

INQUIRY BASED PRACTICAL INSTRUCTION AND ITS EFFECT ON
STUDENTS' ACADEMIC PERFORMANCE IN SECONDARY SCHOOL
CHEMISTRY IN THARAKA-NITHI COUNTY, KENYA

JUSTUS MAKORI **LOBOSO**

E55/CE/34798/2016

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF
EDUCATION (SCIENCE EDUCATION) IN THE SCHOOL OF EDUCATION
OF KENYATTA UNIVERSITY

Oboso, Justus Makori
*Inquiry based practical
instruction and its*



MAY, 2023

KENYATTA UNIVERSITY LIBRARY

DECLARATION

This thesis report is my original work and has not been presented for any academic award at any university or any Institution of higher education for any consideration.

Signature:  Date: 29.05.2023

JUSTUS MAKORI OBOSO

E55/CE/34798/2016

Supervisors

This thesis report has been submitted for assessment with our approval as university supervisors.

Signature:  Date: 29-05-2023

PROF. NICHOLAS WANJALA TWOLI

Department of Educational Communication and Technology.

Kenyatta University

Signature:  Date: 29-05-2023

PROF. SAMSON ROSANA ONDIGI

Department of Educational Communication and Technology.

Kenyatta University

DEDICATION

First and foremost, I dedicate this work to my dear spouse Eusabia Bosibori and our children, Fatima Kemunto and Gabriella Mong'ina, for their prayers, support and encouragement which always gave me the strength to come this far.

Finally, the dedication of this thesis goes to my loving parents Dinah Kemunto, my late Father, Francis Oboso Ombura for not only nurturing and educating me but also laying a strong sense of values and importance of prayers in me, that enabled me to go through the difficult and challenging times that resulted to this thesis.

ACKNOWLEDGEMENT

First, I express my gratitude to the Almighty God for giving me the grace, good health and strength to complete this thesis report. My sincere thanks also go to my very able Supervisors led by Prof. Twoli Nicholas and Prof. Ondigi Samson for their professional guidance and dedication. I must say that you have mentored me very well and this has seen me through the entire process.

Secondly, I express my sincere gratitude to my family that is my dear loving wife Eusabia and our daughters Fatima and Gabriella for the understanding, support and encouragement especially during the time I was away from them, for many hours to write this thesis. To my father-in-law, Dr. Ondieki Cleophas, I thank you for your immense financial support. To Rev.Fr.Alois Stuppner, thank you for financing my undergraduate education.

To all my lecturers during my course work; Dr.Khatete, Dr.Waweru, Dr.Kariuki and posthumously Dr.Mwangi I say thank you for laying a strong scholarly foundation on my classmates and me. To all the teaching and supportive staff in the Department of Educational Communication and Technology, I say a big thank you for the invaluable advice in the course of my study.

To my colleague teachers where I currently teach, I thank you for your moral support.

TABLE OF CONTENTS

| | |
|--|-----|
| DECLARATION..... | ii |
| DEDICATION..... | iii |
| ACKNOWLEDGEMENT | iv |
| LIST OF TABLES | ix |
| LIST OF FIGURES | x |
| ABBREVIATIONS AND ACRONYMS | xi |
| ABSTRACT..... | xii |
| CHAPTER ONE | 1 |
| INTRODUCTION..... | 1 |
| 1.1 Background to the Study | 1 |
| 1.2 Statement of the Problem | 8 |
| 1.3 Purpose of the Study | 9 |
| 1.4 Objectives of the Study | 9 |
| 1.5 Research Hypotheses | 10 |
| 1.6 Significance of the Study | 10 |
| 1.7 Limitations of the Study..... | 11 |
| 1.8 Delimitation of the Study | 12 |
| 1.9 Basic Assumptions of the Study..... | 12 |
| 1.10 Theoretical Framework | 13 |
| 1.11 Conceptual Framework | 14 |
| 1.12 Definition of Operational Terms..... | 16 |
| CHAPTER TWO | 18 |
| LITERATURE REVIEW | 18 |
| 2.1 Introduction | 18 |
| 2.2 Overview of Chemistry Practical..... | 18 |
| 2.2.1 Secondary School Chemistry Instructional Methods | 19 |
| 2.2.2 Guided and Unguided Inquiry Instructional Method | 20 |
| 2.2.3 Inquiry-Based Method of Teaching..... | 21 |
| 2.3 Integration of Inquiry Based Chemistry Practical and Performance..... | 22 |
| 2.4 Quality of Inquiry Based Chemistry Practicals and Academic performance..... | 24 |

| | |
|--|-----------|
| 2.5 Frequency of Inquiry Based Chemistry Practical and Academic performance..... | 27 |
| 2.6 Gender and Academic Performance in Inquiry Based Chemistry Practical..... | 28 |
| 2.7 Conclusion to Literature Review..... | 31 |
| CHAPTER THREE | 33 |
| RESEARCH METHODOLOGY | 33 |
| 3.1 Introduction | 33 |
| 3.2 Research Design | 33 |
| 3.3 Location of the Study..... | 35 |
| 3.4 Target Population..... | 35 |
| 3.5 Sampling Technique and Sample Size..... | 36 |
| 3.5.1 Sampling Technique..... | 36 |
| 3.5.2 Sample Size..... | 37 |
| 3.6 Research Instruments..... | 37 |
| 3.6.1 Chemistry Achievement Tests (CAT)..... | 38 |
| 3.6.1.1 Pre-Test – (CAT)..... | 38 |
| 3.6.1.2 Post –Test-CAT..... | 39 |
| 3.6.2 Interview Guide for Chemistry Teachers..... | 39 |
| 3.6.3. Chemistry Observation Checklist..... | 40 |
| 3.7 Pilot Study | 40 |
| 3.7.1 Validity of the Research Instruments | 41 |
| 3.7.2 Reliability of Research Instruments | 42 |
| 3.8 Data Collection Procedure | 43 |
| 3.8.1 Training of Chemistry Teachers..... | 43 |
| 3.9 Data Analysis..... | 44 |
| 3.9.1 Data Analysis for Observation Schedules and Interview Guide..... | 46 |
| 3.10 Logistical and Ethical Consideration | 47 |
| CHAPTER FOUR..... | 48 |
| PRESENTATION OF FINDINGS, INTERPRETATION AND | |
| DISCUSSION..... | 48 |
| 4.1 Introduction | 48 |
| 4.2 General Demographics..... | 48 |

| | |
|--|-----------|
| 4.2.1 Proportions of the Groups..... | 48 |
| 4.2.2 Proportions of Participants by Gender..... | 50 |
| 4.3 Integration of Inquiry-Based Chemistry Practicals and Academic Performance..... | 51 |
| 4.3.1 Post-Test Students' Academic Performance..... | 54 |
| 4.4.1 Quality of Inquiry Based Chemistry Practicals and Academic Performance..... | 58 |
| 4.5. Effect of Frequency of Inquiry Based Chemistry Practical on Students' Performancer..... | 64 |
| 4.6 Gender Differences and Students' Performance in Inquiry Based Chemistry Practicals..... | 68 |
| 4.6.1 Overall Descriptive Statistics in Post-Test Scores by Gender..... | 69 |
| CHAPTER FIVED..... | 72 |
| SUMMARY, CONCLUSIONS & RECOMMENDATIONS..... | 72 |
| 5.1 Introduction..... | 72 |
| 5.2 Summary of the Study..... | 72 |
| 5.3 Summary of Study Findings..... | 73 |
| 5.3.1 Learners Academic Performance before Treatment..... | 73 |
| 5.3.2. Effects of IBCP and CPW on Students' Academic Performance in Chemistry..... | 73 |
| 5.3.3 Effect of Quality of IBCP on Students' Academic Performance in Chemistry..... | 74 |
| 5.3.4 Effect of Frequency of Inquiry Based Chemistry Practical on Students' Performanced..... | 75 |
| 5.3.5 Effects of IBCP on Academic Performance of Students by Gender..... | 75 |
| 5.4 Conclusions..... | 76 |
| 5.5 Recommendations..... | 77 |
| 5.5.1 Recommendations for Action..... | 77 |
| 5.5.2 Recommendations for Further Study..... | 79 |
| REFERENCES..... | 80 |
| APPENDICES..... | 88 |
| Appendix I: Consent Form..... | 88 |
| Appendix II: Chemistry Assessment Test (Pre-Test)..... | 89 |

| | |
|---|-----|
| Appendix III: Teachers' Training Manual..... | 91 |
| Appendix IV: Chemistry Assessment Test (Post-Test)..... | 93 |
| Appendix V: Chemistry Teachers Interview Guide..... | 96 |
| Appendix VI: Classroom Observation Checklist..... | 97 |
| Appendix VII: Marking Scheme of Pre-Test..... | 100 |
| Appendix VIII: Marking Scheme of Post –Test Cat..... | 102 |
| Appendix IX: Research Authorization Letter..... | 103 |
| Appendix: X: NACOSTI Research Permit..... | 104 |
| Appendix XI: Map of Tharaka-Nithi County..... | 105 |

LIST OF TABLES

| | |
|--|----|
| Table1.1: KCSE Performance of Students in Chemistry at National Level: 2011 to 2019 | 6 |
| Table1.2: KCSE Performance of Students in Chemistry in Tharaka Nithi County (2010-2018) | 7 |
| Table 3.1: Research Design | 34 |
| Table3.2: Sampling Frame (Actual Populations)..... | 37 |
| Table3.3: A summary of Methods of Data Analysis as per the Study Hypotheses..... | 44 |
| Table3.4: Data Analysis for Interviews and Observation Checklist..... | 46 |
| Table 4.1: Distribution of Participants | 49 |
| Table 4. 2: Gender Distribution of Respondents | 50 |
| Table 4.3: Pre-Test Mean Scores for all Groups..... | 51 |
| Table 4.4: Comparison of Pre-Test Mean Scores of EGA and CGA | 53 |
| Table 4.5: Comparison of Pre-Test Mean scores of EGB and CGB..... | 53 |
| Table 4.6: Groups Post-Test Mean Scores and Standard Deviations | 54 |
| Table 4.7: Comparison of Post-Test Mean Scores of Groups | 56 |
| Table 4.8: Comparison of Pre-Test Mean Scores of EGB and CGB | 56 |
| Table 4. 9: Process Skills Observations Results | 59 |
| Table 4. 10: Process Skills Mean Scores Before Treatment..... | 60 |
| Table 4. 11: Process Skills Mean Scores During Treatment..... | 61 |
| Table 4. 12: Comparison Between Process Skills Mean Scores and Post-Test Mean Scores..... | 62 |
| Table 4. 13: Comparison Between Strategies and Post –Test Mean Scores | 66 |
| Table 4. 14: Chi-Square Values for EGA and EGB..... | 67 |
| Table 4. 15: Descriptive Statistics of Post-Test Scores by Gender in Experimental Groups..... | 68 |
| Table 4. 16: Independent Sample t-test of Post-test Mean Scores by Gender in EGA and EGB..... | 69 |
| Table 4. 17: Post-Test Scores by Gender | 69 |
| Table 4. 18: Independent Sample T-test of Post-Test Mean Scores by Gender | 70 |
| Table 5. 1: Summary of Hypotheses Testing..... | 76 |

LIST OF FIGURES

| | |
|--|----|
| Figure 1.1: Conceptual framework for the study | 15 |
| Figure 3.1: Study Design and Process..... | 34 |
| Figure 4. 1:Percentage Distribution of Groups..... | 49 |
| Figure 4.2: Gender Distribution of the Respondents | 50 |
| Figure 4.3: Groups Mean Score for Pre-Test..... | 52 |
| Figure 4.4:Groups Mean Scores for Post-Test..... | 55 |
| Figure 4.5: Process Skills Mean Score..... | 62 |

ABBREVIATIONS AND ACRONYMS

| | |
|-----------|--|
| CAT | Chemistry Achievement Test |
| CEMASTEIA | Centre for Mathematics, Science and Technology Education in Africa |
| CPW | Conventional Practical Work |
| IBCP | Inquiry Based Chemistry Practical |
| KCPE | Kenya Certificate of Secondary School |
| KCSE | Kenya Certificate of Secondary Education |
| KICD | Kenya Institute of Curriculum Development |
| KNEC | Kenya National Examinations Council |
| MoE | Ministry of Education |
| NACOSTI | National Commission of Science, Technology and Innovation |
| NRC | National Research Council |
| SDGs | Sustainable Development Goals |
| SMASSE | Strengthening of Mathematics and Science in Secondary Schools |
| TSC | Teachers Service Commission |
| UK | United Kingdom |
| USA | United States of America |

ABSTRACT

Inquiry based practical is meant to promote meaningful learning in science subjects. The aim of the study was to ascertain the academic performance differences in Chemistry between learners exposed to Inquiry Based Chemistry Practicals(IBCP) and those taught using conventional practical approach. The specific objectives were first, to determine the difference in academic performance of learners taught using integration of inquiry based instruction in Chemistry practicals. Secondly, to compare the quality of IBCP on students' academic performance in secondary schools. Thirdly, to determine the frequency of using IBCP on students' academic performance. The last objective was, to establish whether there were gender differences in academic performance of learners in Chemistry when taught using inquiry based instruction. The research adopted quasi-experimental based on pre-test and post- test arrangement. There were 110 Secondary Schools in Tharaka-Nithi County. Four Secondary Schools were purposively sampled and they included two Girls' and two Boys' Secondary Schools. The four Schools were assigned randomly to either Control or experimental groups. The study sample comprised 182 Form Three Chemistry learners from the selected Public secondary schools. The study involved two Schools in the experimental groups who were exposed to the treatment and two control groups that were not exposed to inquiry-based Chemistry practical on the topic "Qualitative analysis" for a period of six weeks. This topic involves identification of cations and anions in compounds. Data collecting instrument were; Chemistry Achievement Test (CAT); pre-test and post-test, Chemistry observation schedules and interview guide. The pre-test CAT and post-test CAT were administered before and after exposure to both experimental and control groups respectively. A pilot test was done using the instruments that were used in the actual study in two Secondary Schools in Tharaka-Nithi County. The Schools were assumed to have the same characteristics as those that were sampled. The study assumed that the findings could be useful not only to the curriculum developers but may also provide insights to researchers in science education. The data was keyed in SPSS version 26, reports were generated and analyzed using both descriptive and inferential statistics. The differences between the means of the two groups were analyzed using t-test. The statistical significance was tested at $\alpha = 0.05$. The findings of the study indicated that the students who were instructed through IBCP attained higher scores than their counterparts who instructed through CPW. The study further revealed that the female students attained higher scores than male students when both were instructed through inquiry based Chemistry practical approach. The study recommends the use of inquiry-based approach by teachers of Chemistry to enhance the academic performance of students. The study further recommends that curriculum developers in secondary schools should emphasize teaching through inquiry-based approach.