do not know why and how they can be involved in school activities. They are thus unsure of their responsibility as parents and how education at home serves as the basis for education at school. As such some parents are unable to assist their children with school work, in order to supplement what is taught at school. This is even more difficult when we consider assisting their children with learning of science.

2.2.1.5. Funding of LTSM

Science subjects are prioritized in many developing countries in the world and this practice can be traced back to the curriculum provision initiatives of the 1970s (Manana 1994). Despite the fact that science subjects are prioritized, lack of sufficient funds to purchase commercially manufactured equipment remains a big challenge in many developing countries, including South Africa.

An enormous amount of time and money is invested in making practical work an element of secondary school science. Schools employ lab technicians, consume consumables of all kinds and invest large sums in pieces of apparatus that most

© University of Venda

University of Venda
Creating Future Leaders

learners have never seen elsewhere and are never likely to encounter again after school. In the current era of local management and devolved budget, it is evitable that the traditional expense of practical work will be questioned by someone running the school. Science educators need to be able to justify the time and money spent on practical work not only for this reason, but also in order to answer the two further questions of 'what' and 'how?' (Wellington 2000). From this argument it is clear that financing practical work in Physical Science learning is not commonly understood and accepted by many.

Provision of apparatus to schools by the various education departments in the past was varied both in method and efficiency, but in almost all cases has resulted in classrooms being ill equipped for meaningful science teaching (Webb and Raubenheimer 1994). All these differences were as a result of different funding levels to the various education departments by the government of the day. Now that the playing field has been levelled because we have one department of education in South Africa, funding should also be equitably distributed to all the schools according to needs.

After 1999, the inter-governmental fiscal review of the budgeting process was stabilized; an emphasis fell on targeted pro-poor funding mechanisms as well as a stronger emphasis on social justice and human right programmes. In 2000 the department introduced the national norms and standards for school funding, the aim of which is to focus non-personnel expenditure on those schools with the greatest need. All schools are assessed in terms of their physical condition and poverty levels of the community in which they are located. Resources are now targeted at those schools... items such as water and electricity, teaching equipment and supplies, and learner support materials are distributed according to the resource targeting list. Government has recognized some weakness in the system of resource targeting. With this budget process approach and its subsequent improvement, there is hope in future, to improve the provision of LTSM in schools (RSA 2003).

© University of Venda

University of Venda
Creating Future Leaders

As the backlog of providing the required learning and teaching support materials to all schools in the country is so massive, an alternative is that of supplying low-cost apparatus and science kits. The advantage of these materials is that their utilization only needs a work surface such as a desk, and are independent of formal laboratory services, as well as being low-cost in terms of their maintenance requirements. Education departments should take full financial responsibility for the dissemination and replenishment of apparatus and consumables in all the schools, otherwise poorer schools will suffer. This view is supported by Passe (1999:178): "Despite the protestations of some taxpayer groups, politicians, and conservative commentators, wealthy schools can offer more options with more materials under better conditions than poorer schools".

It is also significant to note that when schools have microscopes, slides, telescopes bunsen burners, chemicals, and other equipment and facilities, educators are prepared to implement and process goals. Schools that do not have well-stocked science closets are more likely to ignore scientific thinking. Unfortunately, poorer schools cannot afford to provide concrete experiences, and their learners become hampered by curriculum disabilities in science, and, as a result the entire society suffers (Passe 1999). It is for this reason that funding for provision of learning and teaching support materials (LTSM), low-cost equipment included, should be the responsibility of the state and not of the individual schools.

One aspect of funding that is often overlooked is the ability to attract properly qualified educators. On this important matter, Passe (1999) maintains that college or university students who are skilled in science and who are potential good science educators tend to opt for higher paying professions instead of teaching. School systems are, therefore, forced to compete for educators that are willing to sacrifice earning power for the love and responsibility of teaching science. The question of properly qualified educators who would have the know-how of utilizing LTSM effectively is just as important. If they are not available then having fully fledged laboratories will not help. It is therefore important that science educators be remunerated or rewarded more so as to keep them in teaching.

© University of Venda

University of Venda
Creating Future Leaders

From the Table 2.1 below it is evident that expenditure per learner in Limpopo Province, for the entire period under review, is below average. As a result the province is unable to meet the learning requirements of its learners, particularly those from rural schools. Better-resourced, white and mainly urban schools are in a position where they are able to augment departmental funding by increased school fees.

The following Table 2.1 shows how provincial budgets are structured in terms of expenditure per learner by province (Rand).

Province	1999-2000 Actual	2000-2001 Actual	2001-2002 Actual	2002-2003 Estimate
EC	2846	3362	3866	4466
FS	3570	3910	4433	5155
G	4021	4384	4655	5077
KZN	2633	3069	3432	3762
L	3211	3452	3674	4015
M	3019	3287	3685	4321
NC	4438	4858	5139	5805
NW	3602	4065	4447	4727
WC	3987	4391	4721	5081
Average	3234	3631	3995	4437

Source: RSA 2003:54

Note: EasternCape(EC),Free(FS),Gauteng(G),KwaZuluNatal(KZN),Limpopo(L), Mpumalanga(M),North West(NW),Northern Cape(NC),and Western Cape(WC).

In addition to school fees, there are other burdens that the poor have to carry that inhibit full participation in schooling. A 2003 departmental review of the financing, resourcing and costs of education in public schools (DOE 2003a) revealed that despite budget reforms to ensure equality in per-learner expenditure, poorer schools need assistance in procurement of goods and services and asset management and also continue to suffer from expensive textbooks and an inefficiently managed ordering process, high school uniform and transport costs, as

© University of Venda

University of Venda
Creating Future Leaders

well as poor management of school nutrition programmes (Chisholm 2005). All these impact negatively on the budget to provide the much needed LTSM.

In the light of the foregoing discussion, it is evident that the cost factor of providing the necessary resources and well-equipped laboratories becomes exorbitant and indeed prohibitive (Naik 1994). In the poor and rural areas, these constraints become even more problematic because of insufficient funding. Funding of LTSM thus needs proper planning and prioritizing by the Department of Education at Provincial and National levels.

2.2.2 Historical use of LTSM in practical learning of Physical Science.

Modern practical work in Physical Science learning dates back to the 17th century (Jeans 1947). This implies that initial types of LTSM also date back to that period. Development of practical work and appropriate LTSM kept on evolving with time as methods and approaches changed.

2.2.2.1 In the developed world

In developed countries such as those in Europe and Britain, the use of the laboratory for practical work in science became an accepted requirement for science education as early as in the 19th century. However, with science education still in its infancy, practical work was mainly used to confirm taught theory and not designed as child-centred research. Although school laboratories that were equipped for genuine experiments became more common, experiments performed in science lessons were usually used to support the science theory lessons (Bradley 2005).

By 1880 laboratory equipment could be found in high schools and as Fay said "... the laboratory in many cases almost entirely superseded the textbook ..." (1931:1550). In 1886, at Harvard University, laboratory work was considered

© University of Venda

University of Venda
Creating Future Leaders

essential for learners as it provided training in observation, provided detailed information about theories learned from textbooks, trained learners to use their brain power to develop their mental abilities and aroused learner interest (Moyer 1976).

Practical work has been the key component of science teaching in the UK for over 150 years(Gee and Clackson, 1992; Jenkins, 1998). Projects and curriculum initiatives have come and gone over the years, some with amazing alacrity, leaving the education profession with a wealth of experience. Having tried the 'Nuffield approach' and the 'process approach' along with traditional methods, and recognised strengths and weaknesses of each practical style, one might think that we should be in a position to state the best way of carrying out practical work in schools. What causes the difference in stating the best of carrying out practical work in schools is the fact that each educator has his or her own views about practical work, formed by the influence of a number of factors such as :

- his or her own experiences of science at school
- learning about practical work and classroom experiences during the period of initial educator education and training
- the scheme of work and the textbooks used
- other educators in the science department
- government initiatives, such as the Science National Curriculum and A-level specifications(Parkinson 2003)

The introduction in the United Kingdom of the statutory Science National Curriculum (SNC) in 1989, with its emphasis on an investigative approach, forced all educators to reflect on the nature of their subject. The SNC required educators to adopt a frame of thinking that was quite different to that required for a traditional teaching style. In the past, practical work has mainly been concerned with illustrating the concepts taught (Parkinson 2003).

© University of Venda

University of Venda
Creating Future Leaders

2.2.2.2 In the developing world

Development of practical work in science education in developing countries of the world resembled to a large extent that of the countries which colonized them, but obviously lagging far behind them. A study conducted by the Female Education in Mathematics and Science in Africa (FEMSA) (1997), in four developing African countries: Cameroon, Ghana, Tanzania and Uganda, reviewed the status of resources and facilities available for teaching and learning of Physical Science. In general, in all four countries, the study found great variations in the resources and facilities available for the teaching and learning of Physical Science. Some of the schools were so impoverished, they did not have the basic necessities, such as sufficient classrooms, offices, desks, textbooks, functional toilets, not to mention facilities like laboratories, libraries, workshops, chemicals, science equipment or apparatus.

Science subjects are prioritised in many developing countries in the world and this practice can be traced back to the curriculum development initiatives of the 1970s (Ogunniyi 1986; Klainin 1988). A trend towards reform coupled with the great drive to improve science and technology teaching has in many cases suffered as a result of poor planning and implementation. Shortage (or absence) of textbooks, lack of funds to purchase commercially manufactured equipment from overseas, overcrowded classrooms, timetables and laboratories, and lack of storage and security have made implementation extremely difficult (Chadwick 1979; Vitta 1979; Woolnough 1992).

Problems related to facilities, which underpin requirements for practical work in school science teaching, are a recurring story in most developing countries (Warren 1983; Okebukola 1986; Fensham 1988). There is no simple solution to the numerous problems facing the promotion of practical work in developing countries. Nevertheless, the use of low – cost apparatus and science kits is the most viable solution to most developing countries, South Africa included.

© University of Venda

University of Venda
Creating Future Leaders

Developing countries throughout the world have an active interest in low- cost and locally manufactured science apparatus, and much emphasis is placed on providing INSET courses on this topic whenever problems of science education in developing countries are discussed. A lot of work has been done on this topic and there is a perceived need for an information clearing house and networks to help in dissemination through international and regional organisations (Lochard 1983). Such a strategy could help in further promoting the idea of making low- cost equipment by science educators in their schools.

The general status of schools in all the developing countries is characterized by poor condition of resources and facilities for practical work in Physical Science teaching and learning.

2.2.2.3 In the current South African context.

South Africa, like other developing countries in Africa, carries along a baggage of the previous colonial period even in as far as development of science education practical work is concerned. Once a colony of Britain it inherited changes which took place in Britain regarding practical work in science education.

The state of the current South African science education, however, has experienced major changes, but there are still deep continuities with the past. It is no accident that the poorest provinces with the poorest schools are those that were incorporated in the former home-lands: the current state of schools in these provinces is closely intertwined with the twists and turns of a history more than two centuries old (Chisholm 2005). The major inequalities inherited from the apartheid past have softened but have not been overcome and are still extremely harsh in many areas. The quality of schooling overall, and in the rural areas particularly, still leave much to be desired.

Inequalities between urban and rural schools are visible in the facilities and resources available to them. Continuing backlogs and inequalities are very unevenly spread across provinces. There are differences between provinces,

© University of Venda

University of Venda
Creating Future Leaders

between schools in the same locality and even within the same school grounds. A rural school might have new toilets, but no water and the rest of the school buildings will have collapsing ceilings and broken windows. In rural areas where sanitation is inadequate, children still use dongas or forests or dams, sharing valuable water resources with animals (EPC 2004). The result of South Africa's fee-paying policy has been that richer schools have been able to retain their privilege and edge over poor schools by employing additional educators and improved resources to ensure better quality teaching.

Poorer schools, on the other band, have not charged high fees but are often unable to extract even their low fees from impoverished parents. Kutame (1997) also argues that generally urban schools have high learner enrolment as compared to rural schools, with the result that with their school funding norms provided by the Department of Education, which allocates funds to schools based on poverty index and enrolment, and their own school funds, they are able to purchase more science learning and teaching support materials than those in rural areas. Kutame (2004) further alluded to the fact that rural schools, as opposed to urban schools, are characterized by poor infrastructure, which is required for effective teaching and learning of science.

Grant –Lewis and Motala (2004) argue that schools in better resourced communities have, on the whole, been able to use the powers granted them under the 1996 South African schools Act to better effect than schools in rural communities. In both urban and rural communities, local elites play a significant role in schools. Learner-centred educational pedagogies show a similar pattern, working well in the better-resourced schools, and less well in poorer rural schools (Harley and Wedekind 2004).

The main initiative since 1994 has been the introduction of outcomes-based education and Curriculum 2005 in 1997. At the heart of Curriculum 2005 is a set of values linked to social justice, human rights, equity and development, as well as a learner-centred approach to teaching and learning. In 2000 this curriculum was reviewed and revised (Chisholm 2003; DOE 2002). The revision was undertaken

© University of Venda

University of Venda
Creating Future Leaders

partly in response to studies which showed that despite the new curriculum and pedagogy which it mandated, 'learners' scores are far below what is expected at all levels of the schooling system, both in relation to other countries (including other developing countries) and in relation to the expectations of the South African curriculum (Taylor, Miller and Vinjevold 2003). One of their most significant conclusions is, however, that 'learners who attend classes conducted in a language which is not their first language are at a significant disadvantage and that 'this disadvantage is accentuated when the language of teaching and learning is not the first language of the educator' (Taylor, Muller and Vinjevold 2003).

The quality of educators and educator to learner ratios in classrooms are amongst the most critical resources for making an impact on teaching and learning in schools. The numbers of unqualified and under qualified educators in the system and the quality of educator education on offer is still a cause for concern.

In South Africa, another notable intervention to practical work in Physical Science learning is the one conducted at RADMASTE starting in 1991. Typically, more than 100 college lecturers from all over South Africa would attend. New teaching materials were created for these events; these were designed to support learner-centred methodologies (Slotwinski 1997; Pomario 1998; Malcolm 1999; Malcolm et al 1999). The intervention helped to sort out a major problem of equipment for practical science learning (Bradley and Smith 1994). This linked with information from other schools projects, indicating a widespread absence of equipment from schools classrooms (Lynch 1994). Practical activity was perceived as a more-or-less non-negotiable feature of science teaching and learning. During the same intervention lecturers were frequently provided with experience in improvisation and use of locally- available materials, where traditional scientific equipment was not available. Such strategies have, of course, been advocated for many years and, for periods of time in particular places, considerable success has been reported (Musar 1993).

The above intervention resulted in development of micro-science kits which could be used anywhere: classrooms, home, field or laboratory. The research studies by

© University of Venda

University of Venda
Creating Future Leaders

Vermaak 1997 and Kolobe 1998 showed that attitudes of both educators and learners towards micro scale practical work were strongly positive. However, it should be mentioned that practical work, including micro scale, will not result in positive concept learning by learners unless the educator is able to facilitate this happening. The quality of the educator remains pivotal to learning and teaching of Physical Science. Micro scale practical science requires management skills of the educator to ensure sustained motivation on the part of the learners.

The low status of practical work in the majority of schools in South Africa is a cause for concern. The major areas of concern are provision, and the availability of service and Physical Science teaching apparatus as well as specialised equipment. All these resources need more attention in order to improve science teaching in schools, particularly in rural schools.

In conclusion it can be indicated that the quality of provision and utilization of LTSM overall, and in rural areas particularly, still require decisive action.

2.2.2.4 In the current Limpopo Province context.

The situation of provision and utilization of LTSM for practical work in Physical Science learning for Limpopo Province is obviously not entirely different from the rest of South Africa as described in 2.2.2.3 above. It is, however, important to indicate that improvements on the state of South African's schools are to a large extend unevenly spread, and the provinces that suffered the greatest neglect in the apartheid period still shows the greatest difficulties in overcoming the legacy of apartheid. These are the provinces that incorporated the previous homelands, and Limpopo Province tops the list, followed by Eastern Cape and KwaZulu-Natal Provinces.

The Directorate Curriculum Provision of the Limpopo Province Department of Education issued a policy on guiding the provision; submission and evaluation of Learning and Teaching Support material (LTSM) (LDOE 2003) (see Annexure D).

© University of Venda

UNIVERSITY OF VENDA
LIBRARY

University of Venda
Creating Future Leaders

According to this policy LTSM are classified as follows:

a) Primary Learning and Teaching Support Materials
b) Supplementary Learning and Teaching Support Material.

The current implementation of the LDOE policy on LTSM focuses on Primary LTSM and not Supplementary LTSM as listed above. Provision and dissemination of apparatus, which is part of the supplementary list of LTSM is therefore not receiving attention at the moment. Therefore the provision and distribution of LTSM, so far, covers textbooks, prescribed books and stationery. Except for text books, no other Physical Science LTSM is supplied. Only 50 schools in the entire province, which are categorised as DINALEDI schools, are so far supplied with science LTSM by LDOE.

2.2.3 Curriculum models in Physical Science learning and the place of LTSM

Science curriculum models are developed to provide a theoretical basis of understanding and interpretation of a curriculum. Bradley quoted a statement made by Yaxley in his presidential address to the annual conference of the Australian Science Teacher's Association, CONASTA in 1963:

> Many of us are dissatisfied with actual science courses recommended because they emphasize factual knowledge and do not adequately represent the true meaning, scope and structure of science as a discipline and as part of our culture (2005:29).

It was on the basis of this statement that a science curriculum model for the development of a science curriculum in Australia was developed. The model is represented in Figure 2, 1 below.

The Australian Science Curriculum Model, that Cohen developed (Figure 2.1) consisted of two broad phases: development and implementation. In the

© University of Venda

University of Venda
Creating Future Leaders

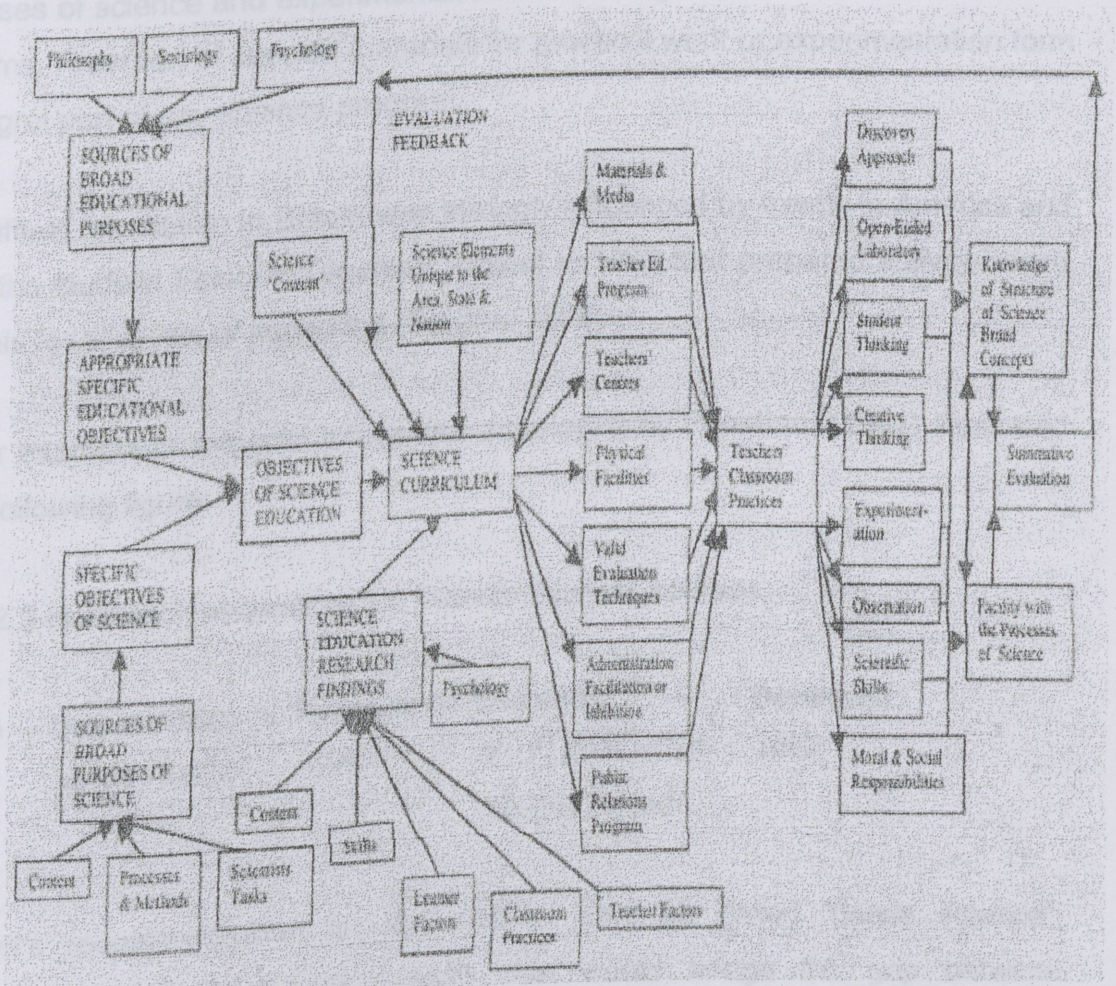
implementation phase of the model the element Teacher's Classroom Practices flows through to eight components:

- Discovery approach
- Open Ended laboratory
- Student Thinking
- Creative Thinking
- Experimentation
- Observation
- Scientific Skills
- Moral and Social Responsibilities

© University of Venda

University of Venda
Changing Futures Together

Figure 2.1. The Australian Science Curriculum Model (Bradley 2005).



The model indicated the importance of practical work in Student Thinking and Creative Thinking. What is significant, for this study, is that the developed model requires support materials for its effective implementation. It is for that reason that Owen (1977) had to argue that using expert resources from the scientific and larger education community, new courses and support materials were developed with the major aim of updating the content and placing an emphasis on the processes of science and experimentation as an integral part of science education programs. Provision of support materials for practical work or experimentation form an integral part of any science program.

© University of Venda

University of Venda
Creating Future Leaders

with the major aim of updating the content and placing an emphasis on the processes of science and experimentation as an integral part of science education programs. Provision of support materials for practical work or experimentation form an integral part of any science program.

The Nuffield foundation in Britain was strongly influenced by trends in America and set up the Nuffield Science Teaching Project in 1962 that prepared activity-based materials for all levels of schooling (Bradley 2005)

Another example of a model is the one developed by Fensham (1981) illustrated by the following figure:

Figure 2.2 Instruction sequences for "hands science" courses.

Primitive Skill	→	Demonstration and Practice	→	Improved Skill → Knowledge X, Y, Z on which Skill is based	→ Developed Skill

Fensham's recommendation for the 1980's, what he called "hands science", emphasized meaningful practical skills that would bridge the gap between theoretical science and technology. The step of skills acquisition, moving from the *Primitive Skill* to the *Developed Skill* is summarized in the figure.

Considerable attention has been paid to the past that the development of skills and processes play in science curricula. Practical work in science learning has been a rich source for educational researchers. In this model also, provision of LTSM is very critical for its effective implementation.

Following the work of Miller and Driver (1987), Osborne and Freyberg (1985) and Piaget (1964), science curriculum developers recognized the importance of prior knowledge and existing beliefs in the learners conceptual development and achievement of understanding. Many writers now support a constructivist view of learning, recognizing that learners and educators (in fact, everyone) contract their

© University of Venda

University of Venda
Creating Future Leaders

own meanings from their experiences. "All learning involves the construction of meaning, whether the learning is discovered or received by direct transmission" (Fensham, Gunstone, and White 1994). Constructed meaning depends on existing meaning or conceptual framework. The educators' role is to promote conceptual development and change is made possible by utilizing appropriate LTSM.

Goodrum, Hackling, Rennie (2001) assert that learners need practical experience of genuine scientific investigations that promote conceptual development and the construction of meaning. Provision of appropriate LTSM is thus a prerequisite for the effective implementation of the constructivist curriculum model.

Coming back to South Africa, the National Curriculum Statement (NCS) as a model of curriculum delivery also require LTSM for practical work. Practical work is central to the teaching of concepts in the NCS document. Educators should as much as possible incorporate practical work that help to explain concepts. Everyday examples about things that learners experience in their surroundings, whether at school or at home, are a best way of explaining the concepts. Educators can also improvise their own practical work materials (DOE 2006).

2.3 THEORETICAL BASIS FOR LTSM IN PRACTICAL LEARNING OF PHYSICAL SCIENCE.

2.3.1 A theoretical review of practical learning of Physical Science and the place of LTSM.

It is generally agreed by scientists that practical work is an essential part of scientific research. Science educators and science learners also agree that practical work is an essential part of science education. Practical work in science education is designed to promote science learning and is determined by the particular goals and aims of the science education program (Bradley 2005).

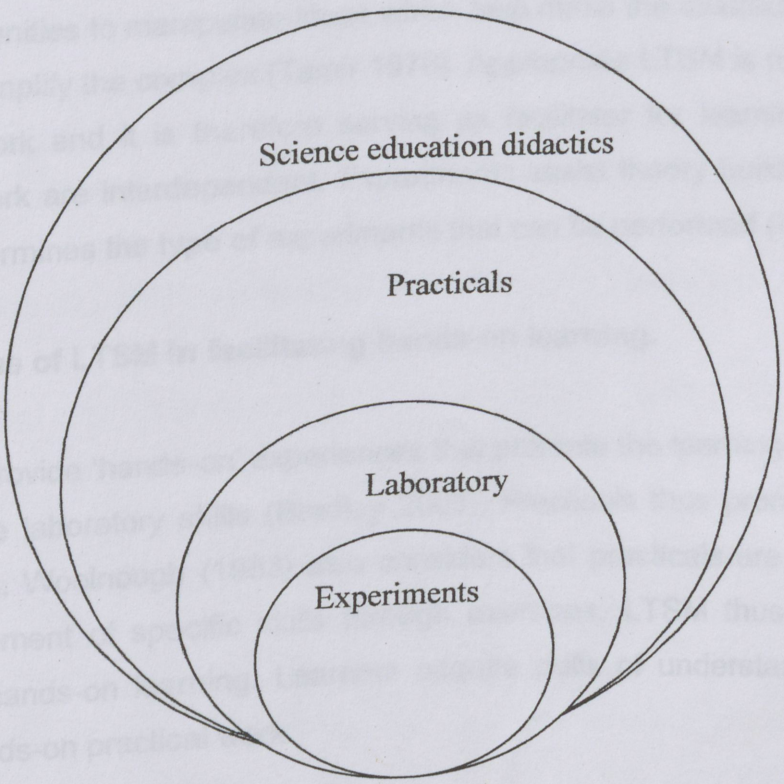
For the purpose of this study, the definition of practical work follows that of Hodson (1988) and Kirschner (1991). A practical is a didactic method of learning and

© University of Venda

University of Venda
Creating Future Leaders

practicing all the activities involved in science. Experiments are considered a subset of laboratory work. Laboratory work is a subset of practical work, which is, in turn, a subset of the didactics of science education. This definition includes investigation and task-orientated problem solving. Most scientists and science educators agree that practical work in the form of a laboratory practical is an essential part of science curricula. Novak (1988) also recognized that the science laboratory has always been regarded as the place where learners should learn the process of doing science.

Large science education projects and the provision of science education for all, for the development of scientific literacy, stress the importance of practical work. Practical work requires a large allocation of resources in terms of time, equipment, laboratories and specialised science educators. Laboratories should be fully furnished with chemicals, equipment, gas, electricity and the needed devises. Figure 2.3 below illustrate the interrelationship between experiments, laboratory work, practicals and didactics of science education (Hodson 1988 and Kirschner 1991).



© University of Venda

University of Venda
Creating Future Leaders

The figure illustrates the interwove ness of learning science. Key to this model is the provision of the needed LTSM, hence the purpose of this study. According to this model, experiments are at the core of science education didactics.

A common rationale for the inclusion of practicals in traditional science curricula is that they enable illustration, confirmation, acquisition or discovery of the substantive structure of science (Woolnough 1983). Kirschner (1991) recognised four commonly held motives for implementing practicals in science programs and these are discussed as follows:

2.3.1.1 LTSM facilitating practical learning

Practical work serves to illustrate, verify or confirm substantive scientific knowledge, concepts or theories that may have been taught earlier in a separate theory lesson. It can also be stated that science involve abstract and complex subject matter, which learners find it difficult to understand. In such cases, practicals are therefore considered to provide learners with concrete experiences and opportunities to manipulate ideas which help make the abstract more concrete and help simplify the complex (Tamir 1976). Appropriate LTSM is required for such practical work and it is therefore serving as facilitator for learning. Theory and practical work are interdependent. Experiments assist theory building and theory, in turn, determines the type of experiments that can be performed (Hodson 1988).

2.3.1.2 Value of LTSM in facilitating hands-on learning.

Practicals provide 'hands-on' experiences that promote the learning and practice of manipulative laboratory skills (Bradley 2005). Practicals thus promote 'hands-on' experiences. Woolnough (1983) also considers that practicals are best suited for the development of specific skills through exercises. LTSM thus play a role in facilitating hands-on learning. Learners acquire skills of understanding concepts through hands-on practical work.

© University of Venda

University of Venda
Creating Future Leaders

2.3.1.3 Value of LTSM in empirical work in practicals.

Empirical work in practicals enables the learner through experiences of natural phenomena, to develop insight and understanding of the experiences and the laws of nature. Appropriate LTSM are therefore required to facilitate the empirical work. The view here is that learners will gain understanding from the interpretation of practical work with natural phenomena. The thinking is that learners start with no understanding of a theory, principle or concept; they then collect data from experiences and from their interpretation of the data, an understanding of the experienced phenomena develops

In order to develop understanding learners need to have prior knowledge, a schema, perceptions, or a conceptual framework in their minds to make sense of what they see. The importance of prior knowledge in the development of understanding of new phenomena, the construction of new conceptual frameworks and the ability to solve problems has been recognised by many authors, such as, Hewson(1980) and Suchman(1966).The amount of experimentation and empirical work necessary to make sufficient interpretive experiences to develop understanding and meaning requires so much time, energy and resources(LTSM). Multiple exposures to demonstrations of a concept are required for adequate understanding to develop (Kreitler and Kreitler 1974).Multiple exposures to demonstrations require more provision of LTSM.

2.3.1.4. Value of LTSM in practicals that rely upon discovery approach

Practicals that rely upon discovery offer the best, if not the only, way to achieve meaningful learning in science (Bradley 2005). The rationale for discovery learning assumes that the attainment of scientific attitudes, the encouragement of interest in science, the acquisition of scientific skills, the learning of scientific knowledge, and understanding the nature of science, can all be achieved through applying the methodology of science that is inductive in its approach. For practicals that rely on discovery approach to be possible, sufficient and relevant provision of LTSM is required as a matter of importance. Supporters of the view that discovery in a

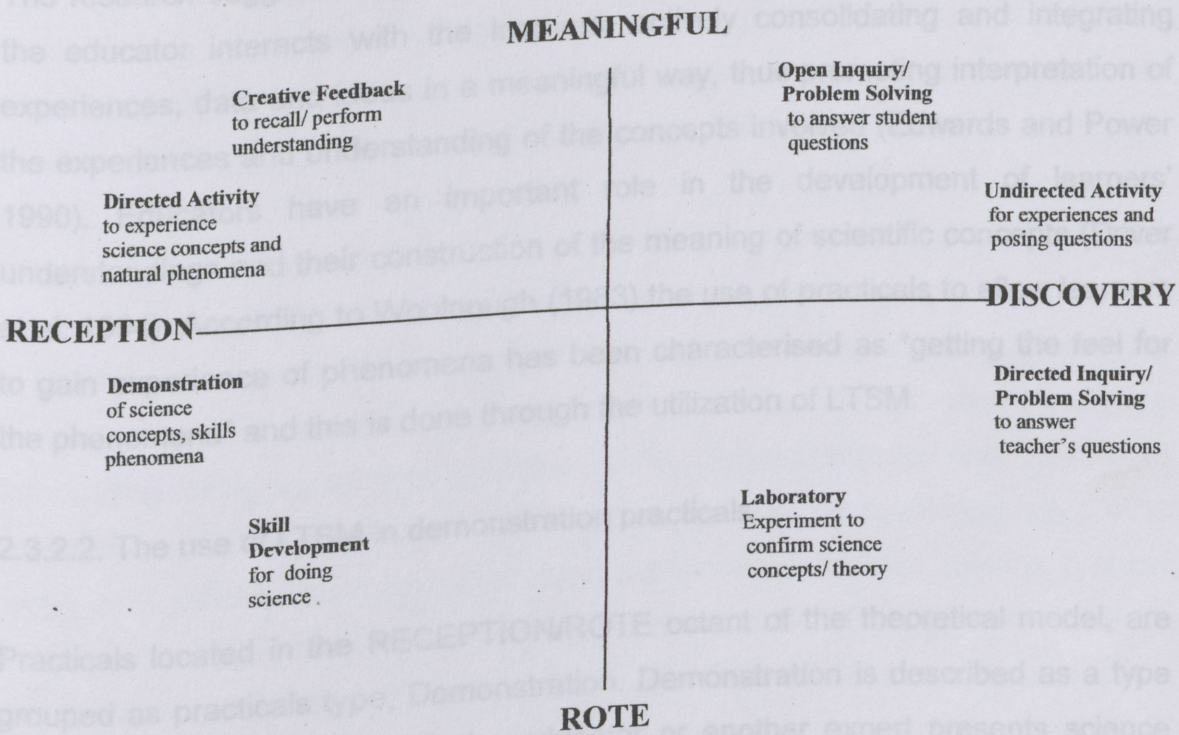
© University of Venda

University of Venda
Creating Future Leaders

laboratory is the only way to achieve meaningful learning equate reception learning with rote learning and discovery learning with meaningful learning(Novak 1978; Summers 1982).

2.3.2 The place of LTSM in facilitating theoretical models of practical learning of Physical Science.

The Theoretical Model for Science Practicals, after Ausbel (1963), Novak (1978) and Elton (1987) is shown in Figure 2.4 below:



In terms of this model, each type of practical can be located by the two terms that define each quadrant. The first mentioned term is adjacent to the octant that contains the practicals being considered , and is the dominant dimension, for example, the practicals located in the RECEPTION/ROTE octant are grouped as practicals type, Demonstration, while the practicals located in the MEANINGFUL/RECEPTION octant are grouped as practicals type ,Creative Feedback. Each type of practical will now be considered.

© University of Venda

University of Venda
Creating Future Leaders

2.3.2.1. The use of LTSM in directed activity and reception.

Practicals located in the RECEPTION/MEANINGFUL octant of the theoretical model, are grouped as practicals type, Directed Activity. Directed Activity is concerned with reception learning that may be either meaningful or rote. Directed Activity is described as educator directed activity in which the learner is required to do an activity, following educator instructions and answer questions provided by the educator, to support science theory or experience scientific phenomena. For all this to happen appropriate LTSM should be provided and used.

The research suggests that learner achievement of unit objectives is enhanced if the educator interacts with the learners, actively consolidating and integrating experiences, data and ideas in a meaningful way, thus promoting interpretation of the experiences and understanding of the concepts involved (Edwards and Power 1990). Educators have an important role in the development of learners' understandings and their construction of the meaning of scientific concepts (Driver et al. 1994). According to Woolnough (1983) the use of practicals to allow learners to gain experience of phenomena has been characterised as "getting the feel for the phenomena" and this is done through the utilization of LTSM.

2.3.2.2. The use of LTSM in demonstration practicals

Practicals located in the RECEPTION/ROTE octant of the theoretical model, are grouped as practicals type, Demonstration. Demonstration is described as a type of science practicals in which the educator or another expert presents science phenomena to support science theory, and directs learner attention and the discussion of results. The more learners actively involved in the presentation or performance of the demonstration, the closer the practical comes to Directed Activity (Bradley 2005).

Demonstration does not require independent discovery by the learner. In experimental seminars (Conway, Mendoza, and Read 1963) learners watch an

© University of Venda

University of Venda
Creating Future Leaders

experiment performed by an expert, or learners perform an experiment cooperatively. In this way they may gain experience and knowledge about how experiments are performed. For experiments to be performed by an expert or by a group of learners, provision of appropriate LTSM is required and effectively utilized.

2.3.2.3. The use of LTSM in skill development practicals.

Practicals located in the ROTE/RECEPTION octant of the theoretical model, are grouped as practicals type, Skill Development. Skill Development is described as the acquisition and development of basic scientific skills, in order to do science, these include manipulative skills, such as, the correct and safe use of apparatus, like the microscope, heating equipment and glassware; and science process skills, such as, observation, measurement and hypothesising(Bradley 2005).

Gagne (1963) states that Skill Development is an essential part of understanding science. Gagne (1965) identified eleven skills or processes of science arranged in a hierarchy of basic skills including: observing, measuring, inferring, classifying, collecting data and recording data; and higher level integrated processes including: interpreting data, controlling variables, defining operationally, and formulating hypotheses. Higher skills or integrated processes may be developed using other types of practicals, such as, laboratory experiments, directed inquiry/ problem solving or open inquiry/ problem solving. All forms of Skill Development practicals require provision and effective utilization of appropriate LTSM to be implemented.

2.3.2.4. The use of LTSM in laboratory practicals.

Practicals located in the ROTE/DISCOVERY octant of the theoretical model, are grouped as practicals type, Laboratory Experiment. Laboratory Experiment is described as experimental procedure to confirm science theory, where learners follow set instructions: for the aim of the experiment, to set up apparatus, to collect data, to recognise and correct for errors, to apply theory to achieve the result , to

© University of Venda

University of Venda
Creating Future Leaders

draw conclusions, and to write an experiment report following specific guidelines(Bradley 2005).

Laboratory Experiment is generally a closed type of practical with all the decisions being taken by the educator who presents learners with a recipe to be followed in order to get the correct result (Hackling, Goodrum and Rennie 2001). Laboratory Experiment cannot be implemented without provision and utilization of the required LTSM.

2.3.2.5. The use of LTSM in undirected activity practicals.

Practicals located in the DISCOVERY/MEANINGFUL octant of the theoretical model, are grouped as practicals type, Undirected Activity. Undirected Activities are described as informal hands-on activities, which increase learner experience of science phenomena, including, for example, play, trial and error, and tinkering. They may challenge the learners' prior knowledge and lead to the posing of questions and the identification of problems. (Bradley 2005).

The role of the educator in Undirected Activity is important and interactive, encouraging learners to challenge their prior understandings in the light of new experiences. A certain amount of LTSM is required when implementing these practicals.

2.3.2.6. The use of LTSM in inquiry-problem solving practicals.

Practicals located in the MEANINGFUL/DISCOVERY octant of the theoretical model, are grouped as practicals type, Open Inquiry/Problem Solving. Open Inquiry/Problem Solving is described as the active search for understanding to answer questions raised, or resolves problems posed by learners. The learners plan the inquiry/problem solution, carry out the inquiry or try the solution, and answer the question/solve the problem (Bradley 2005).

© University of Venda

University of Venda
Creating Future Leaders

The Open Inquiry part of this type of practical can be related to the experimental laboratory described by Kirschner (1991).It is also described throughout the literature as, for example; open-ended, inductive, discovery orientated, unstructured project, laboratory or investigation (Fairbrother 1986; Gott and Duggan 1995;Hackling 1998;Jones,Simon, Black, Fairbrother, and Watson 1992).The inquiry encourages learners to develop understanding and meaning by interpreting their experiences obtained by working directly with natural phenomena in a variety of contexts, supported by discussion and educator interaction(Driver 1989).The use of LTSM in inquiry-problem solving is required when implementing these practicals.

2.3.2.7. The use of LTSM in directed inquiry-problem solving.

Practicals located in the DISCOVERY/ROTE octant of the theoretical model, are grouped as practicals type, Directed Inquiry/ Problem Solving. Directed Inquiry/ Problem Solving is described as practicals in which, the educator sets the inquiry question/problem, then the learners plan the inquiry/solution, carry out the inquiry/trial the solution, and answer the inquiry question/solve the problem(Bradley 2005).

The Directed Inquiry/ Problem Solving practicals are regarded as a compromise between Laboratory Experiment and Undirected Activity. Directed Inquiry/Problem Solving may be considered similar to the divergent laboratory (Lerch 1971) in which parts of the experiment are set by the educator and are standard for all learners. The implementation of Directed Inquiry/ Problem Solving practicals require provision and utilization of appropriate LTSM if is to succeed.

2.3.2.8. The use of LTSM in creating feedback.

Practicals located in the MEANINGFUL/RECEPTION octant of the theoretical model, are grouped as practicals type, Creative Feedback. Creative Feedback is described as practicals that require learners to demonstrate their understandings by, for example, group discussions, investigation reports, problem solution reports,

© University of Venda

University of Venda
Creating Future Leaders

construction of charts, models, simulations, simulation games, multimedia presentations, concept mapping, dramatic representation and role-play (Bradley 2005).

Creative Feedback practicals enable learners to consolidate meaningful learning, whether discovered or received. Creative Feedback practicals include, for example, group discussions (Bently and Watts 1989; Kirschner 1991; Tamir 1977); investigation reports and problem solution reports (Keys, Hand, Prain, and Collins 1999); construction of charts and models (Gilbert 1993); simulations, simulation games and multimedia presentations, and concept mapping (Mason 1992; Novak 1990, 1992, 1998; Novak, Gowin, and Johansen 1983); and dramatic representation and role-play (Chester and Fox 1966).Creative Feedback practicals are an essential part of a science learning program that will take full advantage of the learning experiences provided to maximize understandings and the creation of meaning. Provision and utilization of appropriate LTSM is critical for the successful implementation of these practicals.

2.4. THE GAP IN PROVISION AND UTILIZATION OF LTSM

Practical work is central to the teaching and learning of Physical Science. Without practical work the teaching of Physical Science remains at a theoretical level, where there will be no experiments to enhance understanding of concepts and application of knowledge. Practical work, on the other hand, is dependant on provision of the required LTSM and resources.

Analysis of the LDOE Policy on provision of LTSM, except for the supply of textbooks, revealed that provision of practical work resources for teaching and learning of Physical Science are not included. There are, however, few DINALEDI schools which are provided with adequate practical work resources. As a result of this gap of not providing practical work resources, the majority of schools which are offering Physical Science in Limpopo Province are doing so theoretically. The

© University of Venda

University of Venda
Creating Future Leaders

majority of such schools are rural schools which are unable to provide all the required practical work materials through their own funding.

The other serious problem in schools which offer Physical Science is the gap created by failure to utilize the available practical work materials and resources by educators. According to Science Audit (1999) as referred to by Mangena (2001), more than 68% of science educators have no formal subject training in this subject. Although they are properly qualified as educators, their training in teaching science is inadequate. Based on these findings, utilization of available LTSM for practical work poses serious challenge to such educators who are inadequately trained. This happens mostly in rural schools, since better qualified educators are taken by urban or former Model C schools.

2.5. CONCLUSION

Practical work is an essential part of science education, designed to promote science learning according to the goals and aims of the program. Throughout this chapter it has been argued that practical work, important as it is in science education; it cannot take place without adequate provision and effective utilization of appropriate LTSM.

The review of literature in this chapter considered and covered the following:

- The role and significance of practical work when teaching and learning Physical Science, as well as the role played by LTSM in such practical work.
- Provision of LTSM for effective teaching and learning of Physical Science was emphasised. Provision of low-cost materials, such as, science kits, was seen to be the best option considering the high costs involved when supplying proper laboratories and equipments. However, provision of physical resources such as well quipped Physical Science laboratories, audio-visual aids rooms, media and library centres, and computer laboratories, were shown to be significant for effective

© University of Venda

University of Venda
Creating Future Leaders

teaching and learning of Physical Science. Provision of services such as gas, water, and electricity were also shown to be significant for practical work in learning of science. Improvisation of low-cost materials by educators was emphasised.

- The significance of effective utilization of LTSM was explored. Practical participation of learners in performing experiments, where sufficient LTSM has been supplied, was emphasised. The importance of educators training on utilization of LTSM, both during pre-service and in-service period, was emphasised. The use of only textbooks when teaching and learning Physical Science was shown to be not good enough, but instead hands-on experience was stressed. Parental assistance of learners when studying Physical Science was also considered.
- The discrepancy and inadequate funding of LTSM by DOE was explored. A comparison of expenditure per learner by province was done. Budgets for rural provinces, like Limpopo, were shown to be lower than those of the other more urbanised provinces. The result is that rural provinces have poor infrastructure provided per learner.
- Historical use of LTSM in practical learning of Physical Science was explored. The historical review considered practical work in learning science in the developed world, the developing world, the entire South Africa, and Limpopo Province which is the focus area of this study.
- A consideration of the use of LTSM in the different theoretical curriculum models was done.
- Consideration of the gap between theory and practice was also explored.

It is on the basis of this literature review that the researcher collected and interpreted data analysed the results and made recommendations for the solution of the problem identified in this study.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter presents methodological aspects of empirical fieldwork, procedures followed in the collection and analysis of data. The data collected gave support to the main problem and objectives of the study that has been described in chapter one.

When carrying out empirical data collection I decided to combine aspects of both quantitative and qualitative approaches. According to McMillan and Schumacher (2001) quantitative research approach is characterised by the following:

- Explicit description of data collection and analysis procedures
- Scientific measurement and statistics used
- Deductive reasoning applied to numerical data
- Statements of statistical relevance and probability.

Qualitative research approach is defined by McMillan and Schumacher (2001) as follows:

- Explicit description of data collection and analysis
- Detailed description of the phenomenon
- Inductive reasoning applied to evidence gained from sources
- Synthesised interpretation
- Extensions of understandings by others

Stainback and Stainback (1984) summarise the direct contrast between the quantitative and qualitative approaches by stating that the purpose of quantitative research is to evaluate objective data consisting of numbers while qualitative research deals with subjective data that are produced by the minds of respondents or interviewees.

© University of Venda

University of Venda
Creating Future Leaders

In both quantitative and qualitative approaches there are advantages and disadvantages. One of the advantages of quantitative approach is that it takes less time to administer and analyse the results. However, one of its disadvantages is that it is not flexible and as such misunderstanding of questions cannot be ruled out completely. On the other hand, one of the advantages of qualitative approach is that it is flexible. In an interview the interviewer can probe for answers that are more specific, and can repeat a question when the response indicates that the respondent misunderstood the question. This view is supported by Cohen *et al. (2005)* who maintains that interviews have a higher response rate and that the researcher has an opportunity to probe. Some of the disadvantages of qualitative approach are that it is costly and time consuming to administer and analyse results.

I targeted the following groups for collection of data: educators, learners and curriculum officers attached to District Office and Provincial Office. The targeted groups were identified because of their direct involvement with provision and utilization of science LTSM.

Fieldwork took place in Vhembe District schools. Vhembe District is one of the six districts of Limpopo Province's Department of Education (see map attached: Appendix H). It is situated in the far northern part of the province. Vhembe District has six Area Offices which are Malamulele, Mutale, Sekgosese, Soutpansberg, Thohoyandou and Vuwani.

The data documentation process consisted mainly of identifying the population; selecting the sample; designing and testing the instruments; organising letters of permission from departmental authorities; data collection; data capturing and finally data analysis (Mouton 2001).These steps are discussed below:

3.2 POPULATION

The population of this study includes all grade12 Physical Science learners and their respective educators in the Vhembe District. The identified Curriculum

© University of Venda

University of Venda
Creating Future Leaders

Officers, two attached to the District Office and two at Provincial Office also form part of the population. The three target groups in their respective institutions constituted the total number of the population the research work focused upon.

Educators and learners were chosen because of their role in utilization of science LTSM in the teaching and learning of Physical Science. Curriculum Officers were targeted because of their responsibilities in provision of LTSM to schools. Further more, Curriculum Officers at district level who are Subject Advisers are responsible for monitoring, supporting educators and in-service training of educators in the teaching and learning of Physical Science. Curriculum Officers are responsible for procurement and distribution of LTSM to all provincial schools, including Vhembe District schools.

3.3 SAMPLE AND SAMPLING PROCEDURE

3.3.1 The Sample

The sample comprised of the three target groups. Furthermore, I ensured that the sample fully represented the entire population. The three target groups were represented as follows:

- One thousand three hundred and twenty (1320) grade 12 Physical Science learners from urban, peri- urban and rural areas. The majority of learners were from rural areas
- Fifty five grade 12 Physical Science educators from schools were learners were selected
- Four Curriculum Officers, two from District Office and two from Provincial Office.

A large number of learners and educators were targeted in order to accurately represent the population under consideration. I decided to include district Curriculum Officers and provincial Curriculum Officers to ensure overall

© University of Venda

University of Venda
Creating Future Leaders

responsibility for utilization and provision of LTSM respectively. The sample is summarised in Table 3.1 below.

Table 3.1 The sample.

Circuit Cluster	No. of schools selected	No. of educators selected	No. of learners selected	No of curriculum officers selected
Malamulele	9	9	216	
Mutale	2	2	48	
Sekgosese	6	6	144	
Soutpansberg	14	14	336	
Thohoyandou	12	12	288	
Vuwani	12	12	288	
District				2
Provincial				2
TOTAL	55	55	1320	4

UNIVERSITY OF VENDA
LIBRARY

3.3.2 Sampling procedure

According to Strauss and Corbin (1990), the aim of sampling is to uncover as many potentially relevant categories as possible, along with their properties and dimensions.

For the purpose of this study I used the simple random sampling method to select the sample in order to give every member of the population an equal chance of being chosen (McNiff et al 1996). The simple random sampling method was applicable to schools in the different Area Offices, but educators chosen belonged to each of the selected schools. In each of the selected schools, twenty four (24) learners were also selected randomly.

© University of Venda

University of Venda
Creating Future Leaders

3.4. INSTRUMENTATION

The data collection methods employed in this study involved quantitative and qualitative approaches. In the quantitative approach, questionnaires were administered and for qualitative data, an interview was applied (Rubin & Babbie 1992; Mouton 2001 and De Vos 2002). Both the questionnaires and the interview schedule were designed by myself with the help of the superviser..

I used questionnaires as instruments to collect data from educators and learners who formed the majority of respondents. Quantitative results from questionnaires were presented in the numerical order which made the analysis much easier and faster.

The development of the instruments took into account competency level of the respondents. The format of the learner's questionnaires was basically multiple-choice questions in order to make it simple for them to respond. What they were expected to do was simply to encircle what they considered the most appropriate solution. On the other hand the format of the educator's questionnaire was a combination of structured and open-ended questions. Open-ended questions were aimed at giving the respondents the opportunity to make comments on matters not covered by closed- questions. In both instances, of learners and educators, the questionnaires sought factual information on the position of resources available for practical work in teaching and learning Physical Science at grade 12 levels and how these were utilized.

The interview schedules for curriculum officers comprised only of open-ended questions for them to discuss in full. The interview as a data gathering source was chosen because of its ability to get fuller feedback and to probe interview items further for more clarification when needed. The questions basically focused on the current LDOE policy on provision of LTSM as well as the status of teaching of Physical Science at Limpopo schools. All the instruments where developed in English since it is the medium of instruction (The current LDOE policy on provision of LTSM is attached as Appendix D).

© University of Venda

University of Venda
Creating Future Leaders

3.5 VALIDITY AND RELIABILITY

Claims of validity rest on the data collection and analysis techniques and also involve issues of ethics and feasibility, because of the variety of designs, research questions and situations (McMillan and Schumacher 2001)

In order to ensure in this study that the developed instruments were capable of measuring what they were intended to measure, all the draft instruments were first scrutinised by the supervisor to establish their face and content validity, and subsequently upon review were subjected to pilot testing using respondents with the same characteristics as the sample in the same population.

Findings from the pilot exercise provided valuable basis for further modification where necessary. Following steps mentioned by Vonkel and Asher (1996) the activity led to further additions, removal and revision of items in the instruments to ensure validity. In order to ensure internal validity and reliability the method of triangulation was applied. Triangulation is defined by Neuman (1994) as the use of two or more methods of data collection techniques in order to examine the same variable. By using triangulation, further reliability was achieved by cross- validating data collected through the two questionnaires with data collected through interview schedule. The information obtained from the qualitative research tool in this study, validated the findings obtained from the quantitative research instruments (De Vos 2002).

Copies of the final version of the learners and educators questionnaires appear as Appendices E and F respectively. The interview schedules for curriculum officers appear as Appendix G.

3.6 DATA COLLECTION PROCEDURE

According to Armer (1973), data collection designs methods should be tailored for the specific research problem and specific cultures being investigated. Since every method has limitations and weaknesses, the most appropriate strategy is generally

© University of Venda

University of Venda
Creating Future Leaders

one employing a combination of methods and data types that counter balance each other's limitation. For the purpose of this study I employed questionnaires and interview methods in order to ensure counter balancing of information gathered. Data triangulation approach was used in this study to collect data.

Data triangulation is defined as the collection of data from multiple sources with the intention of obtaining diverse views on the phenomenon under study for the purpose of validation (De Vos 2001). In this study data was collected through questionnaires administered to educators and learners. Further data was collected through interviews of curriculum officers. Burns and Grove (2001) assert that responses from such multiple sources enhance the reliability of the research results.

The procedure I used to administer questionnaires in the majority of the targeted schools was to visit the schools personally. This approach was done in order to reduce non-response rate and also where clarifications were needed or problems experienced assistance would be offered directly. Only in a few cases did I distribute questionnaires to the targeted schools through Circuit Managers. This approach unfortunately led to non-return of some questionnaires.

The process of collecting data lasted for approximately six months and the overall rate of return of data for learners was 95%; educators 80% and curriculum officers 75%. With these rates of return the researcher was satisfied that there was enough data for generalisation of the findings.

3.7 DATA CAPTURING PROCEDURES

Data collected through questionnaires was captured into a data editor loaded with Statistical Package for Social Sciences (SPSS) file. Although considerable care in capturing data was taken, help of the data analysis expert was obtained in order to cross check for errors that might have occurred during capturing. In order to detect such errors, two approaches were used, namely, examining the data set directly

© University of Venda

University of Venda
Creating Future Leaders

using the case summaries approach and running the procedure and frequency which produced a summary table of values for each variable.

Data collected from interviews was summarized according to themes, consolidated and captured into interview schedules.

3.8 DATA ANALYSIS PROCEDURE

According to Bogdan and Biklen (1998), data analysis is the process of systematic searching and arranging the interview transcript, field notes, and other materials that the researchers accumulate to increase their own understanding of those materials and to enable them to present what they have discovered to others. Analysis involves working with data, organizing them, breaking them into manageable units, synthesizing them, searching for patterns, discovering what is important and what is to be learned, and deciding what to tell others.

For the purpose of analysing data in this study, quantitative and qualitative analysis techniques were used. The non- numeric data was analysed manually while numeric data was analysed electronically using SPSS. The analysis indicated frequencies and percentages of all numeric variables of the data which made it possible to show results in table form (McNiff et al 1996). In order to validate the findings, triangulation approach was used. Some learner's responses were compared with those of educators.

Data collected through interviews was analysed manually in terms of similarities, differences and compatibility. When analysing this data, where appropriate, comparison was done with information collected through questionnaires in the first component of the survey. Methodological triangulation as defined by Kimchi, Polika and Stevenson (1991) was used. They define methodological triangulation as the use of two or more research methods in a single study.

The overall findings of the three instruments were interpreted according to similarities where necessary. The analysis and interpretation of data was

© University of Venda

University of Venda
Creating Future Leaders

performed with the goal of improving the current provision and utilization of science LTSM in Limpopo Province schools.

3.9 DELIMITATION AND LIMITATION OF THE STUDY

3.9.1 Delimitation

This study focuses on provision and utilization of Physical Science LTSM in Limpopo Province schools. For reasons of feasibility the study was conducted in the Vhembe District of Education schools.Vhembe District is one of the six districts of LDOE, which is situated in the far northern part of the province. Specifically the target was FET schools offering Physical Science at Grade 12 level.

3.9.2 Limitations of the study

The limitations on which this study is based are as follows:

- This study is confined to Grade 12 Physical Science learners and educators and does not include those from lower grades. It is envisaged that factors that affect provision and utilization of LTSM in Grade 12 Physical Science learners and educators will also apply to learners and educators in lower grades.
- The questionnaires used were in English, which is a second language to most of the learners and educators who took part in the survey. It is possible, that both learners and educators may have misunderstood some of the questions, despite the effort taken to make the language as simple as possible.
- Subjectivity and bias resulting from my background as a teacher of Physical Science at FET level for 15years, Circuit Inspector and Head of Curriculum Advisers in the Vhembe District of Education.

© University of Venda

University of Venda
Creating Future Leaders

3.10 ETHICAL CONSIDERATIONS

According to de Vos *et al.* (2005), ethical issues serve as standards and a basis upon which each researcher ought to evaluate his or her own conduct and they should, therefore, be continuously borne in mind and be internalised in the researcher's personality. For the purpose of this study, I considered the following ethical issues: permission, appointments, confidentiality, data anonymity and accessing research report.

3.10.1 Permission

Firstly, permission from the Vhembe District Senior Manager was requested to conduct research in the secondary schools under his jurisdiction (Appendix A). A copy of the letter granting the permission appears as Appendix B. Secondly, the researcher further wrote letters to principals of the selected schools to make them aware of the study and solicit their cooperation during the research (Appendix C). Lastly permission was granted by the District Senior Manager and the Head of the Department to have access to policy documents on LTSM (Appendix D) as well as interviewing the targeted curriculum officers.

3.10.2 Appointments

Prior to visiting each school for the purpose of administering questionnaires to educators and learners, letters were sent to respective principals in order to secure appointment. Curriculum officers who were interviewed were also informed in time prior to the actual interview sessions.

3.10.3 Confidentiality

Respondents were assured of the fact that their responses would be kept strictly confidential and that they would be used for the purposes of this study only.

© University of Venda

University of Venda
Creating Future Leaders

3.10.4 Data anonymity

Respondents were assured of the anonymity of their answers to questions asked and that the information they provided for the research would not be divulged, not even to the principal of their school. Respondents were further requested not to write their names on the questionnaires to ensure anonymity of the information they provided.

3.10.5 Accessing research report

The respondents were informed that the research report, once completed, will be made available for access at the Special Collection Section of the University of Venda Library.

3.11 CONCLUSION

This chapter presented procedures used in sampling, designing instruments, collection, capturing and analysis of data. The problems, objectives of the study and research questions were the guiding principles during the process of data collection, analysis and interpretation.

Everything possible was done to reduce or to avoid errors during the process of collection, capturing, analysis and interpretation of data. As a result I am convinced that the process was well managed and that the results obtained are of a good quality.

The next chapter presents the findings, analysis and interpretation of data collected through the three instruments.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter focuses on the results obtained from questionnaires completed by educators and learners as well as interviews conducted with curriculum officers. The presentation and subsequent discussion would begin with results obtained from questionnaires completed by educators who teach Physical Science in Grade 12, followed by those completed by learners of Physical Science, and lastly, those obtained from interviews conducted with Physical Science Curriculum officers.

The analysis and interpretation of data therefore comprises of the following main sections:

- Educator's responses.
- Learner's responses.
- Curriculum officer's responses.
- Conclusion.

Empirical data was obtained by administering three instruments namely, the questionnaire for educators, the questionnaire for learners and interview schedule with Curriculum Officers based at District and Head Office levels. For details of instruments refer to Appendices E, F and G. Respondents of the educators' questionnaire comprised of Grade 12 educators offering Physical Science; while respondents of questionnaire for learners comprised of Grade 12 learners doing Physical Science and respondents for interview schedule comprised Curriculum Officers responsible for provision and utilization of science LTSM.

Analysis and interpretation of data in each section is centered on the two major focus areas of this study - provision, and utilization of science learning and teaching support materials. The results of both the interviews and the

© University of Venda

University of Venda
Creating Future Leaders

questionnaires are discussed according to these focus areas, giving notable findings and indicating any literature relevant to these findings.

The structured items were analyzed by means of a computer using the SPSS programme. Data has been presented in the form of tables. Each presentation of analysis is followed by discussions and interpretations. The order of data presentation as mentioned earlier is in accordance with main sections of this chapter. Each main section consists of sub-sections.

4.2 SECTION A: EDUCATOR' S RESPONSES

This section presents an analysis of the results obtained from the questionnaires completed by educators of Physical Science in Grade 12 from 55 selected secondary schools in Vhembe District of the Limpopo Province. The main categories in this section are personal data, policy on provision of science LTSM, development of LTSM, provision of equipment for performing experiments, provision of chemicals for performing experiments, availability of other physical resources, fittings in Physical Science laboratory, educators' in-service training workshops on utilization of Physical Science LTSM, improvisation of LTSM by educators and conducting experiments as required by the Grade 12 Physical Science CASS policy. The findings are presented according to the above mentioned categories.

4.2.1 Educators' personal data

The effectiveness of utilization of science LTSM depends to a large extent on the quality of human resource available. Educators are the key role players in the utilization of LTSM. The background characteristics of educators can directly or indirectly influence utilization of science LTSM in the teaching and learning of Physical Science. The first five items of the questionnaire established the state of representative ness of respondents with regard to gender, age, experience, academic and professional qualifications of educators, Findings on educators' personal data are presented according to the above sub-categories.

© University of Venda

University of Venda
Creating Future Leaders

4.2.1.1 Educators' Age and Gender.

Table 4.1. Age and gender

Age group	Gender		Total
	Male	Female	
20-30 years	5	-	5
%	11, 4%		11,4%
31-40 years	19	7	26
%	43,2%	15,9%	59,1%
41-50 years	9	2	11
%	20,5%	4,5%	25,0%
51-65	1	1	2
%	2,3%	2,3%	4,5%
TOTAL	34	10	44
	77,3%	22,7%	100,0%

Results show that the majority of respondents who participated in the investigation were male (77.3%); while only about a quarter (22.7%) of those educators who took part in the study were females. This suggests that fewer females are training as science educators, resulting in fewer female science educators in the Vhembe district. A possible explanation for this is that science education, generally all over the country is still male-dominated. Most of the opportunities after doing science are still male-dominated, but the situation is busy changing currently. This situation further suggest that fewer educators are following science teaching as a career, a trend that would impact negatively on the provision and utilization of science LTSM. It is highly likely that there would be a problem of replacing science educators if fewer educators were following science-teaching as a career while some may leave teaching for various reasons. This would lead to educators who are untrained in science being responsible for teaching science, which would in turn negatively affect the provision and utilization of science LTSM.

© University of Venda

University of Venda
Creating Future Leaders

4.2.1.2 Educators' highest academic qualifications.

Table 4.2. Educators' highest academic qualifications.

Qualification	Frequency	Percent	Cumulative %
Grade 12	26	59.0	59.0
First degree	11	25.0	84.0
Honours degree	5	11.4	95.4
Masters degree	1	2.3	97.7
No response	1	2.3.	100
TOTAL	44	100	

The majority of educators (59.0%) who teach Physical Science at Grade 12 level in Vhembe district qualified only up to Grade 12. The majority of educators are therefore not academically qualified to teach Grade 12 because they are on the same level with their learners. They are likely going to struggle when teaching their classes. Ideally educators should hold higher academic qualification than their learners. The results further indicate that those educators who have already completed a degree are few, suggesting that the majority of science educators in the district do not have high academic qualifications that could assist them to effectively develop and utilize science LTSM. This implies that the majority of educators are experiencing difficulty in teaching Physical Science at Grade 12 effectively

© University of Venda

University of Venda
Creating Future Leaders

4.2.1.3 Educators' highest professional qualifications

Table 4.3 Educators' highest professional qualifications.

Professional qualification	Frequency	Percent	Cumulative Percent
Teaching certificate	1	2.3	2.3
Teaching diploma	32	72.7	75.0
First teaching degree (Junior degree)	7	15.9	90.9
Second teaching degree (Senior degree)	3	6.8	97.7
No response	1	2.3	100.0
Total	44	100.0	

Approximately three quarters (72.7%) of the educators who took part in the study only qualify for minimum requirements of teaching Physical Science, that is, they only have a teaching diploma. These educators have just qualified to teach up to Grade12 that is if they have done a 3 years Secondary Teachers Diploma. Those who qualified with first and second degrees in science are a little less than a quarter (22.7%). These results suggest that in Vhembe District, the majority of educators are professionally low qualified to effectively teach Physical Science up to Grade 12 level. This would most likely affect the provision and effective utilization of learning and teaching support materials relevant to Grade 12 science. The argument here is that it is educators with advanced training in science who can be in a better position to understand how science LTSM are developed and

© University of Venda

University of Venda
Creating Future Leaders

utilized at Grade 12 level. Educators with only a diploma in science, if it is not a 3years Secondary Teachers Diploma, only qualify to teach Physical Science up to Grade 10, but because of a shortage of highly qualified educators, they continue to teach up to Grade 12 level, regardless of their low professional qualification

4.2.1.4 Educators' experience of teaching Physical Science at Grade 12 level.

Table 4.4 summarizes experience of educators in teaching Physical Science at Grade 12 level according to gender.

Table 4.4. Educators' experience in teaching Physical Science at Grade 12 level

.

Experience in years	Gender		Total
	Male	Female	
01-10 years %	18 40,9%	2 4,5%	20 45,5%
11-20 years %	13 29,5%	7 15,9%	20 45,5%
21 – 30 years %	3 6,8%	1 2,3%	4 9,1%
TOTAL	34 77,3%	10 22,7%	44 100,0%

Very few educators (9.1%) who participated in the study have more than 20 years experience in teaching Physical Science at Grade 12 level. The assumption here is that, although there are no minimum years of teaching experience, with advance teaching experience the educator will have gathered more skills of doing practical work utilizing the available LTSM, when teaching Physical Science. Another observation is that few female educators (22.7%), as compared to male educators (77.3%), were found to be having experience of teaching Physical Science at

© University of Venda

University of Venda
Creating Future Leaders

Grade 12 level in the Vhembe District. This situation could be attributed to the fact that science education has not been popular with female learners, as already indicated in 4.2.1 above.

4.2.2 Policy on provision of LTSM.

Provision of LTSM to schools by the LDOE is regulated by policy. What is therefore important is the communication of the policy to educators. In this study, educators were requested to indicate whether the policy on provision of LTSM was communicated to them. Table 4.6 gives a summary of responses by educators on the question of communication of the policy.

Table 4.5. Communication of policy on provision and dissemination of science LTSM.

Responses	Frequency	Percent	Cumulative Percent
Yes	11	25,0	25,0
No	31	70,5	95,5
No response	2	4,5	100.0
TOTAL	44	100,0	

The results reveal that only a quarter (25, 0%) of the respondents had access to the policy under discussion. The great majority of the respondents (70.5%) indicated that the policy was not communicated to them. These results would therefore suggest that most Grade 12 science educators in the province were not exposed to the policy. Again this means that nearly all science educators for Grade 12 in Limpopo Province lack understanding of the policy. This is serious because if the situation of science teaching has to be improved, educators should have access and understand the policy that governs the supply and use of science LTSM. In actual fact educators should be involved even in the formulation of the

© University of Venda

University of Venda
Creating Future Leaders

policy in order to ensure not only understanding, but implementation of it in the classroom. Poor communication of the policy leads not only to misunderstanding and misinterpretation of the policy, but also to the disowning of the processes involved in drawing up of the policy by educators. The possibility is that when educators are not involved in the provision or selection of LTSM, it may be difficult for the majority of them to utilize such resources effectively, unless they are sufficiently trained to use them.

Although provision of science LTSM is taking place in 50 DINALEDI schools in the province, a lot is still to be done in a more regular and systematic manner in order to include all the other schools offering Physical Science. Actual provision of the materials takes place from either a local or external development point. Locally developed materials by educators themselves at their respective schools or at a central point in the cluster of schools, refers to those simple and less complex apparatus which could be developed from ordinary materials found in the environment, whereas externally developed materials could be by experts at some central location. Materials to be developed locally by educators do not include laboratory apparatus and equipment, as these require special skills and materials.

4.2.3 Development of science LTSM

In this study, educators were requested to comment on the development of science LTSM locally or externally. Out of 25 educators who made the requested comments, 18 educators commented in favor of locally developed science LTSM (Table 4.6 below) and only 7 educators supported external development (Table 4.7 below). Those in favor of locally developed materials indicated that such materials were economic, easily accessible and relevant to local settings. These results are in support of Lewy (1977) who found that materials produced locally are economic, pedagogical and psychological in nature as they may fit the needs of particular learners.

© University of Venda

University of Venda
Creating Future Leaders

Table 4.6 below reflects comments given by educators in support of the provision of locally developed science LTSM.

Table 4.6. Reasons for local development of science LTSM

Reasons	No of respondents giving the reason
1. Easy access to schools	8
2. Relevance to local stakeholders	6
3. Minimizing the costs	3
4. Participation by local stakeholders	1

The few respondents who were in favor of centrally developed materials also gave their reasons, as indicated in Table 4.7

Table 4.7. Reasons for centrally developed LTSM

Reasons	No of respondents giving the reason
1. Provision of large quantities	4
2. Ensuring uniformity	2
3. Catering for all learners, rural and urban	1

The responses on both local and external development of Physical Science LTSM, as illustrated by Table 4.6and Table 4.7, suggest that local provision is the most favored despite the fact that some of the more complex resources would have to be imported from external sources. It is however, important to note that simple LTSM could be developed in the majority of the local schools provided that educators are trained, supported by curriculum advisors and have resources for production.

© University of Venda

University of Venda
Creating Future Leaders

4.2.4 Provision of equipment to perform experiments

The following table summarizes responses by educators on availability of equipment required for performing Physical Science experiments

Table 4.8. Equipment for performing experiments.

Responses	Frequency	Percent
Very little	6	13,6
Little	11	25,0
Sufficient	6	13,6
Nothing	21	47,8
TOTAL	44	100,0

Only 6 educators (13.6%) indicated that they have sufficient equipment for performing all the required experiments. However, 47, 8% educators indicated that they do not have equipment for performing science experiments. Those with a little supply are little more than those with very little supply as clearly indicated in the table above. These results are consistent with the findings of several researchers. For example Kutame (2004) found that rural schools purchase a small amount of equipment due to the government allocation of funds to schools based on the poverty index and enrolment.

The system of allocation of funds to schools based on their poverty index and enrolment still leaves rural schools unable to purchase sufficient learning and teaching support materials. Urban schools on the other hand have high learner enrolment as compared to rural schools and are able to purchase more equipment. While it could be argued that the funds allocated would be sufficient considering the enrolment, it is important to note that the materials required in terms of quantity may not be related to the number of learners. Rural schools, with little funds allocated based on those government norms, may purchase very little learning and teaching support materials, insufficient to perform all the required experiments.

© University of Venda

University of Venda
Creating Future Leaders

These results therefore suggest that the quality of science teaching in urban schools is considerably higher than in rural schools.

From these findings, it is not surprising why the majority of schools in Vhembe District are not in a position to offer Physical Science practically as required by the syllabus or examinations guidelines. This situation is serious if we take into consideration the findings of Spargo (1994) that procurement and maintenance of equipment for the teaching of sciences is crucial if schools are to achieve better results in science (Spargo 1994).

4.2.5 Provision of chemicals for performing experiments

Table 4.9. gives a summary of responses by educators regarding the availability of chemicals for performing experiments.

Table 4.9. Availability of chemicals for performing experiments

Responses	Frequency	Percent
Very little	4	9,3
Little	12	27,3
Sufficient	7	15,9
Nothing	21	47,8
TOTAL	44	100,0

The respondents who indicated that they have sufficient chemicals required for performing all the required experiments were only seven educators (15.9%). Those who indicated little supply were a little more than those who indicated they have very little as clearly illustrated in figure 4.7 above. About half of the educators (47.8%) indicated that they do not have any chemicals for performing experiments. The implication of these results is that the majority of science educators in Vhembe District are not utilizing science LTSM in their teaching of Physical Science as required by the syllabus. One could further speculate that

© University of Venda

University of Venda
Creating Future Leaders

- the majority of educators are not able to perform experiments which require the use of chemicals;
- in all other districts in the Limpopo Province where similar conditions exist, educators are not afforded the opportunity of utilizing LTSM in the form of chemicals.
- science results in Grade 12 would be negatively affected if some of the curricula needs are not fulfilled.

4.2.6 Provision of physical structures for Physical Science teaching and learning

Some Physical Science LTSM requires a conducive environment such as well-equipped laboratories, audio visual aids rooms, media centres and computer laboratories for their effective utilization. In this study educators were requested to indicate availability of these infrastructures at their schools.

4.2.6.1. Provision of Physical Science laboratories

Table 4.10. Summarizes educator's responses on the question of provision of Physical Science laboratories at school level.

Table 4.10 Availability of Physical Science laboratories

Responses	Frequency	Percent	Cumulative %
Yes	16	36,4	36,4
No	28	63,6	100,0
TOTAL	44	100,0	

More than half (63.6%) of the educators indicated that they do not have Physical Science laboratories in their schools. These results imply that in the majority of schools, Physical Science lessons are conducted theoretically without the use of laboratories. Since most of these schools are rural, this situation is in agreement

© University of Venda

University of Venda
Creating Future Leaders

with Kutame (2004) who indicated that rural schools, as opposed to urban schools, are characterized by poor infrastructure, which is required for effective teaching and learning. Kutame indicates further that on the contrary, urban schools, which are in the minority, are better equipped than rural schools in science learning and teaching support materials and provision of Physical Science laboratories.

The results further suggest that the majority of learners who are doing Physical Science in Vhembe District do not have any practical laboratory experience. The acute shortage of Physical Science laboratories in Vhembe District schools as reflected above has serious implications of undesired theoretical teaching of Physical Science. The same conclusion is applicable at any other district in Limpopo Province where similar conditions exist. Lack of Physical Science laboratories, which are resource centres for the teaching and learning of science in schools, is a serious setback.

As indicated by Chisholm (2005) the quality of science teaching at historically black schools, most of which are situated in rural areas, is considerably lower than that at historically white schools which are predominantly in urban areas. The implication is that urban schools, unlike rural schools, are likely to have better provision of Physical Science laboratories. Such laboratories are expected to be better equipped since schools are able to purchase more science learning and teaching support materials than those in rural areas. These results therefore suggest that the quality of science teaching in urban schools is considerably higher than in rural schools.

© University of Venda

University of Venda
Creating Future Leaders

4.2.6.2. Provision of audio-visual rooms.

Educator's responses on the provision of audio-visual rooms at schools are presented in Table 4.11 below.

able 4.11 Provision of audio-visual room at school.

Responses	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	3	6,8	7,0	7,0
No	40	90,9	91,0	98,0
No response	1	2,3	2,0	100,0
TOTAL	44	100,0		

Out of 43 educators who responded to the question, the majority of them (93.0%) have no audio-visual aids room in their schools. Only 3 educators (7.0%) indicated that they have audio-visual rooms in their schools. It is therefore evident that utilizing such facilities is very minimal in the district. The implication of these results is that practical work which requires audio-visual aids rooms is thus not receiving adequate attention at schools in the Vhembe district. This suggests that intervention by the provincial DOE in providing audio-visual rooms to schools is still needed in order to improve the situation.

© University of Venda

University of Venda
Creating Future Leaders

4.2.6 3. Provision of Library centres

Table 4.12 Provision Library centres

Responses	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	6	13,6	14,0	14,0
No	37	84,1	84,0	98,0
No response	1	2,3	2,0	100,0
TOTAL	44	100,0		

More than three quarters of the educators (86.0%) who responded indicated that there are no library centres at their schools. Only 6 educators (13.6%) indicated that they have library centres at their schools. As a result, most educators and learners are not able to utilize facilities such as Library Centres in their teaching and learning of Physical Science in Vhembe District. The majority of educators are not able to give their learners assignments that require extra reading materials besides the prescribed textbooks. As indicated above, only 13,6% of the educators are able to give their learners work that require extra reading from the library. This is consistent with the findings of a study by Descy (1992) in his investigation of first year elementary school-educators on utilization of instructional media, which indicate that shortage or non-availability of reading materials in science is a serious setback in studying and mastering scientific concepts. Besides textbooks used by educators in class, learners should have the opportunity of studying further and doing research on their own in the Library Centre.

4.2.6.4. Provision of computer laboratories at schools.

Educators were requested to indicate whether or not they use computer laboratories for teaching certain sections of Physical Science. Their responses are summarized in Table 4.13 below.

© University of Venda

University of Venda
Creating Future Leaders

Table 4.13 Utilization of computer centres.

Response	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	3	6,8	7,0	7,0
No	40	90,9	91,0	98.0
No response	1	2,3	2,0	100,0
TOTAL	44	100,0		

Nearly all educators (93.0%) indicated the non-availability of computer laboratories at their schools. Computers have become a very important learning and teaching support material to assist in the effective teaching and learning of certain sections of Physical Science. These results therefore suggest that there is need for computers laboratories to be provided in schools for effective learning and teaching of Physical Science. It should, however, be stated that even without a computer laboratory, as long as computers are made available at a school, they can still be used in an ordinary classroom.

4.2.7 Fittings in Physical Science laboratory

The results, as illustrated by table 4.14 below, also paint a disturbing picture regarding laboratory fittings. Most of the existing laboratories at schools, particularly rural schools, are without adequate or proper fittings.

© University of Venda

University of Venda
Creating Future Leaders

Table 4.14 Availability of laboratory fittings.

Fittings	Yes	No
Water	41.7	58.3
Electricity	54.2	45.8
Gas	29.2	70.8
Appropriate furniture	26.1	73.9
Fume chamber	0.0	100.0

More than half (58.3%) of the educators in the survey indicated that their laboratories are without water connections; nearly half (45.8%) of the educators indicated that they have no electricity in their laboratories; about three quarters (70.8%) indicated that their laboratories have no gas fittings; about three quarters (73.9%) indicated that their laboratories have no appropriate laboratory furniture and all of them indicated that they do not have fume chambers in their laboratories. From these results it is evident that most of the school laboratories are not fully equipped. Without these fittings, these laboratories cannot fully be utilized to perform all the required experiments.

Considering the picture described above, it can be stated that for laboratories to be effective centres of learning, they should be well equipped with the appropriate fittings. These results indicate that the majority of respondents regard the provision of Physical Science laboratories as very poor in the Vhembe District. According to Manana (1994) Physical Science laboratories need to be provided with services, equipment and materials if they are to be utilized effectively. These results also suggest that the teaching and learning of Physical Science in the Vhembe District is negatively affected by lack of appropriate laboratory fittings.

© University of Venda

University of Venda
Creating Future Leaders

The other districts of the province would also not be different in the provision of appropriate laboratory fittings. The implication of these results is that no sufficient supply of Physical Science LTSM by LDOE is taking place at most of the schools in Limpopo Province.

4.2.8 Educator's in-service training workshops on utilization of Physical Science LTSM.

Table 4.15. In-service training workshops on utilization of LTSM

Responses	Frequency	Percent	Cumulative percent
Yes	10	22.7	22.7
No	33	75.0	97.7
No response	1	2.3	100
TOTAL	44	100	

Only 22.7% of the respondents indicated that they had attended in-service training workshops on utilization of science LTSM. Three quarters (75.0%) of the respondents indicated that they did not attend any in-service training workshop on utilization of science LTSM. These results therefore suggest that there are fewer educators who have attended workshops to improve their efficiency in the utilization of Physical Science learning and teaching support materials (LTSM). The great majority of Physical Science educators in Vhembe District are not qualified to teach the subject at Grade 12 level as indicated in sub-section 4.2.3 above. The fact that the majority of educators are not attending any in-service training workshops on the utilization of science LTSM compounds the problem.

© University of Venda

University of Venda
Creating Future Leaders

4.2.9 Improvisation of science LTSM by educators

Table 4.16. Summarizes responses by educators indicating different efforts they undertook in order to improvise Physical Science LTSM for their lessons.

Table 4.16. Efforts for improvisation of Physical Science LTSM.

Efforts	No of educators giving the examples
1. Borrowing apparatus from neighboring school(s).	8
2. Taking learners to the nearest Education Multi-Purpose Center (EMPC) for practical demonstrations and experiments.	7
3. Showing Physical Science videos.	4
4. Borrowing surplus books from nearby schools.	3
5. Using notes and teaching aids developed during training at tertiary institutions.	2
6. Schools purchasing some materials from their budgets.	2
7. Using local crafts and tools made by local craftsmen.	2

Responses by educators regarding the efforts they took for the improvisation of Physical Science LTSM, as reflected on Table 4.9 indicate the seriousness of the difficulty faced by them when they teach Physical Science. The responses of educators indicated that borrowing of apparatus from neighboring schools or taking their learners to the nearest Education Multi Purpose Centre (EMPC) for practical demonstrations and experiments was their improvised solution to the problem of lack of science LTSM required to perform practical work. However, these types of improvisation seem to be unpopular for a substantial number of rural schools which, again, are far from well-resourced schools or the EMPC. Further, the results suggest that:

© University of Venda

University of Venda
Creating Future Leaders

- borrowing of books from other schools is not sustainable, unless those books are in surplus;
- sharing books may not be possible during examination time when learners are required to prepare fully;
- there is bound to be congestion of learners at the EMPC from different schools;
- borrowing of equipment and chemicals from neighboring schools has problems during revision time;
- schools from which educators borrow equipment are few and far;
- few schools are in a position to provide budget and resources needed to transport learners and educators to other schools or EMPC.

As described in the literature review, the majority of schools in Limpopo, and therefore in Vhembe district, are in deep rural areas.

4.2.10 Conducting experiments as required by Grade 12 Physical Science CASS policy.

Educators were requested to indicate the extent to which they are able to conduct the experiments prescribed by the DOE (2004) for continuous assessment (CASS) in Grade 12 Physical Science.

© University of Venda

University of Venda
Creating Future Leaders

Table 4.17 below summarizes responses of educators on the extent of their ability to conduct the prescribed experiments.

Table 4.17.Ability to conduct experiments according to CASS policy

Responses	Frequency	Percent	Valid Percent	Cumulative Percent
I can do all of them	11	25,0	25,0	25,0
I can do most of them	17	38,6	38,6	63,6
I can do few of them	13	29,5	29,5	93,1
I cannot do any of them	3	6,9	6,9	100,0
TOTAL	44	100,0	100,0	

Only a quarter (25%) of the educators indicated that they are able to do all the experiments as required by Grade 12 Physical Science CASS policy: More than a quarter (38.6%) of educators who took part in the survey, however, indicated that they can do most of the prescribed experiments. Some of them (29.5%) indicated that they can do a few of the required experiments. 6.9% of the respondents indicated that they cannot do any of the experiments as required. It is important to note that the majority of educators have indicated that they are able to do some of the experiments despite the acute shortage of resources. This is an indication that educators regard conducting experiments as important in the teaching and learning of Physical Science and therefore make an attempt in order to improve learner performance. However, those who are not able to conduct any experiments have given several reasons for failing to conduct any experiments according to the CASS policy. Table 4.18. presents a summary of the major reasons why educators

© University of Venda

University of Venda
Creating Future Leaders

who participated in the survey were failing to conduct experiments according to the departmental CASS policy.

Table 4.18. Reasons for failing to conduct experiments.

Reasons	No of educators giving the reasons
1. Lack of apparatus and chemicals.	8
2. Do not have enough time.	2
3. Insufficient apparatus and chemicals.	6
4.Lack of appropriate laboratory facilities	8

- The majority of educators who responded to their failure to conduct experiments required by the departmental CASS policy cited the following as major reasons: lack of apparatus, chemicals and appropriate laboratory facilities.

4.3. SECTION B: LEARNER'S RESPONSES

The main categories in this section are personal data, electricity at learners' homes, availability of electricity at school, participation in conducting experiments, shortage of Physical Science textbooks, equipment to perform experiments and chemicals required to perform experiments.

4.3.1 Learners' personal data

The effectiveness of utilization of science LTSM depends to a large extent on participating learners. Learners are one of the key role players in the teaching and learning process. The background characteristics of learners can influence directly or indirectly performance in studying science. The first five items of the questionnaire established the state of representative ness of respondents with

© University of Venda

University of Venda
Creating Future Leaders

4.3.1.2. Learners' age and gender.

Table 4.20 Learners' age and gender.

Age	Gender		Total
	Male	Female	
Younger than 17years	39	65	104
%	3,2%	5,2%	8,4%
17 years	178	205	383
%	14,2%	16,4%	30,6%
18 years	199	182	381
%	15,9%	14,5%	30,4%
Older than 18 years	230	154	384
%	18,4%	12,3%	30,7%
TOTAL	646	606	1252
%	51,6%	48,4%	100,0%

From Table 4.20, it is evident that boys tend to be older than the expected age of 17 years at Grade 12 as compared to girls. More girls (16.4%) as compared to boys (14.2%) are in Grade 12 at the age of 17 years. It is important to note that more boys (51.6%) are doing Physical Science as compared to girls (48.4%). Gender distribution of educators (Table 4.1) showed that there are more male educators (77.3%) as compared to female educators (22.7%). It is possible that this educator gender distribution could be a source of influence for the girls in choosing to do Physical Science. The above results also show that there was an acceptable representation of all age and gender groups of Grade 12 Physical Science learners. Therefore, the views expressed here would reflect those of the entire population of Grade 12 Physical Science learners in the district.

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

University of Venda
Creating Future Leaders

4.3..1.3 Home language and medium of instruction

Demographic information about home languages is significant because to the majority of learners in Limpopo Province, medium of instruction is English and not their home language.

Table 4.21 Home language.

Language	Frequency	Percent	Cumulative Percent
Tshivenda	843	67.3	67.3
Tsonga	243	19.4	86.7
N. Sotho	152	12.1	98.8
English	4	0.3	99.2
Afrikaans	10	0.8	100.0
Total	1252	100.0	

It is evident from Table 4.21 that the sample of learners represented nearly all common languages spoken by the population in Vhembe district. The majority of learners (67.3%) speak Tshivenda as their home language, followed by 19.4% who speak Tsonga and 12.1% who speak Northern Sotho. This is understandable considering the area where this study was conducted. It is important to point out that the majority of secondary schools in the Vhembe district use English as a medium of instruction in the learning of Physical Science in Grade 12, resulting in the majority of the learners not using their home languages. Clearly the results show that the majority of learners (98.8%) have other languages (Tshivenda, Northern Sotho and Tsonga) as their mother tongue, while only 0.3% and 0.8% speak English and Afrikaans respectively as their mother language. This suggests that the majority of learners who speak English as a second or third language would experience problems regarding understanding of Physical Science concepts, even when they are supplied with the required LTSM. There is therefore need for language development.

© University of Venda

University of Venda
Creating Future Leaders

4.3.2 Contribution of electricity in learning Physical Science at learner's homes

A summary of learner's responses with regard to contribution of electricity in the learning of Physical Science at learner's homes is presented in Table 4.22 below:

Table 4.22 Contribution of electricity in learning Physical Science at learner's homes

Responses	Frequency	Percent	Cumulative Percent
Very much	638	51,0	51,0
Much	294	23,5	74,5
Little	131	10,5	85,0
Very little	67	5,4	90,4
Not at all	101	8,1	98,5
No response	21	1,5	100,0
TOTAL	1252	100,0	

Although Vhembe is a rural district, it was encouraging to note that the majority (90.4%) of participating learners had electricity in their homes and that they acknowledged that they benefit from this electricity in their study of Physical Science. The majority of learners (74.5%) indicated that they benefited to a great extent from electricity at their homes. Only a small number of learners (15.9%) indicated that their benefit was to a less extent.

The focus of this study with regard to learners is actual utilization of Physical Science LTSM by themselves. It is therefore important to indicate that availability of electricity at learner's homes may go a long way in enriching their scientific background. Learners may become familiar with electrical scientific equipment, some of which form part of LTSM they require in their study of Physical Science,

© University of Venda

University of Venda
Creating Future Leaders

for example: computers, electric bulbs and television, to mention just a few examples. Physical Science learners with this pre-knowledge or background of scientific electrical equipment have a better chance of mastering usage of this equipment in their Physical Science lessons as compared to their counterparts who come without this scientific experience. In addition some learners even have a chance of viewing video-cassettes which are showing performance of certain experiments conducted by experts or view Physical Science programmes in television which are conducted by Physical Science expert educators. All these add to the knowledge of learners in their application of science learning and teaching materials in class.

Another challenge facing learners when studying Physical Science is that they do not perceive any relationship between school science equipment and science equipment used at home. This challenge was clearly enunciated by George who said:

> ...we have a lot of children in our schools (who) see technology as associated with factories and development and science ... and that has nothing to do with what they do at home. They wouldn't see those processes that Mummy does as anything scientific and the idea of relating the two side by side as important (1992:101).

Physical Science taught at school should relate to life outside of the classroom, such as what happens at home

© University of Venda

University of Venda
Creating Future Leaders

4.3.3 Contribution of electricity in utilizing science LTSM at school

Table 4.23. Contribution of electricity in utilizing science LTSM at school

Responses	Frequency	Percent	Cumulative Percent
Very much	486	38,8	38,8
Much	257	20,5	59,3
Little	181	14,5	73,8
Very little	91	7,3	82,1
Not at all	224	17,9	99,0
No response	13	1,0	100,0
TOTAL	1252	100,0	

The results in Table 4.23 above show that more than three quarters (82.1%) of the learners in the survey indicated that electricity in their schools does play a role in their study of Physical Science to some extent. Only 17.9% of the learners indicated that electricity at school did not help them in their study of Physical Science. This is likely so because as indicated in 4.2.7 above, some laboratories were not fitted with electricity.

When electricity is available at school, learning and teaching support materials which require the use of electricity are utilized by learners in their study of Physical Science. Learners can be able to view practical work programmes and video cassettes which display performances of certain experiments in their syllabus even though the required equipments and chemicals are not available at school.

It can be said, in conclusion, that since the majority of science learners did indicate that electricity does play a role in their study of Physical Science, absence of electricity will therefore impact negatively to those who do not have access to it. The need for dissemination of electricity in schools is therefore of paramount importance in order to offer all science learners with the opportunity of performing experiments which require the use of electricity.

© University of Venda

University of Venda
Creating Future Leaders

4.3.4 Shortage of Physical Science textbooks.

The following Table 4.24. gives a summary of responses by learners on the question of shortage of Physical Science textbooks.

Table 4.24. Shortage of Physical Science textbooks.

Responses	Frequency	Percent	Cumulative Percent
Yes	756	60,4	60,4
No	440	35,1	95,5
No response	56	4,5	100,0
TOTAL	1252	100,0	

It is clear from the above table that more than half of the learners (60.4%) indicated that they experience shortage of Physical Science textbooks at their schools. Fewer learners (35, 1%), however, indicated that they do not have problems of shortage of textbooks. One could speculate that these statistics suggest that the majority of learners are struggling without adequate learning and teaching support materials in the form of textbooks. These results are consistent with the findings of Kutame (2004) that some books are supplied late to schools in the year or in some extreme cases, they end up not being supplied. The teaching of Physical Science without adequate or appropriate textbooks becomes very difficult for both the educators and the learners.

© University of Venda

University of Venda
Creating Future Leaders

4.3.5 Equipment for performing experiments

The following table summarizes responses for learners on availability of equipment required for performing Physical Science experiments.

Table 4.25 Equipment for performing experiments

Responses	Frequency	Percent	Cumulative Percent
Yes	495	34,5	34,5
No	757	60,5	100,0
TOTAL	1252	100,0	

More than half (60, 5%) of the learners indicated that they do not have equipment for performing Physical Science experiments. Only 34, 5% of the learners indicated that they have sufficient equipment to perform the required science experiments. These results are confirmed by 47, 8% of educators in sub-section 4.2.4 above who also indicated lack of equipment required to perform science experiments. The implication is that in Vhembe district, the majority of learners are taught Physical Science theoretically.

4.3.6 Chemicals for performing experiments

Table 4.26 gives a summary of responses by learners regarding the availability of chemicals for performing experiments.

Table 4.26 Availability of chemicals for performing experiments

Responses	Frequency	Percent	Cumulative
Yes	495	34,5	34,5
No	757	60,5	100,0
TOTAL	1252	100,0	

© University of Venda

University of Venda
Creating Future Leaders

34, 5% of the learners indicated that they have chemicals for performing experiments. However, 60, 5% of the learners indicated that they do not have chemicals for performing science experiments. These results are supported by 47, 8% educators in sub-section 4.2.5 above who also indicated that they do not have chemicals required to perform experiments. The implication of these results is that the majority of learners in Vhembe district are not exposed to practical work when learning Physical Science.

4.3.7 Participation in conducting experiments by learners themselves.

A summary of responses by learners on whether they should be given the opportunity of handling learning and teaching support materials for practical work by themselves is presented in Table 4.25 below.

Table 4.27. Participation in conducting experiments by learners themselves.

Responses	Frequency	Percent	Cumulative
Yes	1017	81,2	81,2
No	128	10,3	91,5
Not sure	98	7,8	99,3
No response	9	0,7	100,0
TOTAL	1252	100,0	

In this study learners were requested to indicate whether they should be given the opportunity of handling LTSM themselves when doing practical work in their learning of Physical Science. Table 4.9 shows that more than three quarters (81.2%) of the learners do want to have the opportunity of handling LTSM for practical work themselves. Only 10, 3% of the learners indicated that they do not need to perform experiments themselves. These results suggest that learners want to participate in conducting experiments by themselves. However, from the results discussed in sections above, it is evident that the wish learners have may not be

© University of Venda

University of Venda
Creating Future Leaders

realized due to the acute shortage and in most cases, non-availability of equipment required for conducting these experiments.

The implication of the above results is that provision of LTSM should be such that learners are given the opportunity of doing practical work themselves. LTSM may not only be handled by their educators but they should have first hand experience.

4.4. SECTION C: CURRICULUM OFFICERS' RESPONSES

In this section the researcher analysed data collected through interviews conducted with three curriculum officers, two at district and one at provincial levels. The researcher had targeted to interview two curriculum officers at provincial level but only one was available. The officers interviewed are responsible for the implementation of the policy on provision and utilization of learning and teaching support materials (LTSM) respectively. The following themes where considered when analysing data collected from interviewing the curriculum officers:

- Policy awareness by stakeholders
- Provision of LTSM
- Utilization of available LTSM
- Improvisation of LTSM by educators.
- Educators in service training
- Availability of Physical Science laboratory

4.4.1. Policy on provision and utilization of Physical Science LTSM

Respondents were asked about their knowledge of the current LDOE policy on provision of LTSM and to what extent the policy was communicated to all relevant stakeholders. The following were the findings:

- The respondents stated that the current policy covers provision of textbooks, prescribed books, and stationery.

© University of Venda

University of Venda
Creating Future Leaders

- All the curriculum officers interviewed further indicated that LTSM specifically for practical work in teaching and learning Physical Science was not provided at the moment.
- The curriculum officer at provincial level indicated that the policy was communicated to all the relevant stakeholders.

Analysis of responses by Curriculum Officers on matters pertaining to the policy on provision and utilization of LTSM indeed revealed that the policy, in its present form, does not include provision of Physical Science LTSM required for practical work. In actual fact the present policy is divided into two parts, namely, Primary LTSM and Supplementary LTSM. So far, the present focus of the policy is on provision of Primary LTSM which is basically provision of text books, literature books and stationery. Supplementary LTSM, which includes provision of apparatus, is currently not receiving attention from the LDOE. The reason for this, according to the interviewed officer, is budgetary constraints experienced by the Department of Education. The results from interviews further indicate that there are constraints experienced when implementing the current LTSM policy. The following are some of the major constraints identified:

- Funds are always insufficient to purchase all the required LTSM.
- Problems experienced in retrieving departmental books supplied to learners affect the budget seriously because instead of topping up the previous year's supply, the department is forced to purchase big quantities of new books each year.
- Parents and educators have a serious challenge of making sure that books supplied to learners are returned or replaced at the end of each academic year, something which is not happening effectively in most of the schools.
- The quantity of stationery supplied per learner, coupled with ever-increasing enrolment of learners pose a serious challenge to the budget.

The above constraints are some of the reasons for the failure of the department to implement supply of the required Physical Science LTSM. The consequence of this failure results in educators continuing to struggle to teach Physical Science in the

© University of Venda

University of Venda
Creating Future Leaders

proper and effective way. This ultimately leads to the general poor performance of learners in Physical Science as a learning area.

The general poor performance of learners in Physical Science is not only pertaining to Vhembe district or Limpopo Province, it is an issue that affects the entire country of South Africa. This conclusion is supported by the Third International Mathematics and Science Study Repeat (TIMSS-R) report, which clearly indicated that about half of the 225 schools tested in South Africa, indicated that they felt that instruction in Mathematics and Science was seriously hampered by a shortage of materials, equipment and facilities. The report also alluded to the fact that the South African results for Physical Science are significantly below the mean scores of all the other participating countries. Thus the policy on provision of LTSM needs urgent revision and change of focus in order to include all the required Physical Science LTSM.

With regard to communication of the policy, although the interviewed officer claimed that all relevant stakeholders were informed, only 26, 2% of the educators involved in the study indicated that the policy was communicated to them. This leaves the majority of the educators in the dark with regard to the provisions of the policy.

4.4.2. Provision of Physical Science LTSM at schools.

The respondents were asked to indicate the extent of the provision of resources for the teaching and learning of Physical Science in Limpopo schools and the following were the findings:

- The respondents indicated that provision of resources for the teaching and learning of Physical Science has so far not received systematic attention.
- The respondents further stated that provision of practical work resources was taking place at Dinaledi Schools, which at the time of this study were only 52 schools in the province.

© University of Venda

University of Venda
Creating Future Leaders

- It is only the former Model C schools and a few 'homeland' high schools that do have a reasonable amount of Physical Science LTSM and other science resources such as laboratories and media centres.

The above findings from curriculum officers are supported by findings from both educators and learners on the same question. Only 15.9% of educators and 12.5% of learners who responded to the question of provision of resources for practical work when teaching and learning Physical Science, indicated that they have sufficient chemicals required for performing all the required Grade 12 experiments.

The implication of these findings is that teaching and learning of Physical Science in the majority of schools in Vhembe district, as well as in majority of schools in the entire Province of Limpopo with similar conditions, is not receiving its proper attention due to non-provision or inadequate provision of the required science LTSM. The non-availability of Physical Science LTSM also brings about a serious challenge when it comes to determination of Continuous Assessment marks (CASS) for Physical Science. Only a quarter (25%) of the educators involved in the study indicated that they were able to do all the experiments as required by Grade 12 Physical Science CASS policy. The determination is obviously not done accurately in the majority of schools where there is lack of the required LTSM for performing the identified experiments. It is also reasonable to conclude that without the required Physical Science LTSM, learners find it difficult to understand certain science concepts.

4.4.3. Utilization of available Physical Science LTSM

The curriculum officers, based at district level, which are responsible for ensuring the implementation and utilization of the LTSM policy in schools were asked about whether the available science LTSM at schools was utilized by both educators and learners. Their responses were as follows:

© University of Venda

University of Venda
Creating Future Leaders

- The respondents indicated that utilization of the available LTSM differs from school to school depending on the availability of a competent educator with skills to utilize the resources.
- The respondents further indicated that in most cases the resources which are available are in small quantities, such that only the educator can utilize them for demonstration purposes.

Analysis of the findings indicated that failure to utilize the available resources was mainly due to lack of appropriate training of educators during both their pre-service and in-service engagements. Active participation of learners in performing experiments is obviously not taking place in the majority of schools, as it should be the norm in terms of the requirement of the syllabus. The new OBE Curriculum approach requires active participation of learners in the learning process. Educators are thus expected to provide opportunities for learners to do experiments or projects on their own. Important as this is, it is not happening because of a shortage or complete absence of the required science LTSM, as well as a lack of skills by the majority of educators to conduct experiments. The effect of these results is that in Vhembe district the majority of learners are taught Physical Science theoretically with minimal learner's participation.

Considering the need for active participation of learners in performing experiments, as already indicated, the curriculum officers emphasised the urgent need for the LDOE to revise the focus of the present LTSM policy to include provision of science LTSM. The LDOE should endeavour to provide an enabling environment for effective teaching and learning of Physical Science in all schools, particularly the previously disadvantaged rural schools.

4.4.4. Improvisation of simple Physical Science LTSM by educators

The respondents were asked about whether Physical Science educators were encouraged and guided to improvise simple LTSM for their classes wherever possible and the findings are as follows:

© University of Venda

University of Venda
Creating Future Leaders

- Respondents indicated that although encouragement is done, very little improvisation of LTSM is done by educators for different reasons. Some educators indicated that they could not do it because of lack of time, lack of basic materials, or often lack of skill to do the work.

Curriculum officers interviewed indicated clearly that very little is done in this direction for various reasons. Despite willingness to do so, few educators are in a position to undertake this task. Most of the educators do not have the time, the resources or often the skill to be involved in the development of good quality, educationally appropriate learning materials. As a result, professional material developers are better able to produce materials that display a thorough understanding of the curriculum framework, a detailed level of content and skills knowledge, high quality design, layout and printing. In short, professionally produced LTSM are critical resources for educators struggling to facilitate completed forms of learning which are outcomes-based. However, despite all these difficulties educators should be encouraged to design and produce their own learning programmes and LTSM.

These In order to improvise learning materials of good quality, educators should have the following skills and understanding:

- Understand the curriculum framework as a whole at a level that would inform the conceptual design of the learning programme;
- Be an expert in the content, concept and skills outcomes of each learning programme at each grade level;
- Have access to substantial resource materials;
- Master the design of a learning programme in a way that answers progression of concepts, content and skills outcomes in the mind of the learner by giving due attention to assessment standards;
- Be able to graphically illustrate materials (pictures, graphs and maps).
- Have the computer, printer, photo-copier and other resources available for the physical production and reproduction of the materials (DOE 2000:11).

© University of Venda

University of Venda
Creating Future Leaders

These skills are what the majority of educators do not have and thus require assistance from Curriculum Advisers in the form of in- service training.

The curriculum officers further acknowledged the fact that the provision of text books and other materials by LDOE should not inhibit educators who are ready to develop their own learning and teaching support materials. In fact the LDOE suggests that resources should be made available to encourage educators to produce materials like worksheets to supplement textbooks. It is therefore important to indicate that the situation of poor attempt to improvise simple Physical Science LTSM by educators needs serious and urgent attention by Curriculum Advisers.

4.4.5. Educator's training on utilization of LTSM.

The Curriculum Officers at district level were asked about the extent of pre-service training of science educators to do practical work when teaching Physical Science and the role of in –service training in this regard. The response was the following:

- The respondents indicated that the majority of educators did not receive adequate practical work experience or training during their pre-service training.
- They further indicated that very little is done to fill this gap through in-service training.

Curriculum officers alluded to the fact that the majority of educators now teaching Physical Science at Grade 12 level in the Vhembe district said they did not receive adequate pre-service training on utilization of science LTSM. What is more serious is the fact that the majority of them are not receiving in-service training on utilization of LTSM. As indicated in sub-section 4.2.8 above 75, 0% of the educators did not attend any in-service training workshop on utilization of science LTSM. The implication is that the few LTSM that the school acquire through various means, remain unused or inadequately utilized. If educators were not trained to utilize LTSM during their pre-service training they are bound to

© University of Venda

University of Venda
Creating Future Leaders

experience difficulties when they are expected to perform the identified experiments according to the syllabus. The implication is that in Vhembe district the majority of learners are not exposed to practical work when studying Physical Science since their educators are not competent in utilizing science LTSM.

It should therefore be emphasised that the LDOE should ensure that educators of Physical Science receive adequate training in the utilization of science LTSM both during pre-service and in-service training.

4.4.6. Availability of Physical Science laboratories

Respondents were asked about provision of Physical Science laboratories at Vhembe District schools and how they are equipped for practical work. Their findings were as follows:

- The respondents stated that so far the LDOE is not providing Physical Science laboratories to all the schools, with the exception of the few new schools.
- They further stated that the available old laboratories are not being equipped by LDOE.
- Physical Science laboratories that are well equipped are those of former Model C schools, DINALEDI schools and the newly constructed Comprehensive Secondary Schools.

Curriculum officers interviewed, supported by the results obtained from questionnaires completed by both educators and learners, also indicated the limited number of Physical Science laboratories at Vhembe district schools. 63, 6% of the educators and 57, 9% of the learners who responded to questionnaires, indicated that they do not have Physical Science laboratories at their schools.

© University of Venda

University of Venda
Creating Future Leaders

The implication of these results is poor or complete absence of practical work in Physical Science at schools which require the use of a proper laboratory and not an ordinary classroom. For example, experiments which require the use of a fume chamber cannot be performed in a situation where there is no laboratory.

According to responses from officers, educators and learners there are some old rural schools which do have Physical Science laboratories, but these are not fully equipped or they are standing empty. Laboratories which so far are receiving attention in terms of provision of science LTSM for practical work are those from former Model C, DINALEDI, and the newly constructed Comprehensive Secondary Schools. The implication is that the majority of schools in Vhembe district do not have Physical Science laboratories and that the few old ones that exist are not fully equipped. As a result of these results, practical work required when teaching Physical Science which require the use of a fully equipped laboratory are not taking place in Vhembe district schools.

4.5 CONCLUSION

Analysis of all the data collected from educators, learners and curriculum officers revealed the following major findings:

- The current LDOE Policy on the provision of LTSM , except for supply of text books, is not comprehensive enough to include all the other LTSM required for practical work when teaching and learning Physical Science.
- Provision of science LTSM, including text books, at different schools has been found to be inadequate, not equitable and not systematically done. Of the learners, 60,3% indicated a shortage of Physical Science text books at their schools. The Ex- model C and some urban schools were found to be better equipped as compared to rural schools. In terms of the study sample, 88, 4% of the schools were rural and that gives an indication of the gravity of the problem.
- Utilization of the available LTSM was found not to be satisfactory. For example, there are instances where at some schools; delivered

© University of Venda

University of Venda
Creating Future Leaders

materials remain in their containers without being used. This is as a result of educators not having the necessary skills to do practical work.

- Poor provision of LTSM in the form of physical resources such as Physical Science laboratories, audio-visual aids rooms, library and media centres, and computer laboratories. Where these were found, the majority of them were not fully equipped, particularly in rural schools. As a result of poor supply of LTSM, only 25% of the educators indicated that they were able to conduct all the experiments prescribed for Grade 12 Physical Science CASS marks.
- The majority of educators teaching Physical Science at Grade 12 were found to be not academically qualified. 60, 5% of them only had Grade 12 as their highest academic qualification.
- The majority of educators indicated poor pre-service training in Physical Science practical work. Most unfortunately for this group, they do not even attend the few in-service training workshops conducted on utilization of the available LTSM for practical work. Only 22, 7% of the educators indicated regular attendance to such workshops.
- Improvisation of LTSM by educators is taking place at a very small scale for different reasons. Lack of time, lack of basic resource materials, and lack of improvisation skills being some of the reasons.
- Parental assistance in learning Physical Science was found to be lacking in the majority of learners. When learning Physical Science 51, 6% of learners indicated no parental support.
- Availability of electricity at learner's homes contributing to better learning of Physical Science at school. Although Vhembe is vastly a rural district, it was encouraging to note that 98, 5% of participating learners had electricity at their homes, and that 90, 4% of them indicated that they were benefiting from this electricity in their study of Physical Science.

On the basis of these findings, the next Chapter outlines a summary of responses to all the research questions.

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER FIVE

WHAT MIGHT WE LEARN FROM THIS STUDY

5.1 INTRODUCTION

In every scientific study the research problem has to have focus and in order to achieve the expected outcome, relevant research questions are formulated. These questions form the direction factor for the study (McMillan & Schumacher 2001)

5.2 AN OVERVIEW OF RESEARCH QUESTION

The main research question of this study is: *How is provision and utilization of teaching and learning support materials in Physical Science implemented in Limpopo Province schools?*.

In an attempt to gather information towards achievement of the focus of this research question, the following sub- questions were formulated and considered:

5.2.1 SUB- QUESTION ONE

What is the view of scholars on the significance of practical work, including the role of LTSM, when learning Physical Science?

Sub-question 1 of this study focuses in particular on views of scholars on the role of practical work when teaching and learning Physical Science. The aim was to establish from literature the significance of practical work when learning Physical Science. The question also investigates the role of LTSM when conducting practical work as part of learning Physical Science.

© University of Venda

University of Venda
Creating Future Leaders

5.2.2 SUB- QUESTION TWO

How does the LDOE Policy on provision of LTSM meet the requirement of conducting practical work when teaching and learning Physical Science?

Sub-question 2 of this study is particularly concerned with establishing the existence of a policy in LDOE which describes and facilitates the provision of LTSM in all the schools. The question further aims at establishing whether the policy, if it exists, makes provision for the supply of equipment required when doing Physical Science practical work.

5.2.3 SUB- QUESTION THREE

How are equipment for practical work and basic physical facilities such as gas, water, and electricity supplied to schools offering Physical Science?

The focus of sub- question 3 is to establish how LDOE supply equipment for practical work to schools offering Physical Science, and if so, to what extent. The question further focuses on provision of Physical Science laboratories to schools by LDOE, and if they do, how far are these laboratories fitted with the required physical facilities such as gas, water, and electricity.

5.2.4 SUB- QUESTION FOUR

How are educators trained or at least orientated to effectively utilize the available LTSM?

Sub- question 4 in this study focuses on how LDOE makes provision for in-service training or orientation of educators to effectively utilize the available science LTSM at the different schools. The concern here is that in some schools resources are made available but remain in their boxes and never unpacked for use.

© University of Venda

University of Venda
Creating Future Leaders

5.2.5 SUB- QUESTION FIVE

How is Physical Science educators encouraged to improvise simple LTSM, where possible, for their lessons?

Sub- question 5 in this study aims at establishing how educators are encouraged to improvise some simple LTSM for doing practical during their Physical Science lessons. The idea behind is that in the absence of provision of standardized equipment by the department, educators should not fold their arms but do something on their own to facilitate learning process during their lessons.

5.3 RESPONSES TO RESEARCH QUESTION

The information gathered from literature, learners, educators and curriculum officers considered in this study provided the following responses to research question:

How is provision and utilization of learning and teaching support materials in Physical Science implemented in Limpopo Province schools?

In order to respond to this question the following sub-questions were formulated and considered:

5.3.1 SUB- QUESTION ONE

What is the view of scholars on the significance of practical work, including the role of LTSM, when learning Physical Science?

Scholars, throughout literature considered, emphasises the significance of practical work when teaching and learning Physical Science. Practical work in science education is designed to promote science learning and is determined by the particular goals and aims of the science education program (Bradley 2005)

© University of Venda

University of Venda
Creating Future Leaders

As stated by Van der Stoep and Van der Stoep (1973), in practical work learners participate actively in the learning situation as a discovering activity which, to a large extent, ensures permanent success at the end of the learning activity. Practical work provides learners with concrete experiences that enable them to better understand concepts and principles developed during the course of their learning process.

Scholars also confirm that practical work in learning Physical Science is not going to be possible in the absence of adequate provision and effective utilisation of the required LTSM. The provision of LTSM is an integral part of the teaching and learning of Physical Science.

Literature also emphasises the significance of utilization of LTSM by learners themselves. Learners learn better in situations where they experiment, manipulate, collect data, classify and analyse subject matter than in situations where they simply memorise facts. Where learners are not involved in doing practical work, they are without choice, relying on textbook approach. As McNeil (1999) argues, without educators supplementing textbooks by introducing hands-on activities, projects, serious questions about the learner's environment and the like, the science curriculum is likely to be disconnected from real life. The use of textbooks is not good enough; hands-on experiences remain a serious requirement for effective teaching and learning of Physical Science.

5.3.2 SUB- QUESTION TWO

How does the LDOE Policy on provision of LTSM meet the requirement for conducting practical work when teaching and learning Physical Science?

From data collected through interviews conducted with curriculum officers, the researcher established that LDOE has a policy on provision of LTSM.The respondents stated that the current policy covers provision of textbooks, prescribed books, and stationery. They further indicated that LTSM specifically meant for

© University of Venda

University of Venda
Creating Future Leaders

practical work when teaching and learning Physical Science was not provided for at the moment.

The reason for not supplying LTSM specifically meant for performing practical work, according to the officer interviewed was budgetary constraints experienced by LDOE. The consequence of these constraints is that educators continue to struggle to teach Physical Science theoretically at the expense of the learners. This ultimately leads to the general poor performance of learners in Physical Science yearly throughout the Province.

I verified the information given by curriculum officers in their responses to the question of LDOE Policy on provision of LTSM by going through the actual policy document which is herein attached as appendix D.

5.3.3 SUB- QUESTION THREE

How are equipment for practical work and basic physical facilities such as gas, water, and electricity supplied to schools offering Physical Science?

The curriculum officers interviewed, supported by the results obtained from questionnaires completed by both educators and learners, indicated that there are a limited number of schools which have Physical Science laboratories. The majority of these laboratories are reported to be not functional. 63.6% of the educators and 57, 9% of the learners who responded to questionnaires, indicated that they do not have Physical Science laboratories at their schools. The implication of these results is poor or complete absence of practical work in majority of schools when teaching and learning Physical Science.

On the question of provision of LTSM for practical work when teaching and learning Physical Science, almost all the respondents indicated a poor, inadequate or complete absence of supply of the needed resources. Only 15,9% of educators and 12,5% of learners who responded to the question on provision of resources for practical work when teaching and learning Physical Science, indicated that they

© University of Venda

University of Venda
Creating Future Leaders

have sufficient chemicals required for performing all the required Grade 12 experiments. These results are a clear indication of the fact that majority of schools are teaching Physical Science theoretically.

The non-availability of Physical Science LTSM also poses a serious challenge when it comes to determination of Continuous Assessment (CASS) marks for Grade 12 Physical Science. Only a quarter (25%) of the educators involved in the study indicated that they were able to do all the experiments as required by Grade 12 Physical Science CASS policy. The determination is obviously not done accurately in the majority of schools due to lack of the required LTSM for performing the identified experiments.

More than half (58,3%) of the educators who took part in the study indicated that their laboratories are without water connections; nearly half (45,8%) of the educators indicated that they have no electricity in their laboratories; about three quarters (70,8%) indicated that their laboratories have no gas fittings; about three quarters (73,9%) indicated that their laboratories have no appropriate laboratory furniture and all of them indicated that the do not have fume chambers in their laboratories. From these results it is evident that most of the existing school laboratories are not fully equipped. Without these fittings, these laboratories cannot fully be utilized to perform all the required experiments.

The lesson we have learned in this study is that, throughout the Province, there is an acute shortage of well equipped and functional Physical Science laboratories.

5.3.4 SUB- QUESTION FOUR

How are educators trained or at least orientated to effectively utilize the available LTSM?

On the question of educator's in-service training workshops on utilization of Physical Science LTSM, only 22, 7% of the respondents indicated that they had attended such an in-service training workshop. Three quarters (75, 0%) of the

© University of Venda

University of Venda
Creating Future Leaders

respondents indicated that they did not attend any in-service training workshop on the utilization of science LTSM.

Findings of the research also indicate that the majority of educators who are teaching Physical Science at Grade 12 are not adequately qualified. 59, 0% of the educators who took part in the study, only have Grade 12 as their highest academic qualification. The fact that the majority of educators are under-qualified and also that they are not attending any in-service training workshops on the utilization of the available science LTSM, only compounds the problem of ineffective teaching and learning of Physical Science.

The majority of educators now teaching Physical Science at Grade 12 level also indicated that they did not receive adequate pre-service training on utilization of science LTSM. Equally serious is the fact that the majority of them are not receiving any in-service training on the utilization of science LTSM as already indicated. The implication is that the few science LTSM that the schools are acquiring through various means, remain unused or inadequately utilized. Webb and Raubenheimer endorse this conclusion when they state:

> A good educator will use a range of methods to achieve the purpose of a lesson. However, the problem in South Africa is that educators have generally not been exposed to alternative methods of teaching during their own learning experiences. Furthermore, when they studied didactics at College it is likely that this was taught theoretically. Hence educators tend to model their teaching on that with which they are familiar, the chalk and talk method (1994:84).

Training or at least orientation of educators to effectively utilize the available science LTSM should be prioritised by curriculum advisers through in-service training workshops. They should try to close the gap left out during pre-service training of the educators. They should try to dispel the fear of technology which is prevalent amongst the majority of educators. Bellamy *et al.* also attest to this fear when they state:

© University of Venda

University of Venda
Creating Future Leaders

> ... the majority of educators are afraid of media equipment, are unaware of resources available, and are unwilling to expand the extra resources, plan for the use of such resources in a presentation, or make arrangements for set-up and operation of necessary equipment (1978:7).

Unless this challenge of technophobia in utilizing science LTSM is addressed during pre-service training of new educators and also during in-service training of existing educators, the problem of under-utilization or non-utilization of the available science LTSM will persist indefinitely.

5.3.5 SUB- QUESTION FIVE

How is Physical Science educators encouraged to improvise simple LTSM, where possible, for their lessons?

On the question of improvisation of Physical Science LTSM by educators, the responses were that although encouragement is given, very little improvisation of LTSM is done by educators for different reasons. Some educators indicated that they could not do it because of lack of time, lack of basic materials, or often lack of skills to do the work.

In order to improvise learning materials of good quality, educators should have the following skills and understanding:

- Understand the curriculum framework as a whole at a level that would inform the conceptual design of the learning programme;
- Be an expert in the content, concept and skills outcomes of each learning programme at each grade level;
- Have access to substantial resource materials;
- Master the design of a learning programme in a way that answers progression of concepts, content and skills outcomes in the mind of the learner by giving due attention to assessment standards;

© University of Venda

University of Venda
Creating Future Leaders

- Be able to graphically illustrate materials (pictures, graphs and maps).
- Have the computer, printer, photo-copier and other resources available for the physical production and reproduction of the materials (DOE 2000:11).

These skills are what the majority of educators do not have and thus require assistance from Curriculum Advisers in the form of in- service training.

It is important to indicate that the situation of poor attempt to improvise simple Physical Science LTSM by educators needs serious and urgent attention starting from pre-service training and later during in-service training.

5.4 CONCLUSION

This chapter summarised responses to the research question formulated for this study. The responses captured constitute the main thrust of the study and provides highlights of the lessons learned. It is out of these responses that conclusions can be drawn and recommendations made for the solution of the research problem.

On the basis of these responses, the researcher therefore came up with recommendations outlined and discussed in the next chapter in order to improve the unacceptable situation of poor provision and utilization of Physical Science LTSM in Vhembe District Schools, as well as in all other schools in Limpopo Province which has similar conditions.

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

University of Venda
Creating Future Leaders

CHAPTER SIX

SUMMARY, MAJOR CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY

In the past, the education system in South Africa was largely content-based and teacher-centred. The past system was characterized by rigid divisions between 'academic' and 'applied', between 'theory' and 'practice' and between 'knowledge' and 'skills'. There was usually a gap between education and training in theory and what happens in practice. It is true that education and training are inseparable but in practice there is usually a difference between education in theory and training in practice. With the ushering in of democracy in South Africa in 1994, the new system of education sought to correct the imbalances of the apartheid system. The new system of education seeks to bridge the said gap between education and training. Education is now aimed at lifelong learning and equipping learners with appropriate skills required to confidently and creatively respond and rise to the challenging social, political and economic environment.

It is on the basis of this background that the Ministry of Education in South Africa decided to commit itself to an outcomes-based education approach to learning and teaching. Unlike the previous system of education, the outcomes-based approach seeks to elevate the learner to the centre of learning activities while the educator becomes the facilitator of the process. With the new approach to education the Ministry of Education seeks to transform the separate and distinct areas of learning in schools and colleges to an integrated approach to education and training. For this ideal situation to be realised, the Ministry of Education should provide an enabling environment.

Learning areas, such as the Natural Sciences, which require a significant amount of hands-on experience, should be provided with the relevant materials, equipment and facilities. Without these resources, the teaching and learning of natural sciences would become more theoretical than practical. It is for this reason that

© University of Venda

University of Venda
Creating Future Leaders

this study was conducted in order to investigate the provision and utilization of learning and teaching support materials when teaching and learning natural science, in particular Physical Science at FET level.

The study set out to achieve the following objectives:

- To carry out a review of literature in order to establish the theoretical base for this study, and examine scholarly views on the significance of practical work, together with the role of the required science LTSM, in the teaching and learning of Physical Science at school level.
- To conduct a review of the Limpopo Department of Education Policy on provision of LTSM.
- To conduct an overview of actual provision of equipment and physical facilities at schools, with a view to establish the level of practical work in the teaching and learning of Physical Science in the province.
- To conduct a field study in order to examine the utilization of existing Physical Science LTSM by both learners and educators.
- To make recommendations on improvement of the policy on provision of LTSM to include science LTSM. Further recommendations will be on improvement of utilization of available science LTSM and other appropriate facilities.

In order to achieve the objectives and expectations of this study, the following research question was taken into consideration:

How is provision and utilization of learning and teaching support materials in Physical Science implemented in Limpopo Province schools?

The research question was sub-divided into the following sub- questions:

1. What is the view of scholars on the significance of practical work, including the role of LTSM, when learning Physical Science?

© University of Venda

University of Venda
Creating Future Leaders

2. How does the LDOE Policy on provision of LTSM meet the requirement of conducting practical work when teaching and learning Physical Science?

3. How are equipment for practical work and basic physical facilities such as gas, water, and electricity supplied to schools offering Physical Science?
4. How are educators trained or at least orientated to effectively utilize the available LTSM?
5. How are science educators encouraged to improvise simple LTSM, where possible, for their lessons?

A literature and documentary review conducted contributed to the study by emphasising the significance of science LTSM in the study of Physical Science. The review indicated that without availability and utilization of the required materials and equipment curriculum implementation cannot take place effectively. The review further indicated that the availability of learning materials influences what goes on in the classroom when studying Physical Science, since sciences cannot be successfully taught at school level without a certain minimum amount of equipment and materials.

The empirical research of this study took place at 55 schools in the Vhembe District of the Department of Education in Limpopo Province. The participants were 1252 Grade 12 Physical Science learners, 44 Grade 12 Physical Science educators and 3 Curriculum officers. Data was collected through questionnaires completed by both learners and educators. Further data collection was done through interviews conducted with curriculum officers. Presentation of results and interpretation of data was divided into three major sections, namely, educator's responses, learner's responses and curriculum officer's responses. The sections were further sub-divided into two focus areas of this study, namely, provision and utilization of science LTSM.

© University of Venda

University of Venda
Creating Future Leaders

In concluding the summary of the study it needs to be pointed out that throughout the study several conclusions and recommendations were made and sometimes implied and that the following sections 6.2 and 6.3 deals with major conclusions and recommendations thereof.

6.2. MAJOR FINDINGS AND CONCLUSIONS

The major findings and conclusions of this study, which take into consideration both the theoretical and empirical components, are presented according to the criteria that guided both the collection and analysis of data.

.

6.2.1. Findings and conclusions pertaining to the LDOE Policy on provision of science LTSM

When reviewing the current LDOE Policy on provision of LTSM, it was found that, with the exception of text books and stationery, it left out most of the important LTSM which are required for doing practical work in Physical Science. According to the current policy document, LTSM is classified as Primary LTSM and Secondary LTSM. The department is so far providing schools with Primary LTSM, which caters mainly textbooks, prescribed books and stationery. The secondary LTSM, which includes provision of apparatus, is not receiving attention. The implication of this finding is that availability of science LTSM differ from one school to the other. Acquisition of science LTSM thus remains the responsibility of each schools management. Some schools are better resourced because of their advantaged past and some are fortunate to get some donations or are able to purchase them from school funds. The conclusion is that provision of science LTSM is not equitably allocated to schools. Unfortunately the schools that suffer the most as a result of this inequality of distribution of LTSM are the previously disadvantaged rural schools.

This finding is very significant in that the majority of schools in Limpopo Province are found in deep rural settings and cannot afford to provide themselves with required science LTSM without government intervention. This situation needs to be

© University of Venda

University of Venda
Creating Future Leaders

addressed without any further delay if the country is to produce the most desperately required engineers and scientists. The current policy on provision of LTSM in LDOE needs to be improved to include all the required LTSM.

6.2.2. Findings and conclusions pertaining to provision of science LTSM.

Almost all respondents to the questionnaires and interviews attested to the fact that there is a great shortage, if not complete absence in some cases, of science LTSM in most of the schools in the Province, with particular reference to schools in Vhembe district. Further to the shortage of learning and teaching support materials, the research revealed that there is also a serious shortage of Physical Science laboratories (63, 6% of educators indicated that they had no Physical Science laboratory at their schools); Computer laboratories (90, 9% of the educators had no computer laboratory at their schools) and Library Centres (84, 1% of the educators indicated that they had no Library Centres at their schools). It was also found that the few laboratories and media centres that are available are standing almost empty and some of them are even dilapidated.

These findings are very acute since they affect the effective teaching and learning of Physical Science in such schools. As a consequence, only a few schools, where the possibility exists and are fortunate to have resourceful educators, resort to taking their learners to nearby Education Multi-Purpose Centre (EMPC) or Science Centres for practical work. Some schools, also very few of them, are fortunate to be near better resourced schools and are able to borrow equipment in order to conduct at least the prescribed experiments. It should also be indicated that the shortage of the required science LTSM at the majority of schools as already indicated, goes to an extent of hampering the conducting of the identified compulsory experiments according to the continuous assessment (CASS) policy by such schools.

© University of Venda

University of Venda
Creating Future Leaders

Based on the findings of this study, the problem of shortage of science LTSM at schools and the shortage of the enabling science infrastructure is so massive that it requires thorough planning and strategic intervention by the LDOE as soon as possible.

6.2.3. Findings and conclusions pertaining to utilization of LTSM

The findings of the study show that utilization of LTSM at schools is very minimal due to a shortage or complete absence of the required resources, particularly at rural schools. The required resources include both human and physical, that is, educators who are suitably qualified and the availability of resources such as Physical Science laboratories. There are instances where the available LTSM remain in their delivery boxes because of fear of the educator to open and utilize them. Of the educators 75% indicated that they did not attend any in-service training workshops, where they could be assisted in handling some of the apparatus in doing practical work. The research has shown that the majority of the educators now teaching Physical Science at Grade 12 level are not adequately qualified to teach it. Of the educators 59% teaching Physical Science at Grade12 level in the sample only had a Grade 12 academic qualification. Such educators are at the level of the learners they teach, which is not supposed to be the case. Educators should command more knowledge and information than their learners.

The implication of these findings is that Physical Science is not effectively taught. Learners are not made to receive the proper understanding of science concepts. Because of the lack of appropriate skills and non-availability of science LTSM to do practical work, educators resort to that with which they are familiar, the chalk and the talk method. A further implication is that with this cohort of educators even if the required science LTSM where to be supplied to schools, they would not be utilized effectively without prior in-service training.

The situation of the lack of adequate utilization of science LTSM due to shortage of the required resources as described above is very significant and it therefore requires serious and immediate attention. This situation is also exasperated by the

© University of Venda

University of Venda
Creating Future Leaders

fact that the few qualified science educators tend to move away from rural areas in favour of urban areas. The results thereof are that unqualified educators remain in charge of teaching Physical Science at those rural areas. The important point to note is that the sample used in this study represented rural, peri-urban, and urban schools. Only 11,6% of the educators involved in this survey were from urban areas, whereas 88,4% were from rural areas. Limpopo Province as a whole is mostly rural, and that is the reason why most of the educators in this study are from rural areas.

6.3. RECOMMENDATIONS

Based on the major findings and conclusions arrived at in 6.2, the researcher recommends the following model for the provision and utilization of Physical Science in Limpopo Province schools(see appendix I).

The main objective of the model is to create a conducive Science Education environment in Limpopo Province schools. In order to achieve this objective the following should be taken into consideration:

- Improvement of the LDOE policy on provision and utilization of LTSM to include science LTSM as discussed below.
- District to come up with an effective implementation plan for the provision and utilization of science LTSM
- School Management Team to support the effective teaching and learning of Physical Science.

The model comprise of three main components , namely : Provision of science LTSM; Utilization of science LTSM and Practical work done by both learners and educators. Each component is discussed in more detail below.

© University of Venda

University of Venda
Creating Future Leaders

.3.1. Provision of Physical Science LTSM and resources.

The following policy implications may be inferred from the findings of the study. The current LDOE Policy on provision of LTSM needs to be more comprehensive. The variation in the quantity of resources in schools surveyed gives rise to the following recommendations:

- There is need to improve the equity of provision and distribution of educational materials and facilities in schools for the teaching and learning of Physical Science throughout the Province, especially in schools in rural locations.

- Funding for science LTSM require attention. There is need for a definite policy on the funding of Physical Science in secondary schools such that minimum standards or financial provision are set in terms of unit allocation per learner. The same approach which is currently done with the provision of textbooks in the Province is what is recommended here for provision of science LTSM.

- The production of low-cost science teaching equipment for schools is recommended. This is regarded as an answer to the problem of the supply of equipment for many developing countries. Ideally, low-cost equipment production uses local technical knowledge and local materials from the environment, and can easily be suited to local needs. Educators can participate in the design and development of the items, thus, more closely relating the proper use of the apparatus to the curriculum. The purchase of already produced low-cost equipment is recommended, as well as promoting the idea of making low-cost equipment by science educators in their schools.

© University of Venda

University of Venda
Creating Future Leaders

- Well equipped laboratories enhance the teaching and learning of science subjects. Heads of schools and science departments should strive to maximize the use of existing laboratories in their schools. The provision of laboratories and laboratory equipment need serious and urgent attention by the department. Where these are not yet in place it is recommended that at least one room with flat working surfaces, on which practical work can be done, be set aside for group work at every school. Improvising by using locally available material should be emphasised to sustain activities in a laboratory. An effective system of ordering, apparatus and consumables, be introduced, both for initial provision of equipment and replenishment.

- Besides well equipped Physical Science laboratories, there is a need for other infrastructure which enhances the teaching and learning of Physical Science, such as: Computa Laboratories; Media and Library Centres and Audio- visual aids rooms. These infrastructures should be provided to a school in order to ensure effective teaching and learning of science.

- For Physical Science laboratories to function efficiently, the following services should be provided: gas, water and electricity. These services are needed to ensure effective utilisation of some of the science LTSM without which they cannot be utilised.

- It is further recommended that schools in the neighbourhood of an Education Multi-Purpose Centre (EMPC) should form a cluster and use the centre for Physical Science practical work. The department should make sure that the centre is fully equipped with all the required LTSM, particularly those required for the Grade 12 Physical Science Continuous Assessment (CASS) prescribed experiments. Annual stock-taking should take place at such centres in order to ensure proper maintenance and handling of the materials and replenishment of the consumables.

© University of Venda

University of Venda
Creating Future Leaders

- The study found out that there is a great shortage of science educators at the secondary school level, and that the few who are there , have to be shared by a large number of learners which puts a heavy workload on them. The few science educators who are there should be evenly distributed so that they will not be concentrated in only a few schools while others lack experienced ones. The situation of urban schools having better and more experienced educators as compared to rural schools needs to be attended to. Rural allowance is therefore recommended as an incentive to encourage suitably qualified and experienced educators to work in rural schools. Only qualified and experienced science educators should be encouraged to handle primary school learners in order to build a good and strong foundation for them. It is too late to start emphasising quality teaching at FET level when strong foundation was not done at primary school level.

- Provision of some of the simple science LTSM can be done through improvisation by both educators and learners. Both educators and learners, if given guidance and training, can provide some simple LTSM for use during their lessons.

6.3.2 Utilization of Physical Science LTSM

For the effective and efficient utilization of the available Physical Science LTSM purchased by the school, LDOE or donated by NGOs, the following strategies are recommended:

- It is strongly recommended that educators who are still going through pre-service training should receive adequate training on effective utilization of science LTSM. They should also be trained on how to improvise simple LTSM from local resources ,to be used during their lessons.

© University of Venda

University of Venda
Creating Future Leaders

- It is recommended that Physical Science Curriculum Advisers should conduct regular in-service training workshops for science educators in order to re-orient them on their teaching methodologies and acquaint them with the use of new chemicals and new equipment so that they are able to sustain the interest of all learners. This approach will give capacity to educators who were not exposed to sufficient practical work during their pre-service training, or whenever there are supplies of new materials. Curriculum Advisers should also give guidance and assistance to science educators so that they are able to improvise simple LTSM for their lessons.

- It is further recommended that LDOE introduces a Continuing Professional Development (CPD) programme which will offer in- service training to educators, particularly science educators. In order to provide adequate and intensive training, it is recommended that educators be given longer periods of training unlike the one or two day's workshops which have proved to be insufficient. If educators are taken out for a period as long as a semester then it is recommended that they be replaced by temporary educators. This approach may sound inconceivable and expensive, but, if we are to bring about meaningful change to the poor quality of the majority of Physical Science educators (in this study 59% only had Grade 12 as their highest academic qualification), we need to sacrifice somehow. The programme will have to be accredited by one of the Universities to ensure quality and credibility. The trained educators when they go back to their schools must be able to discharge their duties with much more confidence than before. Training should include ample time for practical work so that they will be able to conduct all the experiments that are prescribed in the different FET syllabi. They should be able to utilize all the provisioned LTSM

UNIVEN LIBRARY
Library Item : 20103495

© University of Venda

University of Venda
Creating Future Leaders

6.3.3 Practical work by both learners and educators

When provision and utilization of science LTSM is done as discussed in 6.3.1 and 6.3.2 above, practical work by both learners and educators will be ensured.

The main focus of provision and utilization of science LTSM is conducting of practical work by both learners and educators when studying Physical Science. Through out this study, it has been indicated that practical work enhances the process of learning.

6.3.4 Recommendations for further studies

After conducting a study on provision and utilization of Physical Science LTSM in LDOE schools, the following study areas for future investigations are recommended:

6.3.4.1. The impact of utilization of Physical Science LTSM on learner performance. The focus for this study would be to establish the impact of utilization of science LTSM on actual learner's performance in the learning of Physical Science.

6.3.4.2. Training of Physical Science educators on the utilization and improvisation of LTSM. The focus of this study would be to investigate training of educators both during the pre-service and in-service periods, on the effective utilization and improvisation of LTSM.

© University of Venda

University of Venda
Creating Future Leaders

BIBLIOGRAPHY

Armer, M. (1973) Methodological problems and possibilities in comparative Research. In Armer, M. and Grimshaw, A.D. (Eds). Comparative Social Research: Methodological Problems and Strategies. London: John Wiley and Sons.

Ausubel, D.P. (1963) The psychology of meaningful verbal learning. New York: Grune and Stratton.

Ausubel, D.P. (1989) Educational psychology: A cognitive view. New York: Holt, Reinhart and Winston.

Baird, J.R. (1988) The importance of reflection in improving science teaching and learning. Journal of Research in Science Teaching, 28 (2), 163-182

.

Bayona, E.L.M. (1995) Curriculum Design and development. The role of the teacher, Print Consult: Botswana.

Bell, J. (1993) Doing your research project: A Guide for first time researchers in education and Social Science. Second Edition. Open University Press. Celtic Court. 22 Ballmoor. Buckingham.

Bellamy, R., Whitaker, H., and White, B. (1978) Teacher attitudes toward non-print media. Frankfurt: Kentucky State Department of Education. (ERIC Document Reproduction Services No. ED174- 197).

© University of Venda

University of Venda
Creating Future Leaders

Bennett, J. (2003) Teaching and Learning Science. A guide to recent research and its applications. Continum. London. New York.

Bently,D., and Watts, M.(1989) Learning and teaching in school science : Practical alternatives. Milton- Keynes: Open University Press.

Bogdan, R.C. and Biklen, S.K. (1998) Qualitative Research for Education: An Introduction to Theory and Methods. London: Allyn and Bacon.

Bonwell, C.C., and Eison, J.A. (1991) Active Learning: Creating Excitement in the Classroom, ASHE-ERIC Higher Education Report No.1. The George Washington University, School of Education and Human Development, Washington, DC

Bradley, D. (2005) Practicals in Science Education: A study of the Theoretical Bases, Rationale, and Implementation of Practicals in Junior Secondary. Science Education. Science and Mathematics Education Centre. Australia.

Bradley, J.D. (1994) Pre-service teacher education and high school practical work. University of the Witwatersrand, Johannesburg, South Africa.

Bradley, J.D. and Smith, C. (1994) Pre-service Teacher Education and High School Practical work. Upgrading and Strengthening Practical Work in South African Schools. University of the Witwatersrand. Johannesburg, South Africa.

© University of Venda

University of Venda
Creating Future Leaders

Bradley, J.D. and Smith, C.T. (1994) Upgrading and Strengthening Practical Work in South African Schools. Pretoria: FRD: 95-107.

Burns, N., & Grove, S.K. (2001) The practice of nursing research: conduct, critique and utilization. (4th edition). Philadelphia: WB Saunders.

Caillods, F., Gottelman-Duret, G., and Lewin, K. (1997) Science Education and Development: Planning and Policy Issues at Secondary Level. Paris: UNESCO.

Chadwick, A. (1979) Practical Work in Physics in Developing Countries. Physics Education, 14: 334-335.

Charlene, C. and Chiarelott, L. (1990) Teacher Education for Effective Science Instruction – A social cognitive perspective. Journal of Teacher Education, 41(1): 49-58

Chester, M., and Fox, R. (1966) Role playing methods in the classroom. Chicago: Science Research Association

Chisholm, L. (2003) The state of curriculum reform in South Africa: The issue of curriculum 2005. Cape Town: HSRC Press

Chisholm, L. (2005) The state of South Africa's Schools. State of the nation 2004-2005 report.

© University of Venda

University of Venda
Creating Future Leaders

Cohen, L., Manion, L. and Morrison, K. (2005) Research methods in education. 5th edition. Canada: Routlegde Falmer

Cohen, L., and Warior, L. (1986) Research methods in Education. Second edition. London Croom Helm.

Collette, A.T. (1973) Science teaching in the secondary school. A guide for Modernizing Instruction. Allyn and Bacon, Inc. Boston. Syracuse University.

Conway, R.G., Mendoza, E., and Read, F.H. (1963) The seminar method of teaching experimental physics. Bulletin of the Institute of Physical Society, 14:397-400

De Wet, J.J., Monteith, J.L., deK, and Van Der Westhuizen,G.J. (1981). Opvoedende leer. Pretoria: Butterworth.

Dekker, E.I., and Lemmer, E.M.(1994)Critical issues in modern education. Durban: Butterworths Publishers

Department of Education (1997) Outcomes Based Education in South Africa. Background information for educators.

© University of Venda

University of Venda
Creating Future Leaders

Department of Education (DOE) (1997) Outcomes Based Education in South Africa. Background information for educators.

Department of National Education (1997) Curriculum 2005: Discussion document. Pretoria.

Department of Education (DOE) (1998) Education White Paper 4 on FET. Pretoria.

Department of Education (DOE) (2000) National Curriculum Framework for Further education and training. Draft document

Department of Education (DOE) (2002) Revised national curriculum statement Grades R-9 (schools). Pretoria: DOE

Department of Education (DOE) (2003) Education statistics in South Africa at a glance in 2001. Pretoria: DOE

Department of Education (DOE) (2006) National Curriculum Statement (NCS). Pretoria: DOE

Descy, D.E. (1992) First Year elementary school-teacher's utilization of instructional media. International Journal of Instructional Media, Vol. 19, Issue 1.

De Vos, A.S. (Ed.). (2001) Research at grassroots: A primer for the caring professions. Pretoria: J.L. van Schaik Publishers

© University of Venda

University of Venda
Creating Future Leaders

De Vos, A.S. (2002). (Ed) Research at Grass Roots: for the Social Sciences and Human Service Professions. Pretoria: Van Schaik.

De Vos, A. S., Strydom, H., Fouche, C. B., Delport, C.S.L. (2005) Research at grass roots for the social sciences and human service professions. 3rd ed.: Van Schaik

Doige, M. (1994) Looking back, looking forward – the plight of the Sowetan biology teacher. Paper presented at the 14th National Convention on Mathematics and Natural Science Education, University of Cape Town.

Driver, R. (1989) The construction of scientific knowledge in school classrooms. In R. Millar (Ed.), Doing science in science education (pp.83-106). New York: Falmer Press.

Driver, R., Asoko, H., Leach, J., Mortimer, E., and Scott, p. (1994) Constructing scientific knowledge in the classroom. Educational Reseacher,23(7):5-12.

Education Policy Consortium (EPC) (2004) Participating data: Description, analysis and presentation. Nelson Mandela Foundation Rural Schools Project, Volume A-B.

Edwards, J., and Power, C. (1990) Role of laboratory work in a national junior secondary science project: Australian Science Education Project (ASEP). In E. Hegarty- Hazel (Ed), The student laboratory and the science curriculum. London, Routledge

© University of Venda

University of Venda
Creating Future Leaders

Elton, L (1987) Teaching in higher education: Appraisal and training. London: Kogan Page Ltd

Fairbrother, R.W. (1986) Perspectives on assessment of practical work: Physics Education, 21, 200-203

Fay, P.J. (1931) The history of chemistry teaching in American high schools. Journal of Chemical Education, 8(8), 1533-1562.

Female Education in Mathematics and Science in Africa (FEMSA) (1997) Resources and facilities for Teaching and Learning of Mathematics and Science School. Research document.

Fensham, P.J. (1981) Heads, hearts and hands-future alternatives for science education. Australian Science Teachers' Journal, 27(1), 53-60.

Fensham, P.J. (ed.) (1988) Development and Dilemmas in Science Education. Falmer Press, London

Fensham, P.J. (2005) Interest in science: The urgent international challenge in science education and new directions to meet it. Paper presented at the CONSTAT: Conference of Science Teachers Association of Tasmania, Hobart.

Fensham, P.J., Gunstone, R.F., and White, R.T.E. (1994) The content of science: A constructivist approach to its teaching and learning. London: The Falmer Press.

© University of Venda

University of Venda
Creating Future Leaders

Fraentel, J.R. and Wallen, N.E. (1993) How to design and evaluate research in education. Second Edition. New York, McGraw-Hill.

Gagne,R.M.(1963) The learning requirements for enquiry. Journal of Research in Science Teaching, 1(2):144-153.

Gagne,R.M.(1965)The psychological basis of science: A process approach. Washington: Ginn.

Gallager, J.J. and Tobin. (1987) Teacher Management and student engagement in high school science. Science education, 71(4): 535-555.

Garnett, P.J. and Tobin, K. (1988) Teaching for understanding: Exemplary Practice in High School Chemistry. Journal of Research in Science Teaching, 26(1): 1-14.

Gee, B. and Clackson, S. (1992) The origin of practical work in the English school science curriculum. School Science Review, 73(265), 79-83.

Gilbert, J.K. (1993) Models and modelling in science education. Hatfield, Horts: Association for Science Education.

Goddard, W., & Melville, S. (2001) Research methodology: an introduction. (2nd edition). Lansdowne: Juta & Co, Ltd.

© University of Venda

University of Venda
Creating Future Leaders

Goodrum, D., Hackling, M.W., and Rennie, L.J. (2001) The status and quality of teaching and learning of science in Australia schools: Commonwealth of Australia.

Gordon, A. (1995) Curriculum framework for general phase of education. ANC centre of Education. Policy Development.

Gott, R. and Duggan, S. (1995) Investigative work in the Science Curriculum. Buckingham: Open University Press.

Grant-Lewis, S. and Motala, S. (2004) Education decentralisation and the guest for equality, quality and democracy. Pretoria: HSRC Press.

Hackling, M.W. (1998) Working scientifically: Implementing and assessing open investigation work in science. Perth: Education Department of Western Australia.

Hackling, M.W., Goodrum, D., and Rennie, L.J. (2001) The state of science in Australian secondary schools. Australian Science Teachers'Journal, 47(4):6-17.

Harley, K. and Wedekind, V. (2004) Political change, curriculum change and social formation 1990-2004. Pretoria: HSRC Press.

© University of Venda

University of Venda
Creating Future Leaders

Hegarty-Hazel, E. (ed.) (1990) The Student Laboratory and the Science Curriculum. London: Routledge.

Henning, E., van Rensburg, W. and Smit, B. (2004) Finding your way in qualitative research. Pretoria: Van Schaik

Hewson, P.W. (1980) Learning and teaching science. South African Journal of Science, 76:397-403.

Heystek, J., and Louw, E.M. (1999) Parental participation in school activities- is it sufficient? South African Journal of Education, 19(1):21, 24-27.

Hodson, D. (1988) Experiments in science and science teaching. Educational Philosophy and Theory, 20, 53-66.

Hodson, D. (1990) A critical look at practical work in school science. School Science Review, 70(256), pp 33-40.

Howie, S.J. (1999). Mathematics and Science Performance in Grade 8 in South Africa TIMSS-R, South Africa.

Howie, S.J. (January, 2001) Third International Mathematics and Science Study Report (TIMSS-R)

Hutchinson, S. (2003) Safe science on the nose with teachers too. The Australia, p.3.

© University of Venda

University of Venda
Creating Future Leaders

Jeans, J.H. (1947) The growth of physical science. Cambridge: The University Press.

Jenkins, E. (1998) The schooling of laboratory science. London: Routledge.

Jones, A.T., Simon, S.A. Black, P.J., Fairbrother, R.W., and Watson, J.R. (1992) Open Work in Science: Development of Investigations in Schools. Hatfield: Association of Science Education.

Keys, C.W., Hand, B., Prain,V., and Collins, S.(1999) Using the science writing heuristic as a tool for earning from laboratory investigations in secondary science. Journal of Research in Science Teaching, 36(10):1065-1084

Khosa, N. and Mbokota, G. (2002). Mid-term Evaluation of the Mahlahle Project, Vo.2. Secondary Schools Final Report. Joint Education Trust, Johannesburg

Kimchi, J., Polivka, B., & Stevenson, J.S. (1991) Triangulation operational definition. Nursing Research, 4(6): 364-366.

Kirschner, P.A. (1991) Practicals in higher science education: A study of the objectives and end-terms for practicals in distance and traditional educational settings. Heerlen: Centre for Educational Technology and Innovation, Open University of the Netherlands

© University of Venda

University of Venda
Creating Future Leaders

Klainin, S. (1988) Practical Work and Science Education I. Falmer Press, London

Kolobe, L. (1998) Introduction of RADMASTE Microchemistry kits in disadvantaged schools in Gauteng: a case study. MSC research report. University of the Witwatersrand, Faculty of Science, Johannesburg

Kreitler, H., and Kreitler, S. (1974) The role of experiment in science education. Instructional Science, 3:75-88.

Kutame, A.P (1997) Researching sensitive issues in education in the Limpopo Province of South Africa. Dissertation for the degree of Master of Education, University of Stellenboch.

Kutame, A.P. (2004) Researching sensitive issues in education in the Limpopo Province of South Africa. Dissertation for the degree of Doctor of Philosophy, University of Stellenbosch.

Leach, J. and Paulsen, A. (eds) (1999) Practical work in Science Education; Recent Research Studies. Copenhagen: Roskilde University Press.

Lemlech, J.K. (1994) Curriculum and Instructional Methods for the Elementary and Middle School. Third Edition. Macmillan Publishing Company

Lerch,R.D. (1971) An exploratory study of objective attainment in the divergent physics laboratory. Unpublished Doctoral Thesis, New Mexico State University.

© University of Venda

University of Venda
Creating Future Leaders

Lewy, A. (1977) Planning the school curriculum. Fundamentals of educational planning. UNESCO: International Institute for educational Planning.

Lochard, J.D. (1983) International communication – the need for a Clearing House and information network. In Lowe, N.K. (Ed) (1983). New Trends in school science equipment. UNESCO, Paris.

Lock, R. (1988) A history of practical work in school science and its assessment, 1860-1986. School Science Review, 69(250), 115-119.

Lynch, P.P. (ed.) (1994) Upgrading and Strengthening Practical Work in South African Schools. Pretoria: FRD.

Macdonald, M.A. and Rogan, J.M. (1987) Innovation in South African Science Education: Science Teaching Observed. Science Education: Science Education, 72: 225-236

Maduemezia, A. (1994) Low Cost Equipment: Strategies for Production, Low Cost Science Teaching Equipment 2. A Report of a commonwealth Regional seminar/workshop in Dar es Salaam, Tanzania. Commonwealth Secretariat, London

Malcolm, C. (1999) Making Groupwork Work. Johannesburg: RADMASTE Centre, University of the Witwatersrand.

© University of Venda

University of Venda
Creating Future Leaders

Malcolm, C., Long, C., Chamberlain, E. (1999) Making Continuous Assessment Work, A Guide for Teachers and School Principals. Johannesburg: RADMASTE Centre, University of the Witwatersrand

.

Manana, L.K. (1994) Alternative strategies to the formal laboratory. Upgrading and strengthening practical work in South African schools. University of the Witwatersrand, Johannesburg, South Africa.

Mangena, M. (2001). Paper delivered to the Northern Province Council of Churches School Support Programme Seminar in Pietersburg.

Mason, C. (1992) Concept Mapping: A tool to develop reflective science instruction. Science Education, 76:51-63.

McMillan, J. H., and Schumacher, S. (2001) Research in education: A conceptual introduction. 4th ed. New York: Longman

McMillan, J. H., and Schumacher, S. (2001) Research in education: A conceptual introduction. (5th Edition). New York: Longman, Inc.

McNeil, J.D. (1999) Curriculum. The teacher initiative. Second Edition. University of Califonia, Los Angeles.

McNiff, J; Lomax, P and Whitehead, J. (1996) You and Your Action Research Project. London: Routeledge.

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

University of Venda
Creating Future Leaders

Miller, R., and Driver, R. (1987) Beyond processes. Studies in science education, 14, 33-62.

Mitman, A.L., Mergendoller, J.R., Packer, M.J., and Marchman, V.A. (1984) Secondary Science and Mathematics Improvement Program (report). Far West Laboratory for Educational Research and Development, San Francisco.

Molstad, J.A. (1974) Selective review of research studies showing media effectiveness: A primer for media directors. AV Communications Review, 22: 387-407

Mouton, J. (2001). How to Succeed in Your Masters and Doctoral Studies: A South African Guide and Resource Book. Pretoria: Van Schaik.

Moyer, A.E. (1976) Edwin Hall and the emergence of the laboratory in teaching physics. Physics Teacher, 96-103

Musar, A. (1993) Equipment for Science Education: Constraints and Opportunities. Washington DC: The World Bank.

Myeko, M.S. (2000) Parental involvement in education at senior secondary schools in the Herschel district of the Eastern Cape Province. Unpublished M. Ed Script. Bloemfontein: University of the Free State

Naik, K. (1994) Provision of laboratories, services, equipment and material resources. University of the Witwatersrand, Johannesburg, South Africa.

© University of Venda

University of Venda
Creating Future Leaders

Nemudzivhadi, N.E. (2003) Paper read when accepting science equipment donation from both ESCOM and SAASTA. Thengwe Secondary School: Vhembe District.

Neuman, W.L (1994). Social research methods: Qualitative and quantitative approaches. (2nd Edition). Boston: Allyn & Bacon.

Novak, J.D. (1978) An alternative to Piagetion psychology for science and mathematics education. Studies in Science Education, 5:1-30

Novak, J.D. (1988) Learning science and the science of learning. Studies in Science Education, 15, 77-101.

Novak, J.D. (1990) Concept mapping: A useful tool for science education. Journal of Research in Science Teaching, 27: 937-949.

Novak, J.D. (1992) Concept Mapping. Paper presented at the Research Seminar on Concept Mapping, University of Jyvaskyla, Finland.

Novak, J.D. (1998) Learning, creating and using concept maps as facilitative tools in schools and corporations. Mahwah, NJ: Erlbaum.

Novak, J.D., Gowin, B., and Johansen, G. (1983) The use of concept mapping and knowledge vee mapping with junior high school science students. Science Education, 67: 625-645.

© University of Venda

University of Venda
Creating Future Leaders

National Research Foundation (NRF) (2000) Human resource statistics. Human resource development, South Africa.

Ntombela, M. (1994) Curriculum constrains impacting on practical work in high school science teaching in South African schools. Upgrading and strengthening practical work in South African schools: Johannesburg, University of Witwatersrand.

Odubunmi, O. and Balogum, T.A. (1991). The effect of laboratory and lecture teaching methods on cognitive achievement in integrated science. Journal of research in science teaching, 28: 220.

Ogunniyi, M.B. (1986) Two Decades of Science Education in Africa Studies in Science Education, 70(2): 111-122.

Okebukola, P.A. (1986) The problems of Large Classes in Science: An Experiment in Co-Operative Learning. European Journal of Science Education, 8(1): 73-77.

Onwu, G.O.M. (2000). Learning difficulties in science: Capacity Limitation or strategy deficit? Inaugural address.

Ornstein, A.C. and Lesley II, T.J. (2000) Strategies for effective teaching. McGraw-Hill Higher Education. Third Edition.

Osborne, R., and Freyberg, P. (1985) Learning in science: The implications of children's science. Auckland: Heineman.

© University of Venda

University of Venda
Creating Future Leaders

Owen, J. (1977) The impact of the Australian Science Education Project on schools: Australian Council for Educational Research, Victoria

Parkinson, J. (2003) Improving Secondary Science Teaching. London: Routledge Falmer.

Passe, J (1999) Elementary School Curriculum. Second Edition. McGraw-Hill College.

Petje, M. (2002) Providing Education in South Africa. The Challenges: A paper presented at the Service Delivery Learning Academy. Emnotweni Conference Centre, Nelspruit, Mpumalanga.

Piaget, J. (1950) The psychology of intelligence, London : Routledge and Kegan Paul

Piaget, J. (1964) Cognitive development in children: Development and learning. Research in Science Teaching, 2, 176-186

Pomario, W. (1998) Physics I and II. Sandton: Heinemann.

Rand Daily Mail, (January 14, 1994). Page 2.

Republic of South Africa (RSA) (2003) Intergovernmental fiscal review. Pretoria: National Treasury.

© University of Venda

University of Venda
Creating Future Leaders

Rubin, A and Babbie, E. (1992). Research Methods for Social Work. California: Brooks/Cole.

Sivan, A., Wong Leung, R., Woon, C., and Kember, D. (2000) An Implementation of Active Learning and its Effect on the Quality of Student Learning Innovations in Education and Training International, 37(4): 381-389.

Slotwinski, J.S. (1997) Chemistry I and II. Sandton: Heinemann

.

Smeltzer, D.K. (1988) Media utilization and student-content teaching inventory: A correctional study of community college instructors. International Journal of instructional media, 15: 222-233

.

Smith, C.T. (1998) Topics in Science and Technology. Sandton: Heinemann.

Spargo, P. (1994) Procurement and maintenance of equipment for the teaching of the sciences. University of the Witwatersrand, Johannesburg, South Africa.

Stake, R.E. and Easley, J.A. (1978) Case studies in science education, (vols. 1 and2). Urban: Centre for Instructional Research and Curriculum Evaluation and Committee on Culture and Cognition, University of Illinois at Urbana-Champaign.

© University of Venda

University of Venda
Creating Future Leaders

Stainback, S. & Stainback, W. (1984) Broadening the Research Perspective in Education. Exceptional children, 50, 400-408.

Strauss, A. and Corbin, J. (1990) Basics of Qualitative Research: Grounded Theory Procedures and Techniques. London: Sage Publications.

Suchman, J.R. (1966) A model for the analysis of inquiry. In J. Klausmeier and C.W. Harris (Eds), Analysis of concept learning. New York: Academic Press

Summers, M.K. (1982) Science education and meaningful learning. School Science Reviews: 361-366

Tamir, P. (1976) How are laboratories used? Journal of Research in Science Teaching, 14, 311-316.

Tamir, P. (1977) How are laboratories used? Journal of Research in Science Teaching, 14: 311-316

Taylor, N., and Vinjevold, P. (1999) Getting Learning Right: Report of the Presidents' Education Initiatives (Joint Education Trust, Johannesburg).

Taylor, N., Muller, J. and Vinjevold, P. (2003) Getting schools working: Research and systemic school reform in South Africa. Cape Town: Pearson Education.

© University of Venda

University of Venda
Creating Future Leaders

Tobin, K. and Fraser, B.J. (1989): Barriers to Higher-Level Cognitive Learning in High School Science. Science Education, 73: 659-682

United Nations Educational, Scientific and Cultural Organisation (UNESCO) (1973) New UNESCO Source Book For Science Teaching. UNESCO, Paris.

Van der Stoep, F. and Van der Stoep, O.A. (1973) Didactic Orientation. Johannesburg: MacGrow-Hill Book Company

Vermaak, I. (1997) Evaluation of cost-effective micro scale equipment for a hands-on approach to chemistry practical work in secondary schools. PhD thesis. Johannesburg: University of the Witwatersrand, Faculty of Science

Vitta, P.B. (1979) The Physics Laboratory in Africa. Physics Education, 14: 336-340.

Vonkel, E.L and Asher, J.W. (1996). Educational Research. New Jersey: Englewood cliffs.

Vygotsky, L.S., Cole, M. and Cole(eds)(1978) Mind in society : the development of higher psychological processes, Cambridge, Mass, ; London : Harvard University Press.S

Warren, K. (1983) The Use of Low-Cost Material, Everyday Items and Locally-Constructed Apparatus for Teaching Integrated Science Teaching, 2, UNESCO, Paris

© University of Venda

University of Venda
Creating Future Leaders

Webb, P. and Raubeheimer, D. (1994) Strengthening and upgrading practical work in schools: A primary science response. University of Witwatersrand, Johannesburg, South Africa.

Wellington, J. (ed.) (1998) Practical work in Science: Which way now? London: Routledge.

Wellington, J. (2000) Teaching and Learning Secondary Science: Contemporary issues and
Practical Approaches. London. Routledge.

Woolnough, B.E. (1983) Exercises, investigations and experiences. Physics Education, 18, 60-63

Woolnough, B.E. (ed.) (1991) Practical Science. Buckingham: Open University Press.

Woolnough, B.E. (ed.) (1992) Practical Science. Open University Press, Milton Keynes, Philadelphia.

Woolnough, B.E., and Allsop, T. (1985) Practical work in Science. Cambridge: Cambridge University Press.

© University of Venda

University of Venda
Creating Future Leaders

APPENDIX A

Ref: 80426115
Enq: N.M. Rathando
Tel: 082 460 4692

P.O. Box 67
SHAYANDIMA
0945

10 February 2003

The Senior District Manager
Vhembe District of Education
Private Bag X2250
SIBASA
0970

REQUEST FOR PERMISSION TO CONDUCT RESEARCH AT SOME OF YOUR SECONDARY SCHOOLS

I am currently registered for PhD in Curriculum studies with the University of Venda for Science and Technology.

The topic of my research is:

"An investigation into the supply and utilisation of Learner Support Materials (LSM) in the teaching and learning of Natural Sciences at the FET level: The case of Limpopo Province."

I am thus making a request for permission to conduct research in some of your secondary schools. It is envisaged that the results of this study will assist in making recommendations for improvement in the study of Natural Sciences at our schools.

Trusting that my request will meet your favourable consideration.

Yours faithfully,

(N.M. RATHANDO)

© University of Venda

APPENDIX C

University of Venda
Creating Future Leaders

Enq: N.M. Rathando
Tel: 082 460 4692

P.O. Box 67
SHAYANDIMA
0945

10 February 2003

The Principal
_____
_____
_____

REQUEST TO CONDUCT RESEARCH AT YOUR SCHOOL

I am working on a research to meet a requirement for the PhD studies I am doing with the University of Venda for Science and Technology.

The aim of the research is to improve both the teaching and learning of Physical Science in our schools.

I have decided to focus my attention on grade 12 learners who are doing Physical Science as my target group and on arrival at your school I will select 24 learners by random sampling i.e. 12 boys and 12 girls who will be given a questionnaire to answer. I will further request your Physical Science educator also to respond to a questionnaire.

I intend visiting your school sometime during the period February to May 2003.

Your assistance and co-operation is acknowledged and thanked in advance.

Yours faihfully

(N.M. RATHANDO)

© University of Venda

University of Venda
Creating Future Leaders

LIMPOPO PROVINCE

DEPARTMENT OF EDUCATION

POLICY

Guiding the Development, Submission and Evaluation of

Learning and Teaching Support Material (LTSM)

JANUARY 2003

Copyright © The Directorate Curriculum Development of the Limpopo Province Department of Education

Corner of Biccard and Excelsior streets, Polokwane
Private Bag X9489, Polokwane, 0700

© All rights reserved. Apart from any fair dealing for the purposes of research, criticism or review as permitted under the Copyright Act, and non-profit educational programmes, no part of this policy may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, without permission from the Directorate Curriculum Development of the Limpopo Province Department of Education.

© University of Venda

University of Venda
Creating Future Leaders

INDEX

1.	INTRODUCTION	1
2.	PRINCIPLES UNDERPINNING THE POLICY	1
3.	DEFINITION OF TERMS	1
4.	THE ROLE OF THE PUBLISHERS AND OTHER STAKEHOLDERS	2
5.	THE PROMOTION OF LEARNING AND TEACHING SUPPORT MATERIALS	2
6.	NORMS FOR THE RELATIONS WITH PUBLISHERS AND OTHER STAKEHOLDERS	2
7.	SUBMISSIONS OF LEARNING AND TEACHING SUPPORT MATERIALS	2
8.	SUBMISSION FEES	4
9.	COMPOSITE TITLES	4
10.	RECEIVING SUBMISSIONS	4
11.	INVOLVEMENT OF TEACHERS IN THE DEVELOPMENT OF LTSM	4
12.	CRITERIA FOR THE APPOINTMENT OF SCREENERS	5
13.	THE APPOINTMENT OF SCREENERS	6
14.	CAPTURING DATA	7
15.	THE EVALUATION INSTRUMENTS	7
16.	THE SCREENING, EVALUATION AND SELECTION OF LTSM	8
17.	CONDITIONALLY APPROVED TITLES	9
18.	APPEALS	9
19.	INADEQUATE NUMBER OF SUBMISSIONS	9
20.	THE DRAFT CATALOGUE	10
21.	THE FINAL CATALOGUE	10
22.	MEDIUM OF SUBMISSION	10
23.	NORMS FOR THE DEVELOPMENT OF LTSM BY THE DEPARTMENT	10
24.	LTSM USED DURING PILOTING	10
25.	LTSM USED IN PROJECTS	10
26.	IRREGULARITIES	10
27.	THE ROLE OF THE EVALUATION COMMITTEES	11
28.	THE ROLE OF THE CURRICULUM DEVELOPMENT DIRECTORATE	11
29.	THE ROLE OF THE CHIEF EDUCATION SPECIALIST	12
30.	THE ROLE OF THE SENIOR MANAGER	12
31.	THE ROLE OF THE GENERAL MANAGER	12
32.	THE ROLE OF THE HEAD OF DEPARTMENT	12
33.	PROCUREMENT OF LTSM	12
	REFERENCES	13
	APPENDIX A	
	APPENDIX B	

© University of Venda

University of Venda
Creating Future Leaders

1. INTRODUCTION

Learning and Teaching Support Materials, a key feature of any education and training system, occupy a major place in curriculum development. This document is intended to guide all stakeholders in respect of the development, submission and evaluation of Learning and Teaching Support Materials and any arising appeals.

A comprehensive and complete policy document should ensure that submission, screening and selection are above suspicion and that the system cannot in any respect be manipulated.

2. PRINCIPLES UNDERPINNING THE POLICY

The Policy is underpinned by the following principles:

- The maintenance of impartiality and objectivity at all times during the submission, screening, selection and procurement process
- The just and equitable treatment of all interested parties
- The maintenance of standards
- The best interest of the Department
- Serving the needs of the learner

3. DEFINITIONS OF TERMS

3.1 Learning and Teaching Support Material (LTSM)

Learning and Teaching Support Materials (Primary and Supplementary) are prepared materials which structure and support learning and teaching. They can be prepared by teachers in schools, as well as by other educationists in Non-Governmental Organisations (NGOs), publishers and other institutions. LTSMs can be

- systematic complete self-contained programmes such as textbooks or computer software
- used by teachers to make up or supplement a structured programme of learning. (Czerniewicz et al, 2002: p20)

For the purpose of this Policy document, LTSM will be classified as follows:

Primary Learning and Teaching Support Material

- Teacher's Guide, Learner's book, Learner's work/activity book and Readers

Supplementary Learning and Teaching Support Material

- Reference books
- Readers
- Dictionaries
- Atlases
- Maps
- Wall charts, posters and flip charts
- Games and puzzles
- Audio cassettes
- Video cassettes
- Computer packages
- Models
- Apparatus
- Sets or packages

3.2 Manuscripts

These are typed versions of learners' textbooks, teachers' guides or resources submitted for publication.

© University of Venda

University of Venda
Creating Future Leaders

3.3 Final proofs

Final proofs for the purposes of this document will be defined as the last stage before the book or item per ISBN number goes into print. Artwork and diagrams are completed appropriately placed.

4. THE ROLE OF PUBLISHERS AND OTHER STAKEHOLDERS

4.1 The Department acknowledges that publishers and other producers of educational products will always have a role to play in the development and supply of Learning and Teaching Support Materials. Co-operation is therefore necessary between the Department, publishers and other stakeholders.

4.2 Developers of Learning and Teaching Support Materials must take into consideration:

- The purpose of the materials;
- The target users;
- What competencies or outcomes the user will achieve

5. THE PROMOTION OF LEARNING AND TEACHING SUPPORT MATERIALS

5.1 Only approved LTSM may be promoted.

5.2 Publishers and other producers of LTSM must obtain permission from the Senior District Manager's office to visit schools.

5.3 Publishers and other producers of LTSM may visit schools for purposes of conducting research or running promotional workshops after normal teaching hours.

6. NORMS FOR RELATIONS WITH PUBLISHERS AND OTHER STAKEHOLDERS

6.1 All communication between the Department and any publisher should be directed through the office of the General Manager Curriculum Development and Support. All communication should be in writing and could entail the following:

- Requests for submission of Learning and Teaching Support Material.
- Queries regarding the screening process.
- Report back to publishers in respect of recommended manuscripts.
- Appeals regarding screening.

6.2 Publishers and LTSM developers may not pay visits to officers in the Curriculum Development Directorate on matters relating to LTSM policies without the permission of the General Manager.

7. SUBMISSION OF LEARNING AND TEACHING SUPPORT MATERIALS

7.1. The office of the General Manager Curriculum Development (GMCD) will solicit submissions for Learning and Teaching Support Materials through the placement of an advertisement in a national newspaper. Letters requesting submissions will also be sent to all known producers of Learning and Teaching Support Materials.

7.2. The Department is under no obligation to evaluate LTSM simply on the grounds of the developing thereof by the publishing house on its own initiative. Submission must be made only after a formal request by the Department.

7.3. For evaluation purposes, Learning and Teaching Support Material should be submitted 18 months before implementation.

7.4. Publishers and producers of LTSM will be informed of the final submission dates 6 months in advance.

7.5. Producers of LTSM are expected to submit four copies of each title. Each title is screened and evaluated by three different screeners and the Curriculum Development Section retains a fourth copy for reference purposes.

7.6. The following must accompany the submission:

© University of Venda

University of Venda
Creating Future Leaders

- A cheque covering the submission fees, made out to Limpopo Department of Education. *The Department will not screen submissions without payment on delivery.*
- A disc with the details of all titles submitted using a Microsoft Excel spreadsheet (LPDE/LTSM/01) indicating the submission details according to the following fields: (see requirements, LPDE/LTSM/02, for the completion of this form)
  - ✓ Name of the Publisher
  - ✓ Grade
  - ✓ Learning Area/Programme or Subject
  - ✓ ISBN
  - ✓ Title
  - ✓ Author(s)
  - ✓ Language
  - ✓ Description
  - ✓ Price including VAT
  - ✓ Number of pages (where applicable)
- A printout of above information
- A written undertaking by publishers that the price will remain the same for a 12-month period after submission

7.7. Only final proofs or completed books are accepted.

7.8. If the submission is in the form of a final proof, the following additional information regarding the book or item per ISBN number must be fixed to the back of the cover page:

- Title
- ISBN number
- Author(s) (the identity of ALL those involved in the development of the specific LTSM)
- Publisher
- Learning area
- Language
- Price (VAT Inclusive)
- The type of paper that will be used in the eventual format;
- The type of cover material and binding that will be used;
- The colour of the illustrations in the final print
- The number of pages the printed book will consist of;
- The exact size of the pages
- The type and quality of consumable materials;
- The maximum price at which the books will be delivered and the expected annual escalation. However, the price will be subject to negotiation;

7.9. The above-mentioned information will be known to all potential developers or publishers with the understanding that

- failure on the part of the publisher to observe the above-mentioned requirements on submission of the manuscript; or
- failure to reveal in the prescribed submission letter the full identity of all those involved in the development of the specific book at the time of submission thereof

will lead to disqualification of acceptance for screening.

7.10. It is strongly recommended that publishers deliver submissions personally or send them by courier. Submissions per mail will not be accepted.

© University of Venda

University of Venda
Creating Future Leaders

8. SUBMISSION FEES

8.1 Submission fees are levied per title pack.

8.2 This fee may be amended as costs escalate, e.g. administrative costs. If submission fees are to be amended, the Head of Department must approve the amended fee.

8.3 All cheques must be made out to the Limpopo Province Department of Education.

8.4 The fees will be deposited and managed by the Limpopo Province Development Trust.

8.5 Surplus funds will be channelled into teacher development programmes for LTSM development.

9. COMPOSITE TITLES

9.1 Foundation Phase

The Foundation Phase (Grades R – 3) follows a holistic approach.

Where composite titles are submitted for screening, TEN copies of each title should be submitted. This allows for three screeners each from Numeracy, Literacy and Life Skills to evaluate the title, and one copy to be placed in the reference section of the Curriculum Development Directorate.

9.2 Intermediate and Senior Phase

Composite titles will not be accepted for other phases.

10. RECEIVING SUBMISSIONS

10.1 Submissions will be received by the Curriculum Development Sub-Directorate of the Limpopo Province of Education on predetermined dates.

10.2 Actual submissions are checked against the submission documents and requirements.

10.3 All forms and covering letters and other information are filed.

10.4 Submission details are downloaded on an MS Excel spreadsheet.

10.5 Cheques are received and recorded by the appointed official(s).

10.6 The submissions will be unpacked in the presence of the person submitting the Learning and Teaching Support Material on behalf of the producers to ensure that all the relevant detail and manuscripts are contained in the submission.

10.7 All titles are immediately organised according to Grade, Learning Area or Programme or Subject and language.

10.8 Incorrect submissions are followed up with publishers for correction.

10.9 Corrections are received from publishers and changes affected accordingly.

11. INVOLVEMENT OF OFFICIALS AND TEACHERS IN THE DEVELOPMENT OF LTSM

11.1 It is accepted as a general principle that the Department in the submission, screening and selection of LTSM, would strive to serve all interests in a respectable manner and to obtain the following during all processes:

- neutrality
- objectivity
- transparency
- justice and equity
- professionalism

© University of Venda

University of Venda
Creating Future Leaders

11.2 In principle, it is acknowledged that specialists in the service of the Department, by virtue of their exceptional expertise,

- should provide a valuable contribution to the development of LTSM
- should receive a legitimate remuneration for such quality work if such work is performed outside office hours.

11.3 The involvement of any official in the above-mentioned context is subject to the observance of departmental policy instructions and possible legal prescriptions in this regard.

11.4 In the best interest of both the official and the Department, the Department reserves the right to discourage officials from becoming involved in the development of LTSM where such involvement, on the grounds of the official's intimate knowledge of the expectations of the Department, could be interpreted as deliberately giving the advantage to officialdom at the cost of the private sector.

11.5 Where an official is involved, or becomes involved in the development of LTSM, such an official may:

- in no respect become involved in any facet of screening;
- not exercise or utilize his official competence or position in such a way as to obtain advantage to him/herself or certain persons/organisations; or to disadvantage certain persons or organisations;
- not be involved in
  - the compiling of specifications or conditions relating to the action of acquisition of LTSM
  - the compiling of evaluation forms; and
  - the appointment of screeners

11.6 When an official, who by nature of his/her official duties or position, acquires a direct or indirect interest in the development of LTSM, such an official must withdraw from the actions mentioned in paragraph 11.5 as well as any decision making in this regard. The Department must also be informed in writing regarding such interest. The Department further reserves the right to transfer such an officer to another section of the Department.

12. CRITERIA FOR THE APPOINTMENT OF SCREENERS

12.1 It is desirable to have in place a transparent, legitimate mechanism for the identification and appointment of screeners. This necessitates that potential candidates be allowed to apply to be appointed as screeners.

12.2 The advertisement for screeners will be conducted internally, within all educational institutions in the Limpopo Province through subsequent structures.

12.3 Teachers' organisations will be supplied with the criteria for identifying suitable candidates before they nominate representatives.

FOUNDATION PHASE SCREENERS

Requirements:

- At least three years' college or university specialisation in a course relevant to the Learning Programme that will be evaluated, as well as a teaching qualification
- At least five years' teaching experience in a subject/subjects related to the Learning Programme in the Foundation Phase
- Training and exposure to Outcomes-Based Education and Training

Experience: (serves as an additional recommendation)

- Previous experience as Learning and Teaching Support Material evaluator
- Member of an official Departmental Working Committee or Learning Area Committee
- The screener must be teaching in the Foundation Phase (2005

© University of Venda

University of Venda
Creating Future Leaders

Declaration:

A candidate must be willing to declare that he/she and his/her immediate family is not involved in the writing, publishing or marketing of Learning and Teaching Support Materials. (Appendix A LPDE/LTSM/03)

INTERMEDIATE PHASE SCREENERS

Requirements:

- At least three years' college or university specialisation in a course relevant to the Learning Programme that will be evaluated, as well as a teaching qualification
- At least five years' teaching experience in a subject or subjects related to the Learning Programme in the Intermediate Phase
- Training and exposure to Outcomes-Based Education and Training

Experience: (serves as an additional recommendation)

- Previous experience as Learning and Teaching Support Material evaluator
- Member of an official Departmental Working Committee or Learning Area Committee
- The screener must be teaching in the Intermediate Phase

Declaration:

A candidate must be willing to declare that he/she and his/her immediate family is not involved in the writing, publishing or marketing of Learning and Teaching Support Materials. (Appendix A LPDE/LTSM/03)

SENIOR PHASE SCREENERS

Requirements:

- At least three years' college or university specialization in a course relevant to the learning area that will be evaluated, as well as a teaching qualification.
- At least five years' teaching experience in a subject related to the Learning Programme in the Senior Phase
- Training and exposure to Outcomes-Based Education and Training

Experience: (serves as an additional recommendation)

- Previous experience as Learning and Teaching Support Material evaluator
- Member of an official Departmental Working Committee or Learning Area Committee
- The screener must be teaching in the Senior Phase

Declaration:

A candidate must be willing to declare that he/she and his/her immediate family is not involved in the writing, publishing or marketing of Learning and Teaching Support Materials. (Appendix A LPDE/LTSM/03)

13. THE APPOINTMENT OF SCREENERS

13.1 On receiving all the applications for screening, the Curriculum Development Directorate will study the relevant applications for their specific Learning Area/Programme or Subject. Suitable candidates will be short-listed and further screened until the required number of screeners for a particular screening process has been identified. The names will be submitted to the Head of Department through the line function, Curriculum Development, for final approval.

13.2 Following the approval of screeners by the Head of Department, screeners will be informed in writing of their appointment as screeners. The screeners are appointed for a three year period, and may be appointed for consecutive periods.

13.4 Three trained impartial, uninvolved and unprejudiced screeners, of whom anonymity before and during screening is maintained at all times, will do screening of a title.

© University of Venda

University of Venda
Creating Future Leaders

13.4 Screeners are remunerated for their services according to a predetermined remuneration tariff scale. Funds for this purpose are obtained by means of levying a submission fee on publishers.

13.5 By neglecting to complete an evaluation form as specified in the prescriptions, or in the opinion of the Evaluation Committee affecting the evaluation duties in a way that gives evidence of inadequate evaluation of the product, screeners lay themselves open to forfeiture of the evaluation fee and/or dismissal as screener.

13.6 The services of screeners who, in the opinion of the Department, function in an unsatisfactory manner, can be terminated immediately.

14. CAPTURING OF DATA

The following information must be captured on the SAP system at different stages of the screening process by **trained authorised officials.** (The Training Manuals explain the procedures in detail):

14.1 **Publisher details** (Create or update)

Publisher's Name	Contact person	Postal address	Tel no.	Fax no.	Cell no.	e-mail

14.2 **Screener details** (Create or update)

Title	Surname	First name	ID no.	PERSAL no.	Postal address
Tel no.	Fax no.	Cell no.	e-mail address	Appointment date	
Phase	Grade	Learning Programme/Area or Subject		Screener Group	
Gender	Race	Rank	Institution	Language	Teaching experience

14.3 **Title pack details** (Capture on submission)

Pack title	Bank name	Branch	Account	Cheque no.	Amount	Publisher	Submission date
Book title	Author	Component	Genre	Phase	Grade	Learning Area	Subject
Submission	Format	Language	Level	Price	Quantity		

14.4 **Titles per screener** (Capture as soon as titles have been sorted per screener)

Phase	Title no.	Screener no.	Report back date	Screening rate

14.5 **Feedback from screeners** (Capture after Evaluation Committee meeting)

Screener no.	Screening status	Quality comment

14.6 **Screener payments** (Capture after Evaluation Committee meeting)

Screener no.	Screening rate (subject to quality of screening done)

14.7 **Screening Status** (Capture after Recommendations made by SMCD)

Title no.	Screening status (recommended, recommended as resource, not recommended)

15. EVALUATION INSTRUMENTS

15.1 The Curriculum Development Directorate has developed two evaluation instruments in conjunction with UNICEF, SLO, CITO and the National Department of Education. The instruments are aimed at objective assessment of all LTSM. Standards are maintained on the grounds that, in the screening and evaluation of LTSM, it must be ensured that the most suitable products are approved, prescribed and bought. The evaluation instruments make provision for valid, reliable Learning Programme/Area or Subject specific criteria and norms for screening; to ensure, as far as possible, the uniformity of recommendations.

© University of Venda

15.2 Screening will be done by means of these evaluation instruments on which only a "✓" or "X" is awarded for specific criteria.

15.3 These evaluation instruments will be made available to potential suppliers on request as supplementary guidelines for authors.

15.4 The evaluation instruments are attached - LPDE/LTSM/07 and LPDE/LTSM/08.

16. THE SCREENING, EVALUATION AND SELECTION OF LTSM

16.1 Record and check materials (within one week after receiving LTSM)

- Download title details on a MS Excel spreadsheet from discs provided by the publishers - LPDE/LTSM/02.
- Enter titles in the SAP system.
- Provide each Curriculum Development Coordinator with title lists to check the titles he/she received for his/her Learning Area/Programme or Subject.

16.2 Prepare packages for screeners: (one week)

- Curriculum Development Coordinators sort the LTSM into separate packages for each screener - different groups of screeners per Learning Area/Programme or Subject should get more or less the same number of pages to screen
- Allocate titles to screeners on the SAP system (ZML06) and/or sort titles according to screeners on the MS Excel spreadsheet LPDE/LTSM/02
- Each screener package must be provided with
  - two copies of a Screener Title List LPDE/LTSM/06 or SAP ZMR08
  - the relevant evaluation instrument for each title (LPDE/LTSM/07 or LPDE/LTSM/08)
- It should be ensured that identical packs of LTSM are distributed to three screeners to ensure the fast processing and discussion of results.

16.3 Conduct a pre-screening workshop:

- The Curriculum Development Coordinators host orientation workshops with contracted screeners to ensure that all screeners understand the process, the screeners' reporting format and that they are conversant with all the criteria and policy guidelines.
- Screeners sign the Screener Declaration LPDE/LTSM/03

16.4 Screening the LTSM (four weeks)

- After the workshop, each screener receives his/her package, check it against the Screener Title List LPDE/LTSM/06 or SAP ZMR08., sign the list and leave a copy with the Curriculum Development Coordinator.
- Each title is screened and evaluated.
- Screeners complete a report in English based on the relevant evaluation form, LPDE/LTSM/07 or LPDE/LTSM/08, for each title or item.

16.5 Drafting final reports

- A composite report is drafted for each title or item during a discussion by the Evaluation Committees. The individual reports are studied and reviewed and all merits and demerits of a particular book or item are weighed before a final evaluation report is drafted (.LPDE/LTSM/09 or LPDE/LTSM/10) and a decision about the status of the title is made, i.e.
  - Recommended
  - Recommended as resource
  - Not recommended

Title will be recommended as a resource if:

© University of Venda

University of Venda
Creating Future Leaders

- it can make a reasonable contribution to the capacity building of teachers in a relevant field, e.g. assessment, creation of teaching aids, etc. and/or
- it can be used to the best advantage in the teaching/learning process at the level for which it has been developed;

A title will be recommended conditionally if it is acceptable in all respects apart from editorial mistakes or incomplete illustrations.

The drafting and typing of these reports is the responsibility of the Learning Area/Programme or Subject Coordinators (LPDE/LTSM/09 and LPDE/LTSM/10)

- Final reports are duplicated and one copy is filed alphabetically according to title per Learning Area/Programme or Subject and Language with a summary list of titles indicating their status (use LPDE/LTSM/06). Reports from Learning Areas/Programmes or Subjects must be divided with clear divisions.
- The other copies of the reports are arranged alphabetically according to titles per Learning Area/Programme or Subject and Language per Publisher.
- Final reports should by available within three months from the date that screeners have received the LTSM for evaluation by the Chief Education Specialist.
- The Chief Education Specialist evaluates the reports and gives feedback to the coordinators within two weeks after receiving them and hand them over to the office of the Senior Manager Curriculum Development.
- The Senior Manager Curriculum Development does spot checks on the evaluation reports and gives feedback within two weeks.
- Recommendations made by the Senior Manager Curriculum Development are discussed and implemented. The status of each title is finalised and captured.
- On completion of input, the lists are forwarded to the office of the Head of Department for approval.
- Copies of all reports (LPDE/LTSM/09 and LPDE/LTSM/10) are sent to the relevant publishers for their attention.

16.6 Screening must be completed within four months after the LTSM have been submitted for evaluation and the results of the screening as well as the selection process must be made known within five months.

17. CONDITIONALLY APPROVED TITLES

A final proof, although acceptable in all respects apart from editorial mistakes or incomplete illustrations, can be referred back to those who submitted the product with the request to edit and finalise it. After editing, one copy must be resubmitted within 21 days for final evaluation by departmental officials. No further submission fee is required.

18 APPEALS

In cases where the publisher contests the results of the screening process, the publisher may lodge an appeal in writing through the office of the Head of Department within fourteen days after receiving the report. The Head of Department will appoint an appeal committee to deal with appeals.

19 INADEQUATE NUMBER OF SUBMISSIONS

If there are initially an inadequate number of acceptable titles for a specific Learning Programme for a specific grade for inclusion on the book list, the Department may decide to:

- agree to repeat the appropriate procedures of the screening/selection process;
- give consideration to the screening and selection of titles submitted by publishing houses on an ad-hoc basis.

LIBRARY

© University of Venda

University of Venda
Creating Future Leaders

20 DRAFT CATALOGUE

20.1 A Draft Catalogue is compiled, reflecting the final evaluation and selection of the Limpopo Province Department of Education.

20.2 The draft catalogue is forwarded to publishers to correct all details regarding

- Title
- Author(s)
- ISBN number
- Price
- Description

20.3 Feedback is received from publishers by the Curriculum Development Directorate.

20.4 The Draft Catalogue is corrected based on the feedback of the publishers.

20.5 The corrected Draft Catalogue is forwarded to the publishers to certify that all information is correct and they return it to the Directorate Curriculum Development.

20.6 The Catalogue is submitted to senior management for final approval.

21 THE FINAL CATALOGUE

21.1 The Directorate Curriculum Development hands the Final Catalogue over to the Sub-Directorate LTSM Provisioning.

21.2 The Sub-Directorate LTSM Provisioning distributes the Final Catalogue to publishers, Districts and Schools.

21.3 The Sub-Directorate LTSM Provisioning updates the database.

22 MEDIUM OF SUBMISSION

The Learning and Teaching Support Materials are to be submitted in all the official languages of the Province. Authors, who are experts in the specific language and Learning Programme/Area or Subject, will do the writing/translation where there is a need. It is the publisher's responsibility to ensure that proper translations are submitted.

Versioning shall be promoted instead of translations.

23 NORMS FOR THE DEVELOPMENT OF LTSM BY THE DEPARTMENT

If after the evaluation of the LTSM, the Department is not convinced of the quality of the submitted material, it may consider commissioning/outsourcing the writing of such LTSM at its own discretion. The Department of Education will retain the copyright and the right to price the developed LTSM for acquisition by schools.

24 LTSM USED DURING PILOTING

Only Learning and Teaching Support Materials approved by the Department may be used in piloting unless the National Department of Education supplies such materials.

25 LTSM USED IN PROJECTS

Only Learning and Teaching Support Materials approved by the Department may be used in projects. In special circumstances the LTSM may not be listed in the catalogue.

26 IRREGULARITIES

All irregularities will be investigated. Where a party has not adhered to the policy of the Department, necessary steps will be taken. The office of the General Manager will be accountable.

© University of Venda

University of Venda

27 THE ROLE OF THE EVALUATION COMMITTEE

27.1 With a view to the creation of an acceptable and credible organisational climate and to ensure that the screening, selection and procurement of books are effected in an objective manner, the responsibility for final decisions regarding recommendations is vested in the Evaluation Committees.

27.2 An Evaluation Committee will be constituted for each Learning Programme/Area or Subject, within each Learning Phase/Band.

27.3 The Evaluation Committee will consist of the following:

- The screeners appointed to screen the particular Learning Programme/Area or Subject
- The relevant subject/ Learning Area Coordinator;
- An official of at least the level of Chief Education Specialist to act as Chairperson.
- A union representative per Learning Area: PEU, SADTU and SAOU

27.4 The Evaluation Committee has the overarching responsibility for:

- The control over the quality and validity of the screening process per title;
- Compilation of a concise final report of the outcome of the screening process per title;
- The final recommendation of titles found suitable for selection with reference to the inclusion thereof in the catalogue.

28 THE ROLE OF THE CURRICULUM DEVELOPMENT DIRECTORATE

28.1 The responsibility for establishing the need for LTSM and the requirements for the screening, selection and procurement thereof, resides in the Curriculum Development Directorate, in close co-operation with the Subject Advisory services.

28.2 The Directorate Curriculum Development has the overarching responsibility for

i. calling for the submission of manuscripts from Learning and Teaching Support Materials Developers;

ii. the implementation and maintenance of the screening and selection process;

iii. the appointment of suitable screeners who are uninvolved in the development of LTSM;

iv. control over the quality and validity of the screeners' reports;

v. final decisions regarding the acceptability and suitability of LTSM for use in institutions under the jurisdiction of the Department;

vi. determining tariffs for submission of titles by publishers and other producers of LTSM and submitting these to the Head of Department for approval;

vii. determining tariffs for screening and submitting these to the Head of Department for approval;

viii. the compilation of the recommended title lists;

ix. submitting the approved list of LTSM for purchase by the Department;

x. the compilation of requisition catalogues for LTSM.

28.3 The responsibility for all administrative and logistic operations related to the above, resides in the provisioning administration component which is also responsible for the following:

i. The receipt of LTSM submitted for screening and the liaison with publishing and production houses in this regard.

ii. All liaison related to the screening and evaluation process, including the:

- notification of screeners regarding their appointment;
- dissemination of manuscripts/LTSM submitted for screening to screeners;
- receipt of screening reports;
- preparation of submissions regarding the screening;

© University of Venda

University of Venda
Creating Future Leaders

REFERENCES

Czerniewicz, L. et al 2002 *The Role of Learning and Teaching Support Materials in C2005.* Department of Education Pretoria.

Free State Province Department of Education 2001 *Policy for the Sreening, Evaluation and Selection of Learning and Teaching Support Material*

APPENDICES:

A Forms for administering the Screening Process

B Guidelines for the Evaluation of Learning and Teaching Support Material

© University of Venda

University of Venda
Creating Future Leaders

RESEARCH : CURRICULUM STUDIES

QUESTIONNAIRE FOR LEARNERS

Thank you very much for your time, cooperation as well as your willingness to answer the following questions. Your answers will be treated confidentially and will be used for this study only. Your answers will assist in improving the teaching and learning of Physical Science in our schools.

Neither your name nor that of your school should appear on the questionnaire. Please answer all the questions honestly to the best of your understanding and knowledge.

Answer each of the following questions by encircling the appropriate code:

1. Indicate your gender

MALE	1
FEMALE	2

2. What is your home language?

TSHIVENDA	1
TSONGA	2
N. SOTHO	3
ENGLISH	4
AFRIKAANS	5
OTHER	6

© University of Venda

University of Venda
Creating Future Leaders

3. Indicate your age.

Younger than 16 yrs	1
16 yrs	2
17 yrs	3
18 yrs	4
Older than 18 yers	5

4. In which language are you taught Physical Science?

ENGLISH	1
AFRIKAANS	2
OTHER	3

5. If the language you are taught Physical Science is not your mother tongue how are you coping with understanding of concepts?

Without difficulty	1
With difficulty	2

6. Do you intend following science career after passing matric?

YES	1
NO	2
NOT SURE	3

7. How often do your parent/guardian assist you whenever you have problems in Physical Science?

Always	1
Sometimes	2
Never	3

© University of Venda

University of Venda
Creating Future Leaders

8. Do you have electricity at your home?

YES	1
NO	2

9. If there is electricity at your home, to what extent does this contribute, to your Study of Physical Science?

Very much	1
Much	2
Little	3
Very little	4
Not at all	5

10 If there is electricity at your school, to what extent does this contribute to your study of Physical Science?

Very much	1
Much	2
Little	3
Very little	4
Not at all	5

11 Do you have a Physical Science laboratory at your school?

YES	1
NO	2

If your answer is YES, please answer the following questions:

11.1 Indicate availability of equipments for performing experiments.

Very little	1
Little	2
Sufficient	3
Very much	4
Nothing	5

11.2 Indicate availability of chemicals for performing experiments

Very little	1
Little	2
Sufficient	3
Very much	4
Nothing	5

© University of Venda

University of Venda
Creating Future Leaders

11.3 Your laboratory is fitted with

11.3.1. Water

YES	1
NO	2

11.3.2. Electricity

YES	1
NO	2

11.3.3. Gas

YES	1
NO	2

11.3.4. Appropriate laboratory furniture

YES	1
NO	2

11.3.5. Fume chamber

YES	1
NO	2

11.4 Your laboratory is able to accommodate all learners doing Physical Science at a time

YES	1
NO	2

12. How often do you take part in conducting experiments during your Physical Science lessons?

Often	1
Sometimes	2
Not at all	3

13. Your Physical Science teacher conducts experiments in order to demonstrate what he/she is teaching

Often	1
Sometimes	2
Not at all	3

© University of Venda

University of Venda
Creating Future Leaders

14. Your Physical Science teacher mostly teaches by reading from the textbook.

Strongly Agree	1
Agree	2
Undecided	3
Disagree	4
Strongly Disagree	5

15. Experiments make me understand the concepts in Physical Science quite easily

Strongly agree	1
Agree	2
Undecided	3
Disagree	4
Strongly Disagree	5

16. Learners should be given the opportunity of handling learner support materials for practical work themselves.

Strongly agree	1
Agree	2
Not sure	3
Disagree	4
Strongly Disagree	5

17. My Physical Science teacher often comes to class well prepared to teach.

Strongly agree	1
Agree	2
Not sure	3
Disagree	4
Strongly Disagree	5

18. To what extent do you agree that you experience the following problems in your study of Physcial Science:

	SA	A	D	SD
(a) Shortage of Physical Science text books				
(b) Lack of apparatus to perform experiments				
(c) Your teacher has problem in teaching Physical Science				
(d) You have difficulty in mastering Physical Science concepts because it is taught in a language which is not your mother tongue/first language				

© University of Venda

University of Venda
Creating Future Leaders

(e)There is no Physical Science laboratory at your school and that is the reason why you have difficulty in mastering your Physical Science study.				

19. In about two or three lines make your recommendations for improving the teaching and learning of Physical Science in your school.

© University of Venda

APPENDIX F

University of Venda
Creating Future Leaders

RESEARCH : CURRICULUM STUDIES
QUESTIONNAIRE FOR EDUCATORS

Thank you very much for your time, cooperation, as well as your willingness to answer the following questions. Your answers will be treated confidentially and will be used for this study only. Also note that your answers will assist in recommendations for improving the teaching and learning of Physical Science in our Schools.

Neither your name nor that of your schools should appear on the questionnaire. Please answer all the questions honestly to the best of your understanding and knowledge.

Answer each of the following questions by encircling the appropriate code:

1. Indicate your gender

MALE	1
FEMALE	2

2. Please indicate the age group to which you belong

20 – 30	1
30 – 40	2
40 – 50	3
50 – 65	4

3. Indicate your experience of teaching Physical Science at grade 12

01 – 10	1
10 – 20	2
20 – 30	3
More than 30	4

© University of Venda

4. Indicate your highest Physical Science teaching qualification

Certificate	1
Diploma	2
First Degree	3
Second Degree	4
Third Degree	5
Fourth Degree	6

5. Please indicate your highest academic qualifications

Std 10	11
Degree	2
Honours	3
Masters	4
Doctorate	5

6. Please indicate where your school is situated

Urban	1
Rural	2

7. The DoE in Limpopo Province has a policy on development and supply of Learner Support Materials (LSM). Has this policy been Communicated to you?

YES	1
NO	2

If your answer is Yes, please answer the following questions:

7.1. Do you understand the policy?

Yes, Completely	1
Yes, mostly	2
No, not quite	3
No, not at all	4

© University of Venda

University of Venda
Creating Future Leaders

7.2. Do you agree with the policy?

Yes, completely	1
Yes, mostly	2
No, not quite	3
NO, not at all	4

Please give reasons to support your response above.

_____

_____

_____

_____

7.3. Is the policy practicable?

Yes, completely	1
Yes, mostly	2
No, not quite	3
No ,not at all	4

Please give reasons in support of your response above

_____

_____

_____

_____

8. The policy on CASS with regard to Physical Science at grade 12 level require a certain minimum amount of experiments to be done. To what extent are you able to do these experiment?

I can do all of them	1
I can do most of them	2
I can do few of them	3
I cannot do any of them	4

What are the reasons for your response above.

_____

_____

_____

_____

© University of Venda

University of Venda
Creating Future Leaders

9. Do you have a Physical Science laboratory at your school?

YES	1
NO	2

If your answer is Yes, please answer the following questions:

9.1. Please indicate availability of equipments for performing experiments.

Very little	1
Little	2
Sufficient	3
Very much	4
Nothing	5

9.2. Indicate availability of chemicals/consumables for performing experiments.

Very little	1
Little	2
Sufficient	3
Very much	4
Nothing	5

9.3. Your laboratory is fitted with.

9.3.1. Water

YES	1
NO	2

9.3.2. Electricity

YES	1
NO	2

9.3.3. Gas

YES	1
NO	2

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

17. The following are some of the causes of poor performance in Physical Sciences ,at grade 12 level. Please rank them in descending order of significance.

	Rank order
17 1. Lack of laboratory facilities.	
17.2. Incompetence of teachers to perform practical work.	
17.3. Inadequate or non-supply of appropriate text books.	
17.4. Medium of instruction which very often is second language to learners.	
17.5 Teachers not adequately qualified to teach Physical Science this level.	
17.6 Lack or inadequate support from Physical Science Curriculum Advisors	
17.7.Poor foundation of Physical Science teaching at lower levels	
17.8.Learners not having the appropriate aptitude for studying Science.	
17.9.Teachers not able to teach effectively all the sections of the syllabus viz Physics and Chemistry.	
17.10 Learners not exposed to adequate written work	

18. Please supply information with regard to availability of facilities which are also critical to the teaching and learning of Physical Science at your schools

Facility	Availability		Level of equipment		
	Yes	No	Fully equipped	Partially equipped	Not equippe
Audiovisual room					
Computer Centre					
Media & Library Centre					

19. In order to improve the teaching and learning of Physical Science the following resources are needed. Pririotise them in the order of importance according to you

	Rank order
19.1. Learning materials	
19.2. Learning aids	
19.3. Laboratory apparatus	
19.4. Laboratory equipments	

© University of Venda

University of Venda
Creating Future Leaders

RESEARCH: CURRICULUM STUDIES

INTERVIEW SCHEDULE : PRINCIPALS/CURRICULUM DIRECTORATE OFFICERS(S) /CURRICULUM ADVISORS

QUESTIONS	RESPONSES
1. The current policy of development and supply of learner support materials in Limpopo DoE focuses on textbooks, prescribed books and stationery.	
• To what extent has the policy been communicated to all relevant stakeholders?	
• How far has the policy been successful in achieving the intended goal?	
• How realistic are the provisions of the policy?	
• What constraints have so far been identified in implementing the policy?	

UNIVERSITY OF VENDA
LIBRARY

© University of Venda

• Learning materials and learning aids are very important in the teaching and learning of Physical Science. Are they been supplied by the DoE?	
• Whenever supply of LSM is done is it taking into consideration learners with disability?	
3. In the teaching-learning situation the role of the teacher cannot be over emphasised.	
• To what extent is teachers' pre-service training in teaching Physical Science related to current reality in our schools?	
• How does the Department ensure that teachers of Physical Science are kept informed about new methodologies and techniques of teaching?	
• How are teachers encouraged to improvise simple LS.M where possible for their l lessons?	
• The OBE curriculum approach is learner centred. To what extent do teachers provide opportunity for learners to do experiments/projects on their own?	

© University of Venda

• To what extent are Physical Science teachers given support and guidance by Physical Science curriculum advisors?	
4. The new OBE Curriculum approach require active participation of learners in the .learning process.	
• What is the impact of failure to supply LSM for doing practical work in Physical Science?	
• How far are teachers involved in curriculum development?	
• In determining CASS mark in Physical Science a certain amount of experiments are to be done during the year how far is this receiving attention?	
• What do you think needs to be done in order to improve the teaching and learning Physical Science in our schools	

University of Venda
Creating Future Leaders

University of Venda

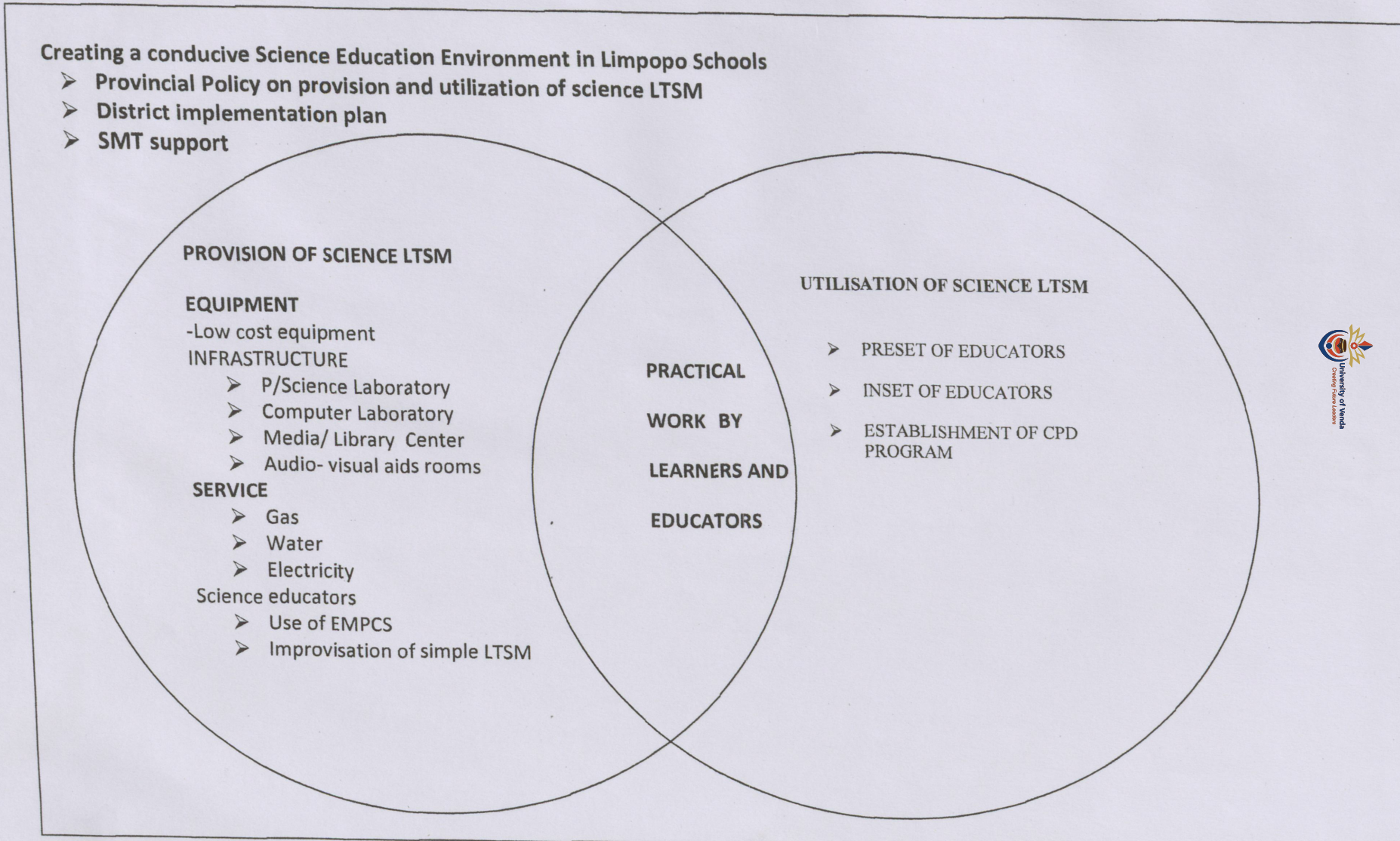
APPENDIX H

DISTRICTS OF THE NORTHERN PROVINCE AND THEIR RELATED POPULATION DENSITIES

Fig1.2

© University of Venda

RECOMMENDED MODEL FOR PROVISION AND UTILISATION OF SCIENCE LTSM IN LIMPOPO PROVINCE SCHOOLS



© University of Venda