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# The influence of practical work on chemistry teaching and learning: an approach using microchemistry kits in Mozambican junior secondary schools

**Madeira, Antonio Cristo Pinto**

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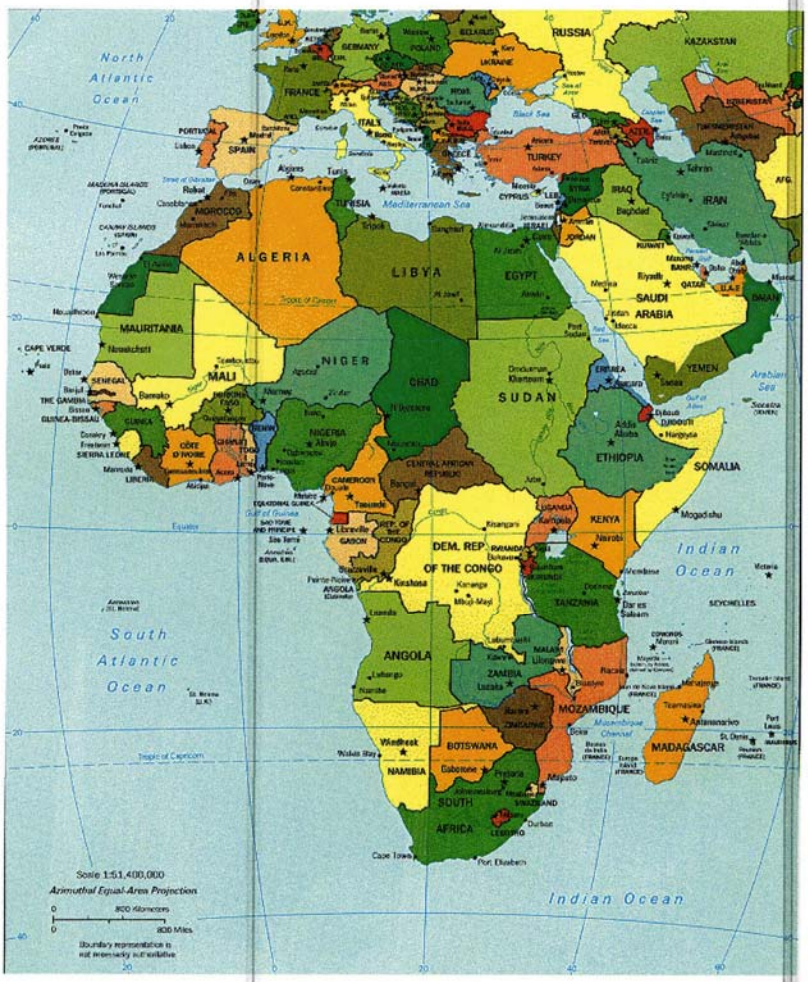
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# *Appendix A*

Contents:

Map of Africa with Mozambique Highlighted in Brown

# Map of Africa

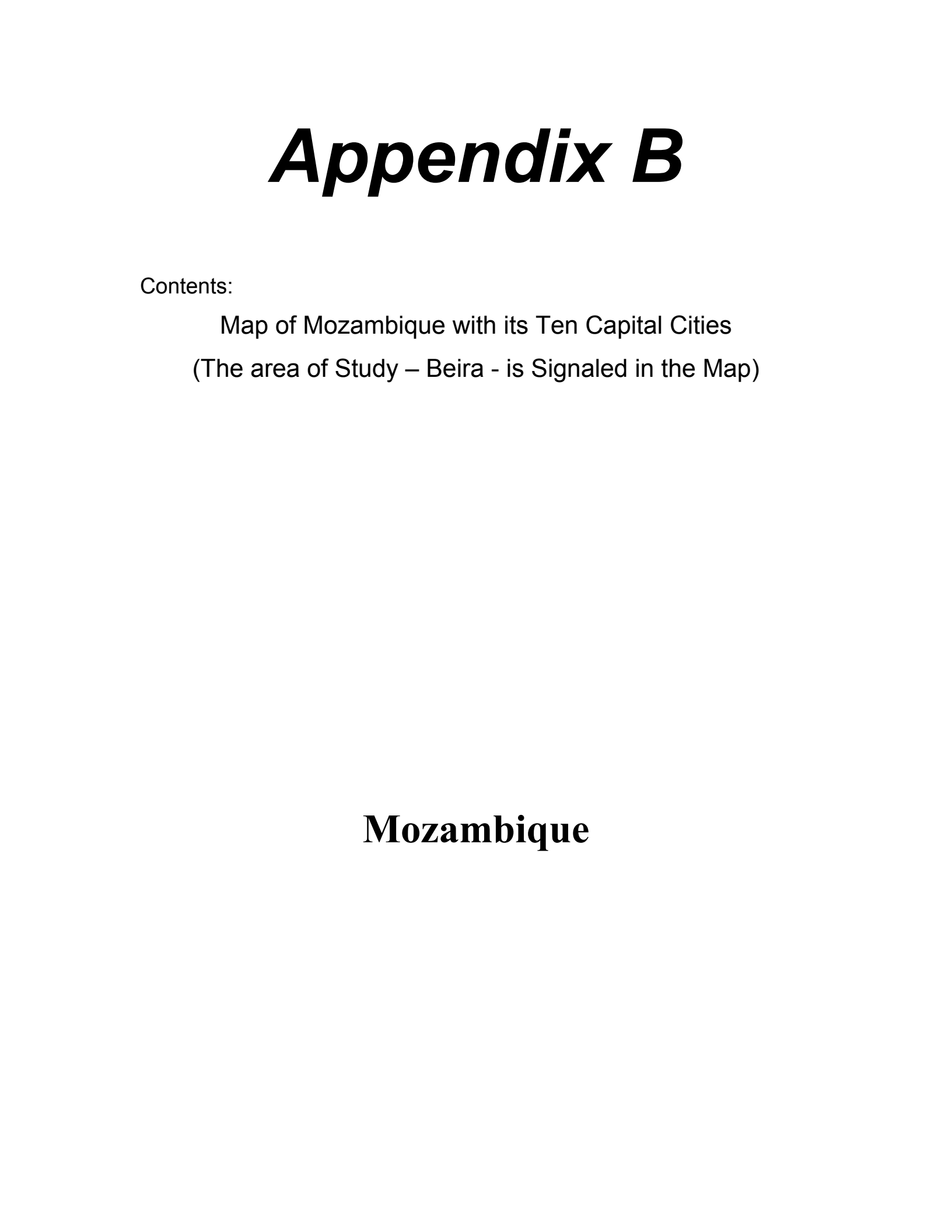


# *Appendix B*

Contents:

Map of Mozambique with its Ten Capital Cities

(The area of Study – Beira - is Signaled in the Map)




Lake
Nyasa
TANZANIA
ZAMBIA
Lichinga
Pemba
MALAWI
Nacala
Nampula
Tete
ZIMBABWE
Quelimane
Chimoio
Beira
Mozambique
Channel
Chicualacuala
Inhambane
MAPUTO
SWAZILAND
Indian
Ocean
SOUTH
AFRICA

# *Appendix C*

Contents:

Some Numbers and Historic Facts about Mozambique.

# Mozambique

## A Country Profile

**Capital:** Maputo
**Government:** Multiparty Democracy
**Population:** 18,115,250 million
**By Gender:** 48.6% male, 51.4% female
**Under 20 yrs:** 28.2% male, 27.8% female
**Density:** 58 per square mile
**Living in urban areas:** 33%
**Annual growth:** 2.9%
**Annual per capita income:** $86
**Literacy:** 33%
**Language, official:** Portuguese
**Languages, indigenous:** approximately 23, including Xitswa, Makua, Malawi, Tsonga, and Shona
**Ethnic groups:** Bantu tribes
**Religions:** Indigenous beliefs 60%, Christian 30%, Muslim 10%
**Location:** Southeastern coast of Africa
**Bordered by:** Tanzania, Malawi, Zambia, Zimbabwe, South Africa, Swaziland
**Area:** 303,769 square miles
**Coastline:** 2000 miles
**Arable Land:** 4%
**Provinces (10):** Maputo, Gaza, Inhambane, Sofala, Manica, Tete, Zambesia, Napula, Niassa, and Cabo Delgado
**Climate:** Tropical to subtropical
**Rainy Season:** October to April
**Rainfall:** 20-30 inches (Southeast Lowlands) to 56 inches (Northwest Highlands)




**Infant Mortality Rate:** 170/1000
**Under 5 Mortality Rate:** 250/1000
**Low Birth Rate:** 20%
**Life Expectancy:** 47 male, 51 female
**Temperature, Southeast Lowlands:** 79-86 F (January) to 59-68 F (July)
**Temperature, Northwest Highlands:** 71-77 F (January) to 52-59 F (July)

The indigenous people of Mozambique are descendants of various Bantu tribes. The official language is Portuguese, but because of long historical links with Arab traders along the coast, Swahili is also widely spoken, especially along the

border with Tanzania to the north. The climate is tropical in the north and temperate in the south.

The economy is essentially agricultural (85%), but tourism and other commercial enterprises are also important. The principal exports are cashew nuts, cotton goods, and sugar. Illiteracy is high, and medical services do not meet the nation's health needs.

The first Portuguese trading post was established in 1505. As in Angola, the Roman Catholic Church reinforced Portuguese colonial policies and opposed the overthrow of imperialism. On June 25, 1975, after a 16-year armed struggle waged by the Front for the Liberation of Mozambique (FRELIMO), Mozambique threw off 500 years of Portuguese colonial rule and became independent.

The founder of FRELIMO was Dr. Eduardo Mondlane, who studied at the Cambine Boys' United Methodist Boarding School in Inhambane Province, where he developed his revolutionary ideas. He later obtained a United Methodist Crusade Scholarship to study at universities in Lisbon, Portugal, and the United States.

When Dr. Mondlane was assassinated by a parcel bomb in 1969 while working in his office in Tanzania, his successor, Samora Moises Machel, led the country to independence. President Machel, a Maoist, instituted a rigid single-party form of government. A South African government-backed guerrilla movement, which calls itself the National Resistance Movement of Mozambique (RENAMO), relentlessly waged a bitter war of destabilization against the Mozambican government.

In 1986, President Machel and several members of his cabinet were killed in a plane crash on the South African border while returning from a meeting in Zambia. Machel was succeeded by Joaquim Alberto Chissano, who managed to bring about changes in the original FRELIMO Marxist constitution and replace it with a multiparty democratic constitution. These changes, plus the thawing of the Cold War, made it possible for RENAMO and FRELIMO to meet in Rome for peace talks.

Guerrilla warfare caused much death and suffering; as many as six million people sought refuge in camps in neighboring countries. Over a million people were killed and another million were in refugee camps inside Mozambique. Mozambique continues to have one of the largest concentrations of land mines in the world.

Droughts, combined with the malicious destruction of crops, roads, bridges, and rail, telephone, and electricity lines by RENAMO, have wrecked the country's infrastructure and brought life in Mozambique to a near standstill. The national literacy rate was only four percent at independence, which meant that the country

lacked the elements necessary for building a modern economy. RENAMO's subversive activities prevented the addressing of critical social and economic problems.

The new government guarantees freedom of worship but not the right to proselytize or to baptize minors. After so many centuries of foreign subjugation, the new Mozambican leaders are trying to encourage pride in the nation and its culture. Some of them see the existence of many denominations as divisive.

Developments since independence have strengthened cooperation and desire for church union among various denominations. The Christian Council of Mozambique is encouraging the Protestant churches to speak with one voice. The Nairobi-based All-Africa Conference of Churches and the missionary church agencies in Europe and North America have also supported this posture. Because of the government's increased confidence in the churches, the Christian Council of Mozambique initiated the holding of negotiations between the government and the RENAMO group, resulting in the Rome Peace Accords and the cessation of violence in November 1992.

On October 27-28, 1994, the first multiparty elections in the history of the country were held, resulting in Joaquim Chissano being elected as president and FRELIMO obtaining slightly more than 50% of the Parliamentary seats, with RENAMO the second largest party in the Parliament with approximately 43% of the seats. The repatriation of 1.7 million Mozambican refugees officially ended in June 1995.

In 1999 the country held its second multiparty elections won by FRELIMO and Joaquim Chissano being elected as president. In 2004 the country held the third multiparty elections won by FRELIMO and Armando Guebuza, a candidate appointed by FRELIMO to succeed Chissano, was elected president.

# *Appendix $D_1$*

Contents:

**The Strategic Plan of Education in Mozambique (1998 – 2003)**



REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA EDUCAÇÃO

# *Plano Estratégico de Educação 1999-2003*

## *"Combater a Exclusão, Renovar a Escola"*

MAPUTO, OUTUBRO 1998

# *Appendix $D_2$*

Contents:

**The Strategic Plan of Education in Mozambique (2004 - 2008)**

Jacinta Madeira
15/12/03

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA EDUCAÇÃO

XXVIII CONSELHO COORDENADOR

**"Por uma visão futura e segura da Educação"**

# Plano Estratégico da Educação 2004-2008

MAPUTO, 25 A 29 DE AGOSTO DE 2003

**Doc. 11 – XXVIII CONCOOR MINED**

# *Appendix $D_3$*

Contents:

**Chemistry Programs for Junior Secondary School.**

REPÚBLICA DE MOÇAMBIQUE
MINISTÉRIO DA EDUCAÇÃO

# PROGRAMAS DA DISCIPLINA DE QUÍMICA DO 1º CICLO DO ENSINO SECUNDÁRIO GERAL

© MINED/DNESG * 2004

# *Appendix E*

Contents:

Letter Requesting Authorization to Carry on the Research

(Statement of Consent to Carry on the Research)

**Exmo Senhor Director Provincial de Educação da Provincia de Sofala**

**Beira**

***Assunto*: *Pedido de Autorização para Realização de Pesquisa*.**

***Antonio Cristo Pinto Madeira*,** docente afecto ao Departamento de Quimica da universidade Pedagogica – Delegação da Beira, desde o ano passado a cumprir com o programa de pos-graduação para obtenção do grau académico de Mestrado na República da Africa do Sul, cidade de Johannesburg, na Universidade de Witwatersrand, vem por este meio solicitar autorização para a realização do seu trabalho de pesquisa campo nas escolas secundárias estatais da cidade da Beira e Dondo.

A pesquisa consiste, na sua primeira fase, em administrar questionários a alunos da nona classe, bem como aos respectivos professores de química. A fase seguinte consiste em utilizar algumas turmas da nona classe para fazer experiências laboratoriais utilizando kits de microquímica que serão disponibilizados aos professores e alunos das turmas seleccionadas.

**N.B.**

- A duração da pesquisa vai de 21 de Junho a 15 de Setembro, periodo durante o qual os professores das escolas seleccionadas ensinarão conteúdos de quimica realizando experiências laboratoriais.
- As experiências por realizar serão as que estão previstas nos programas de ensino da disciplina, e serão realizadas na ordem em que aparecem nos programas.

Sem mais assuntos de momento despeço-me com a esperança de que este pedido merecerça de V. Excia a máxima consideração.

Beira, aos 12 de Junho de 2004.

Antonio Cristo Pinto Madeira

CC:/ Prof.Dr. Gerre Zebedias Sithole
(Chefe de Departamento de Qímica)

# *Appendix F*

Contents:

Profile of the Teachers who Participate in the Study

**Number of Teachers per School**

| Group | Name of School and Code | Number of Teachers |
|---|---|---|
| ***Comparison Group*** | *Dondo Secondary School (**School A**)* | 4 |
| | *Sansao Muthemba Secondary School (**School B**)* | 4 |
| **Experimental Group** | *Manga Secondary School (**School C**)* | 5 |
| | *Samora Machel Secondary School (**School D**)* | 5 |
| **Total:** | ***4*** | ***18*** |

**Teachers' Experience as Chemistry Teachers.**

| Number of Years working as Chemistry Teachers. | Percentage of Teachers (n = 18) |
|---|---|
| 1 – 4 | 28 |
| 5 – 9 | 33 |
| 10 – 14 | 17 |
| 15 - 19 | 22 |

**Initial Training Received.**

| Degree or Level | Percentage of Teachers (n = 18) |
|---|---|
| ***Basic Training*** (Grade 10 + two years teachers training course). | 11 |
| ***Medium Training*** (Grade 12 + two years teachers training course). | 28 |
| ***University Degree*** (Grade 12 or Basic training + 5 years teachers training at University). (Medium training + 2 years teachers training at university). | 61 |

**N. B:**

There are two public universities which award teachers with a university degree, one based only in Maputo, and the other based in Maputo and three other provinces.

# *Appendix G*

Contents:

Teachers' Questionnaire before the Intervention

**Name: _____**

**Name of School:_____**

**Institution where you got your initial training:**

**_____**

**_____**

**Name of the Course:_____**

**Main disciplines: _____**

**Duration of the course: _____ Years. (from: _____ to _____)**

**How many years have you been teaching chemistry?_____ Years.**

## Note:

**1.** This questionnaire is only for the purpose of research undertaken to fulfill the requirements for the Masters degree at the University of the Witwatersrand.

**2.** All information will be confidential and no names will appear in report findings. The information gathered will be used for research and education only.

**3.** We have tried not to make this a burden and have tried to keep questionnaire as short as possible.

***Your Participation is Voluntary***

Thank you for your cooperation

**1.** Do you do practical work in chemistry lessons? Yes____ No____

**1.1.** If yes, explain:

How often per term? _____

How is it organized?

- Demonstration_____
- In group_____
- Individually_____

**2.** List three (3) aims of doing practical work.

(1)_____

_____

(2)_____

_____

(3)_____

_____

**3.** What could be done to teach chemistry in a way which motivates students?

_____

_____

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_____

**4.** What problem, if any, have you, as a chemistry teacher, experienced when teaching chemistry?

**5.** What, if anything, would help you to overcome some of these problems?

# *Appendix H*

Contents:

Learners' Questionnaire before the Intervention

**Name: _____**

**Name of School: _____**

**Grade 9, Class: _____ Number:_____;**

**Age: _____; (date of birth: 19____)**

**First time or repeating grade 9? _____**

## Note:

**1.** This questionnaire is only for the purpose of research. All information will be confidential and no names will appear in report findings. The information gathered will be used for research and education only.

**2.** We have tried not to make this a burden and have tried to keep questionnaire as short as possible.

***Your Participation is Voluntary***

Thank you for your cooperation

**1.** Did you do experiments in your chemistry lessons this year?

Yes____

No_____

**1.1.** If yes, how was it done?

- Teacher's demonstration._____
- In group. _____
- Individually._____

Can you list some experiments performed this year:

**1.2.** If you did no experiences, why do you think this happened?

**2.** What do you think teachers could do to make chemistry lessons more interesting for you?

**3.** Any further comments about the importance of practical work in chemistry lessons?

# *Appendix I*

Contents:

Teachers' Questionnaire after the Intervention

**1.** Did you use the microchemistry Kits?

Yes_____

No_____

**2.** How often did you use them?

_____

_____

**3.** What experiments were they used for?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

**4.** Please comment whether the use of microchemistry kits in your class has contributed to achieving the following possible aims of practical work, and if so, say how:

**4.1.** Increase students' motivation and interest to chemistry.

**4. 2.** Helps students develop manipulative skills and techniques.

**4.3.** Helps students understand chemical concepts.

**4.4.** Helps students develop scientific inquiry skills.

**5.1.** Give your comments about what did you like in the use of microchemistry kits.

**5.2.** Give you comments about what you did not like in the use of microchemistry kits.

**6.** Any other comment you wish to make after teaching chemistry using microchemistry kits.

# *Appendix J*

Contents:

Learners' Questionnaire after the Intervention

**Name: _____**

**Name of School: _____**

**Grade 9, Class: _____ Number:_____;**

**Age: _____; (date of birth: 19____)**

**First time or repeating grade 9? Yes _____ No _____.**

## Note:

**1.** This questionnaire is only for the purpose of research. All information will be confidential and no names will appear in report findings. The information gathered will be used for research and education only.

**2.** We have tried not to make this a burden and have tried to keep questionnaire as short as possible.

***Your Participation is Voluntary***

Thank you for your cooperation

**1.** Have you done practical work in the past weeks? Yes_____ No_____

**2.** If yes, how was it done?

Demonstration done by teacher._____

Group work._____ How many learners per group?_____

Individual work. _____.

**3.** Was there anything you like about experiments? _____

Comment:

**4.** Was there anything you did not like about experiments? _____

Comment:

# *Appendix K*

Contents:

The Piloted Version of the Diagnostic Test.

## Diagnostic Test:

**Note:**

- This is a diagnostic test to test some of your understanding about contents which you have learnt;
- - This test is only for research purpose, so the marks you get will not be used for assessment.

**1.** Complete the following chemical equation:

_____ + _____ --→ $SO_2$

$SO_2$ + $H_2O$ ---→ _____

**2.** Although some acids and bases can be tested using your tongue, explain why it is recommended to use indicators to test acids and bases?

_____

_____

_____

**3.** Imagine that you pour sulphuric acid in a test tube and add universal indicator. After that you will then add an equal volume and concentration of calcium hydroxide slowly to the acid, swirling the liquid so that you can see any colour change.

**a).** What is the purpose of universal indicator?

_____

_____

_____

**b).** Explain what will be in the test tube after all base has been added?

_____

_____

_____

_____

**4.** Give two examples of commonly used products which you would classify as acids and another two which you would classify as bases.

Acids:

(1)_____

(2)_____

(Bases:

1)_____

(2)_____

**5.** Hydrogen sulphide is prepared in a laboratory by reacting dilute aqueous solutions of any strong acid with iron sulphide (FeS).

**a).** Write a balanced equation of reaction of the process.

_____

_____

**b).** state two properties of the hydrogen sulphide which can be used to identify it.

(1)_____

(2)_____

**6.** Describe what you would observe if hydrogen sulphide is bubbled through a blue copper sulphate solution.

_____

_____

_____

_____

**7.** Suppose you have two colourless bottles of aqueous solutions of salts, one containing sulphate ions and the other sulphide ions. If the labels of the bottle fall off, describe what you would do to identify which bottles contains which ions.

_____

_____

_____

_____

**8.** Which of the following statements are correct?

**A.** During chemical reaction the concentration of the reactants decreases and the concentration of the products increases.

**B.** The rate of reaction can be defined either as the rate at which products are formed or as the rate at which reactants are used up.

**C.** The concentration of the products affects the rate of the reaction.

**D.** The rate of the reaction changes as the reaction proceeds because concentrations change.

**E.** The concentration of the reactants affects the rate of the reaction.

**A.**_____

**B.**_____

**C.**_____

**D.**_____

**E.**_____

**9.** Write the balanced chemical equation to represent the reactions by which the following salt could be obtained from the respective acid.

$ZnSO_4$ (s) from $H_2SO_4$ (aq);

_____

_____

**10.** Give the balanced chemical equation to represent the reaction between acid and base: $H_2SO_4$ (aq) + NaOH (aq) --→ _____ + _____

**11.** One of the possibilities to prepare ammonia in the laboratory is through the reaction: $2NH_4Cl$ (s) + $Ca(OH)_2$ (s) ---→ $2NH_3$ (g) + $CaCl_2$ (s) + $2H_2O$ (l)

- Describe how you could identify the ammonia formed.

_____

_____

_____

_____

**12.** One of the possibilities to produce salts is through the reaction between an acid with metallic oxide to form salt and water. Give the balanced chemical equation to obtain $Na_2SO_4$;

_____

_____

**13.** Describe what acid rain is and what causes it?

_____

_____

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# *Appendix L*

Contents:

Questionnaire to Find out Learners' Opinions about the Piloted Version of the Diagnostic Test.

.

**N.B:**

1. The purpose of this questionnaire is to have as many comments as possible about the test you have just written.
2. Respond clearly and honestly to the questions by giving examples of questions, phrases or words and explanation of the problems you have identified in the question.
3. Your comments and opinions will be taken into consideration to improve the test

**Thank you for your Cooperation!**

**1. Language Usage.**

**1.1.** Write down the questions of the test you find it difficult to understand what was asked:

_____

_____

Identify the nature of the problem and comment (i.e. not clear, ambiguity, difficult meaning of words or phrasing):

_____

_____

_____

_____

**1.2.** Write down the questions of the test you find it easy to understand what was asked:_____

_____

Comments on the aspects of the language used considered easy:

_____

_____

_____

_____

**2. Sequence of Questions and Content of the Test.**

**2.1.** Was the sequence of questions in the test easy or difficult to follow and answer all questions?

_____

Give examples of questions to support your answer:

_____

_____

_____

_____

**2.2.** Write down the questions of the test you found it difficult to answer:

_____

_____

Explain which aspects related to the content you found difficult in those questions:

_____

_____

_____

_____

**2.3.** Write down the questions of the test you found it easy to answer:

_____

_____

Comment on the aspects of the content you found easy to answer the in questions:

_____

_____

_____

_____

# *Appendix M*

Contents:

The Diagnostic Test Administered to Learners.

## Diagnostic Test:

**Note:**

- This a diagnostic test to test some of your understanding about contents which you have learnt;
- This test is only for research purposes, so the marks you get will not be used for assessment.

**1.** Hydrogen sulphide is prepared in a laboratory by reacting dilute aqueous solutions of any strong acid with iron sulphide (FeS).

**a).** Write a balanced equation of reaction of the process.

_____

_____

**b).** state two properties of the hydrogen sulphide which can be used to identify it.

(1)_____

(2)_____

**2.** Describe what you would observe if hydrogen sulphide is bubbled through a blue copper sulphate solution.

_____

_____

_____

_____

**3.** You have two colourless bottles of aqueous solutions of salts, one containing sulphate ions and the other sulphide ions. If the labels of the bottle fall off, describe what you would do to identify which bottle contains which ions.

_____

_____

_____

_____

**4.** Which of the following statements are correct?

**A.** During chemical reaction the concentration of the reactants decreases and the concentration of the products increases.

**B.** The rate of reaction can be defined either as the rate at which products are formed or as the rate at which reactants are used up.

**C.** The concentration of the products affects the rate of the reaction.

**D.** The rate of the reaction changes as the reaction proceeds because concentrations change.

**E.** The concentration of the reactants affects the rate of the reaction.

**A.**_____

**B.**_____

**C.**_____

**D.**_____

**E.**_____

**5.** Write the balanced chemical equation to represent reactions by which the following salts could be obtained from given substances.

**a).** $ZnSO_4$ (s) from $H_2SO_4$ (aq);

_____

_____

**b).** $MgCl_2$ (s) from HCl (aq)

_____

_____

**c).** NaBr (s) from NaOH (aq).

_____

_____

**b).** $MgCl_2$ (s) fr

**6.** Give the balanced chemical equation to represent reactions between acids and bases:

**a).** $HCl\ (aq) + Ba(OH)_2\ (aq) \rightarrow$ _____ + _____

**b).** $H_2SO_4\ (aq) + NaOH\ (aq) \rightarrow$ _____ + _____

**c).** $H_3PO_4\ (aq) + Ca(OH)_2\ (a) \rightarrow$ _____ + _____

**d).** $HNO_3\ (aq) + Al(OH)_3\ (s) \rightarrow$ _____ + _____

**7.** One of the possibilities to prepare ammonia in laboratory is through the reaction: $2NH_4Cl\ (s) + Ca(OH)_2\ (s) \rightarrow 2NH_3\ (g) + CaCl_2\ (s) + 2H_2O\ (l)$

**a).** Describe how could you identify the ammonia formed.

_____

_____

_____

_____

**b).** State two applications of ammonia.

(1)_____

(2)_____

**8.** One of the possibilities to produce salts is through the reaction between an acid with metallic oxide to form salt and water. Using this as references give a balanced chemical equation to obtain the following salts:

**a).** $Na_2SO_4$;

_____

_____

**b).** $CaCO_3$;

_____

_____

**c).** $Al(NO_3)_3$.

_____

_____

**9.** Although some acids and bases can be tested using your tongue, explain why it is recommended to use indicators to test acids and bases?

_____

_____

_____

**10.** Imagine that you pour sulphuric acid in a test tube and add universal indicator. After that you will then add an equal volume and concentration of calcium hydroxide slowly to the acid, swirling the liquid so that you can see any colour change.

**a).** What is the purpose of universal indicator?

_____

_____

_____

**b).** Explain what will be in the test tube after all base has been added?

_____

_____

_____

_____

_____

_____

**11a).** Give two examples of commonly used products which you would classify as acids and another two which you would classify as bases.

Acids:

(1)_____

(2)_____

(Bases:

1)_____

(2)_____

**b).** What would you do to ascertain that you have made the correct classification?

_____

_____

_____

_____

_____

_____

**12.** Complete the following chemical equations:

_____ + _____ --→ $SO_2$

$SO_2$ + $H_2O$ ---→ _____

**13.** Describe what acid rain is and what causes it?

_____

_____

_____

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_____

# *Appendix N*

Contents:

***Teachers' Answers to the Questionnaire after intervention***

Teacher 1.

School C

**1.** Did you use the microchemistry Kits?

Yes Sim

No_____

**2.** How often did you use them?

Realizando experiências ensinar os alunos

**3.** What experiments were they used for?

- Reacção Ácido-Base
- O papel dos indicadores (Cores em diferentes meios)
- Preparação do $SO_2$
- Velocidade de reacção.
- Preparação de amónio.
- Preparação do ácido sulfídrico
- Propriedades do amónio.
- Preparação do ácido sulfúrico.

**4.** Please comment whether the use of microchemistry kits in your class has contributed to achieving the following possible aims of practical work, and if so, say how:

Teacher 1

School C.

**4.1.** Increase students' motivation and interest to chemistry.

O facto de se poder comprovar a Teoria, a curiosidade que nasce com os alunos que vão poder realizar experiências, faz com que o motivam crença no seio dos estudantes

**4. 2.** Helps students develop manipulative skills and techniques.

Lógico, pipetar, decanter, e filtar, essas como outros aspectos, desenvolvem algumas técnicas usadas em laboratórios.

**4.3.** Helps students understand chemical concepts.

O saber e o saber fazer são concepções que crescem com as práticas laboratoriais. Portanto, experiências com kits facilitam estas concepções.

**4.4.** Helps students develop scientific inquiry skills.

Teacher 1

School C

**5.1.** Give your comments about what did you like in the use of microchemistry kits.

- fácil manuseamento
- Económico
- Material não perigoso
- Pode-se usar em qualquer ponto do mundo, desde que haja água.

**5.2.** Give you comments about what you did not like in the use of microchemistry kits.

o facto de o material de medição não estar escalado é um aspecto que não contribui para o desenvolvimento de perícias no concernente à exactidão e precisão, atendendo e considerando que contas gotas ou pipetas, não são medições padronizadas.

**6.** Any other comment you wish to make after teaching chemistry using microchemistry kits.

Se se pudesse incluir nos kits micro-balanças e se o material fosse substituído para ser mais preciso, em vez de material plástico (exceto a folha dos pipetas) substituí-los por material

Teacher 1

school C.

de borracha.

Teacher 2

school 5.

**1.** Did you use the microchemistry Kits?

Yes X

No_____

**2.** How often did you use them?

Making analysis of experiments where the microchemistry kits had.

**3.** What experiments were they used for?

- To prepare Sulfide acid.
- To confirm the Velocity of the reactions
- To confirm property acid- Base with indicator.
- To prepare Amamonia
- To confirm indicator acid- Base
- To prepare the salt.

and other experiments.

**4.** Please comment whether the use of microchemistry kits in your class has contributed to achieving the following possible aims of practical work, and if so, say how:

Teacher 2

school D

**4.1.** Increase students' motivation and interest to chemistry.

Yes.
When we were using microchemistry only for some class. Other wanted also because of comment. So it increase Student's motivation and interest to Chemistry.

**4. 2.** Helps students develop manipulative skills and techniques.

Yes.
Because is develop Knowledge and also with practice, the Students are develop manipulative skill and techniques and it is possible to descovery dip of the magnetic needle.

**4.3.** Helps students understand chemical concepts.

Yes.
Because it is possible to make an relation of pratic and theoretic it meaning they are going to understand chemical concepts.

**4.4.** Helps students develop scientific inquiry skills.

Yes,
Because when they are making experiments always they are develop knowledge of chemical and also it become easy to make experiment.

Teacher 2

School S.

**5.1.** Give your comments about what did you like in the use of microchemistry kits.

It is very interest to use micro-chemistry. So it is better to have them for all student and also to buy substance, because in our country is very dificult to find.

**5.2.** Give you comments about what you did not like in the use of microchemistry kits.

For mi it is dificult when the experiments are dangerous, because it is not possible to protect from them.

**6.** Any other comment you wish to make after teaching chemistry using microchemistry kits.

First I want to say thank you because you brought a new conception of laboratory. So I want to make a request for all the schools of this Country to have the microchemistry kits.

Teacher 2

School D.

Most of the students in Mozambique say that Chemistry is very difficult. But if it is possible to make experiments they are going to develop liking this area of science. Them is going to increase the number of people who like to be person skilled in chemistry.

# *Appendix O*

**Contents:**

**Model and Data used to conduct ANCOVA Test.**

| School | Interv | Pre-test | Post-test | |
|---|---|---|---|---|
| 1 | 0 | 13 | 11 | |
| 1 | 0 | 11 | 18 | |
| 1 | 0 | 14 | 5 | |
| 1 | 0 | 11 | 8 | |
| 1 | 0 | 5 | 18 | |
| 1 | 0 | 11 | 10 | |
| 1 | 0 | 5 | 19 | |
| 1 | 0 | 7 | 13 | |
| 1 | 0 | 9 | 8 | |
| 1 | 0 | 9 | 12 | |
| 1 | 0 | 7 | 22 | |
| 1 | 0 | 4 | 10 | |
| 1 | 0 | 13 | 11 | |
| 1 | 0 | 11 | 25 | |
| 1 | 0 | 6 | 4 | |
| 1 | 0 | 14 | 23 | |
| 1 | 0 | 13 | 14 | |
| 1 | 0 | 12 | 20 | |
| 1 | 0 | 7 | 11 | |
| 1 | 0 | 6 | 9 | |
| 1 | 0 | 9 | 13 | |
| 1 | 0 | 11 | 9 | |
| 1 | 0 | 18 | 25 | |
| 1 | 0 | 13 | 14 | |
| 1 | 0 | 15 | 19 | |
| 1 | 0 | 12 | 17 | |
| 1 | 0 | 14 | 14 | |
| 1 | 0 | 13 | 25 | |
| 1 | 0 | 11 | 25 | |
| 1 | 0 | 9 | 4 | |
| 1 | 0 | 9 | 21 | |
| 1 | 0 | 9 | 4 | |
| 1 | 0 | 7 | 5 | |
| 1 | 0 | 7 | 25 | |
| 1 | 0 | 3 | 17 | |
| 2 | 0 | 7 | 14 | |
| 2 | 0 | 15 | 23 | |
| 2 | 0 | 16 | 16 | |
| 2 | 0 | 18 | 22 | |
| 2 | 0 | 15 | 17 | |
| 2 | 0 | 15 | 27 | |
| 2 | 0 | 8 | 19 | |
| 2 | 0 | 14 | 25 | |
| 2 | 0 | 16 | 29 | |
| 2 | 0 | 17 | 19 | |

| | | | | |
|---|---|---|---|---|
| 2 | 0 | 17 | 19 | |
| 2 | 0 | 9 | 20 | |
| 2 | 0 | 17 | 24 | |
| 2 | 0 | 19 | 23 | |
| 2 | 0 | 15 | 23 | |
| 2 | 0 | 20 | 27 | |
| 2 | 0 | 13 | 19 | |
| 2 | 0 | 24 | 21 | |
| 2 | 0 | 9 | 28 | |
| 2 | 0 | 19 | 20 | |
| 2 | 0 | 17 | 16 | |
| 2 | 0 | 9 | 24 | |
| 2 | 0 | 10 | 18 | |
| 2 | 0 | 19 | 20 | |
| 2 | 0 | 20 | 26 | |
| 2 | 0 | 18 | 22 | |
| 2 | 0 | 8 | 20 | |
| 2 | 0 | 19 | 20 | |
| 2 | 0 | 17 | 22 | |
| 2 | 0 | 11 | 19 | |
| 2 | 0 | 19 | 20 | |
| 2 | 0 | 7 | 23 | |
| 2 | 0 | 16 | 16 | |
| 2 | 0 | 16 | 20 | |
| 2 | 0 | 19 | 18 | |
| 2 | 0 | 17 | 15 | |
| 2 | 0 | 19 | 18 | |
| 2 | 0 | 14 | 16 | |
| 2 | 0 | 7 | 11 | |
| 2 | 0 | 8 | 8 | |
| 2 | 0 | 23 | 22 | |
| 2 | 0 | 15 | 21 | |
| 2 | 0 | 11 | 21 | |
| 2 | 0 | 15 | 23 | |
| 2 | 0 | 15 | 19 | |
| 2 | 0 | 15 | 24 | |
| 2 | 0 | 20 | 20 | |
| 2 | 0 | 14 | 27 | |
| 3 | 1 | 30 | 39 | |
| 3 | 1 | 30 | 40 | |
| 3 | 1 | 26 | 33 | |
| 3 | 1 | 18 | 36 | |
| 3 | 1 | 25 | 40 | |
| 3 | 1 | 6 | 39 | |
| 3 | 1 | 8 | 32 | |
| 3 | 1 | 31 | 43 | |
| 3 | 1 | 17 | 31 | |
| 3 | 1 | 14 | 38 | |

| | | | | |
|---|---|---|---|---|
| 3 | 1 | 32 | 46 | |
| 3 | 1 | 16 | 39 | |
| 3 | 1 | 24 | 44 | |
| 3 | 1 | 35 | 43 | |
| 3 | 1 | 23 | 45 | |
| 3 | 1 | 23 | 35 | |
| 3 | 1 | 31 | 45 | |
| 3 | 1 | 31 | 41 | |
| 3 | 1 | 32 | 41 | |
| 3 | 1 | 19 | 44 | |
| 3 | 1 | 31 | 42 | |
| 3 | 1 | 32 | 33 | |
| 3 | 1 | 29 | 33 | |
| 3 | 1 | 31 | 33 | |
| 3 | 1 | 17 | 40 | |
| 3 | 1 | 27 | 43 | |
| 3 | 1 | 22 | 34 | |
| 3 | 1 | 6 | 19 | |
| 3 | 1 | 19 | 35 | |
| 3 | 1 | 35 | 44 | |
| 3 | 1 | 28 | 34 | |
| 3 | 1 | 10 | 30 | |
| 3 | 1 | 21 | 38 | |
| 3 | 1 | 3 | 19 | |
| 3 | 1 | 10 | 28 | |
| 3 | 1 | 32 | 45 | |
| 3 | 1 | 12 | 42 | |
| 3 | 1 | 31 | 43 | |
| 3 | 1 | 12 | 30 | |
| 3 | 1 | 29 | 38 | |
| 4 | 1 | 15 | 18 | |
| 4 | 1 | 21 | 15 | |
| 4 | 1 | 24 | 17 | |
| 4 | 1 | 19 | 18 | |
| 4 | 1 | 20 | 21 | |
| 4 | 1 | 30 | 21 | |
| 4 | 1 | 29 | 22 | |
| 4 | 1 | 6 | 16 | |
| 4 | 1 | 15 | 18 | |
| 4 | 1 | 11 | 15 | |
| 4 | 1 | 14 | 22 | |
| 4 | 1 | 19 | 22 | |
| 4 | 1 | 18 | 15 | |
| 4 | 1 | 21 | 32 | |
| 4 | 1 | 21 | 27 | |
| 4 | 1 | 28 | 32 | |
| 4 | 1 | 25 | 31 | |
| 4 | 1 | 9 | 28 | |

| | | | | |
|---|---|---|---|---|
| 4 | 1 | 11 | 29 | |
| 4 | 1 | 14 | 29 | |
| 4 | 1 | 13 | 26 | |
| 4 | 1 | 32 | 28 | |
| 4 | 1 | 24 | 28 | |
| 4 | 1 | 19 | 32 | |
| 4 | 1 | 18 | 27 | |
| 4 | 1 | 10 | 30 | |
| 4 | 1 | 18 | 26 | |
| 4 | 1 | 25 | 26 | |
| 4 | 1 | 12 | 32 | |
| 4 | 1 | 26 | 37 | |
| 4 | 1 | 23 | 26 | |
| 4 | 1 | 15 | 13 | |
| 4 | 1 | 5 | 16 | |
| 4 | 1 | 37 | 41 | |
| 4 | 1 | 19 | 31 | |
| 4 | 1 | 20 | 33 | |
| 4 | 1 | 23 | 37 | |
| 4 | 1 | 41 | 27 | |
| 4 | 1 | 10 | 15 | |
| 4 | 1 | 20 | 31 | |
| 4 | 1 | 10 | 17 | |
| 4 | 1 | 16 | 15 | |
| 4 | 1 | 23 | 31 | |
| 4 | 1 | 25 | 33 | |
| 4 | 1 | 10 | 14 | |
| 4 | 1 | 16 | 10 | |
| 4 | 1 | 16 | 19 | |
| 4 | 1 | 7 | 2 | |

## Legend:

### *Numbers in the column 1:*

**1 = School A**
**2 = School B**
**3 = School C**
**4 = School D**

### *Numbers in the Column2:*

**0 = Schools without any intervention.**

**1 = School with where the intervention was made.**

### Numbers in the column 3 and 4:

**Learners's scores in the pre-test and in the post-test.**

# *Appendix P*

Contents:

***Overall Results of the Analysis of Covariance (ANCOVA)***

# ***Overall Results of Analysis of Covariance (ANCOVA)*:**

## Model Used:

**Dependent variable:** Change in test score:
(post-test score dependent variable) – (pretest score Independent variable)

**Fixed factor:** Intervention: 1= intervention 0 = no intervention

**Covariate:** School:1= School A, 2= School B, 3= School C, 4= School D

| | | Value Label | N |
|---|---|---|---|
| **INTERV** | **0** | No-intervention | 83 |
| | **1** | intervention | 88 |

**Descriptive Statistics**
Dependent Variable: CHANGE

| INTERV | Mean | Std. Deviation | N |
|---|---|---|---|
| **No-intervention** | 5.10 | 6.00 | 83 |
| **intervention** | 9.51 | 8.95 | 88 |
| **Total** | 7.37 | 7.95 | 171 |

**Levene's Test of Equality of Error Variances(a)**
Dependent Variable: CHANGE

| F | df1 | df2 | Sig. |
|---|---|---|---|
| 1.608 | 1 | 169 | .206 |

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a Design: Intercept+SCHOOL+INTERV

| Tests of Between-Subjects Effects<br>Dependent Variable: CHANGE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Source** | **Type III Sum of Squares** | **df** | **Mean Square** | **F** | **Sig.** | **Eta Squared** | **Noncent. Parameter** | **Observed Power(a)** |
| **Corrected Model** | 1692.441(b) | 2 | 846.221 | 15.689 | .000 | .157 | 31.378 | .999 |
| **Intercept** | 2203.436 | 1 | 2203.436 | 40.852 | .000 | .196 | 40.852 | 1.000 |
| **SCHOOL** | 859.869 | 1 | 859.869 | 15.942 | .000 | .087 | 15.942 | .978 |
| **INTERV** | 1534.806 | 1 | 1534.806 | 28.456 | .000 | .145 | 28.456 | 1.000 |
| **Error** | 9061.348 | 168 | 53.937 | | | | | |
| **Total** | 20038.000 | 171 | | | | | | |
| **Corrected Total** | 10753.789 | 170 | | | | | | |
| a Computed using alpha = .05 | | | | | | | | |
| b R Squared = .157 (Adjusted R Squared = .147) | | | | | | | | |

# Estimated Marginal Means

| INTERV<br>Dependent Variable: CHANGE= (Post-test scores) – (Pre-test scores) | | | | |
|---|---|---|---|---|
| | **Mean** | **Std. Error** | **95% Confidence Interval** | |
| **Intervention** | | | **Lower Bound** | **Upper Bound** |
| **No-intervention** | .519(a) | 1.401 | -2.248 | 3.286 |
| **intervention** | 13.829(a) | 1.335 | 11.193 | 16.464 |
| a Evaluated at covariates appeared in the model: SCHOOL = 2.59. | | | | |

# *Appendix Q*

Contents:

Laboratory without Chemicals and Apparatus in School A (Dodo Secondary School).


ICAD LENDO!




SILÊNCIO!

# *Appendix R*

Contents:

Learners Performing Experiments in the Classroom in School C (Manga Secondary Schools).











# *Appendix S*

Contents:

Learners Performing Experiments in a Laboratory in School D (Samora Machel Secondary School).











