Gender Differences in Performance of Chemistry Practical Skills among Senior Six Students in Kampala District

Fredrick Ssempala
DEDICATION

This dissertation is dedicated to my father, Clement Ssempala, my Aunt, Clementina Nanteza, and my late grandmother, Esther Namakoye Kiwotoka, who played a great role in my education and life in general.
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ABSTRACT

The aim of this study was to determine if there were gender differences in the performance of Chemistry practical skills among senior six girls and boys in selected mixed secondary schools in Kampala District from February to March 2004. The study participants were drawn from five mixed secondary schools in the district. A total of fifty students participated, half of them girls and the other half boys.

A cross sectional descriptive research design was used involving both quantitative and qualitative research strategies. The instruments of data collection were a Chemistry practical test (Quantitative analysis), student questionnaires and in-depth interviews. Questionnaires were filled by all students and forty randomly selected students were interviewed by the researcher.

The following were the findings:
1. There was no statistical significant differences between girls and boys in their ability to manipulate the apparatus/equipment, take observation, report/record results correctly, and compute/interpret/analyze results during the Chemistry practical.
2. Both female and male students perceived interpreting/analyzing results the most difficult skill to perform, whereas manipulation of apparatus/equipment was perceived to be the easy skill to perform during Chemistry practical by both gender.
3. Girls had a poor self-confidence in their ability to perform Chemistry practical, as most of them (90%) believed that boys are better than them.

Although girls performed slightly better than boys overall, the skills in which boys performed slightly better than girls in recording/reporting results correctly, and computing/interpreting/analysing results, contribute a higher percentage in the assessment of Chemistry practical examinations by the UNEB examiners. Hence, it may be the reason why boys perform better than girls in UNEB Chemistry practical examinations, and in ‘A’ Level Chemistry examinations generally.

The recommendations were that Chemistry teachers in ‘O’ Level should make sure that students are taught mole concept, volumetric analysis and Ionic Chemistry, and balancing equations early enough so that both girls and boys are able to compute/interpret/analyze results and also further research be done on gender and Chemistry practical skill performance, considering qualitative analysis practical for both ‘O’ and ‘A’ Level, so that more knowledge is gained about the effect of gender on performance of Chemistry practical skills.
CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Practical work plays a central role in teaching of Chemistry (Fuhrman, M., Lunetta, V. N. & Noviek, S. 1982). According to Okebukola (1987), the main aim of practical work in Chemistry is to: make accurate observation and description of chemical phenomena; develop specific manipulative skills; practice seeing problems relating to Chemistry and seeking ways to solve them; develop a logical reasoning method of thought; develop self-reliance; verify principles and facts already learnt; develop certain disciplined techniques; develop a critical attitude; and be able to comprehend and carry out instructions (Okebukola, 1987).

However, most of the teachers in developing countries consider practical work simply as a means to confirm scientific knowledge (Monk, M. J., Fairbrother, R. W. & Dillan, J. S. 1993) and give little attention to the development of practical skills in students and their assessment.

Kempa (1986) reported that the development of practical skills and abilities must form an integral part of the set of educational goals that is to be associated with science education. That is why practical work has traditionally played a very important part in all science education programmes right from secondary school to tertiary institutions. This has manifested itself in the provision of laboratories and
other facilities required for practical work in science subjects in all our educational institutions.

In Chemistry teaching, the laboratory is the unique forum for the pursuit of the above aims. The expectation is that during laboratory activities, students are provided with experiences predisposing towards acquisition of scientific process skills needed for the collection and discovery of new information. Therefore, the need to equip students with process skills during laboratory teaching becomes evident.

Yanger, R. E., Engen, H. B. & Snifer, B. C. F. (1969) suggested that the laboratory can provide an excellent opportunity for the teaching of technical skills. They found that students in "discussion" settings were able to learn some laboratory-oriented intellectual skills as efficiently as students in laboratory settings, but they were unable to perform competently on a range of technical skills. Other studies by Fits and Pasner (1967) and by Gagne (1970) showed that successful acquisition of technical skills requires the learner to have an overview of the skills routine, specially if complex instruments were involved, and that learning skills required practice and competence continued to improve with practice over long periods.

In Uganda Advanced Certificate of Education (U.A.C.E.) Chemistry syllabus, P525, currently being taught, an experimental approach is emphasized. In fact, two of the aims of the syllabus are directly related to the Practical Chemistry.
i) To teach students to argue from the observed facts (qualitative aspects) and to adopt a quantitative approach to chemical problems.

ii) To help the students to develop the necessary intellectual and manipulative skills to solve practical chemical problems.


Students offering Chemistry P525 are required to do two theory papers and one practical consisting of three compulsory questions. In the first practical question, candidates are given full instructions for carrying out an experiment which may involve, for example, measuring the volume of gas liberated during the reaction, determining the rate of reaction, investigating a chemical equilibrium, and so on. Such experiments involve manipulation of simple laboratory apparatus and may involve weighing. All students are expected to be familiar with the use of electrical balances. The second/third question involves an application of the knowledge of inorganic and/or organic reactions (UNEB, 1998-2003). It is noted in the U.A.C.E. Chemistry syllabus (UNEB, 1998 pg 170) that,

*It is not intended that practical examination should determine the nature of practical work performed by all candidates. The theory papers will also assume a knowledge and understanding of a wide range of practical work. The syllabus is designed such that a large proportion of the practical work can be performed on small scale and using simple apparatus.*
To qualify for a principle pass in P525 Chemistry, a candidate must obtain at least Grade 6 or better in one of the Papers 1 and 2 and must not obtain a Grade 9 in any of the papers taken (UNEB, 1998, pg 13).

Taking into account the above aims of the P525 Chemistry syllabus, and the resources spent in putting up infrastructure and provision of teaching aids for 'A' level Chemistry, one wonders whether the students do acquire the stipulated skills. These skills form a substantial component of practical examination and theory examinations as well, and the practical paper contributes to the overall performance in P525 Chemistry. This implies that students' achievements in practical skills do affect their overall performance in P525 Chemistry exams. The Uganda Advanced Certificate of Education examinations results in Chemistry for the last four years indicate that good performance was by male students (UNEB, 2003). One wonders therefore, whether there may be significant differences in the performance of Chemistry practical skills between males and females students.

A study done by Barbara and Wayne (1996) in USA, showed that gender inequities were most evident in laboratory assignment, consistent with Tobin's (1988) observation that females are less likely to be involved in operating laboratory equipment.

According to Wall (1977), it is the natural differences between men and women, which dictate on their occupational choice, while Liebert (1981) and Okou (1991) concluded that sex has a strong influence on vocational aspirations. Nabulya (1989) also found out that more males than females chose vocational and
technical subjects. Johnson and Murphy (1987) also reported that in Britain, girls performed consistently better than boys in observational skills while boys performed consistently better in measurement skills and computational skills. But in all process skills, Hobbs, E. D., Boldt, W. B., Erickson, G. L., Onelch, T. P. & Sieben, G. A. (1979) reported that performance between the two sexes was about the same.

In a more detailed study on factors affecting choice of science subjects in England, Brickhouse (1990) identified the lack of informal science experience out of class for girls and societal expectations as the main ones limiting girls from opting for Chemistry in high schools. It is against this background that this present study is being undertaken in an attempt to find out whether there are gender differences in performance of Chemistry practical skills among advanced level Chemistry students in Uganda secondary schools.

1.2 Statement of the problem

In Uganda, the trend of academic excellence at `A' level has shown that boys perform better than girls in Chemistry examination (UNEB, 2003). Chemistry being one of the essential science subjects in most of professional courses at the University level, the poor performance in Chemistry by the girls, limits their opportunities to offer professional courses like Human Medicine, Veterinary Medicine, Pharmacy, Agriculture, Food Science and technology, Civil Engineering, Industrial Chemistry, and so on. Poor performance in Chemistry,
which potentially contributes to lowering girls’ interest in the subject, reduces the women in science and technological carriers in Uganda today, where we are currently in need of highly skilled human power for national development.

The ‘A’ level Chemistry examination consists of two theory and one practical paper. It is not yet established whether the difference in performance between boys and girls in these examinations is greatly due to gender differences in the students' ability to perform Chemistry practical skills.

1.3 Purpose

The main purpose of the study was to determine whether there are differences in performance of Chemistry practical skills among senior six boys and girls in selected secondary schools in Kampala District.

1.4 Objectives

This study was guided by the following objectives:

i) To determine gender differences in abilities of students to manipulate the apparatus and equipment during the chemistry practical.

ii) To determine gender differences in students’ abilities in making observations during chemistry practical.

iii) To assess gender differences in students’ reporting skills during the chemistry practical.
iv) To identify gender differences in computing, interpreting and analysis skills during the chemistry practical among students.

v) To examine gender differences of students’ perceptions of their abilities in performing chemistry practical.

1.5 Research questions

In order to realize the above objectives, this study sought to answer the following research questions:

1. What are chemistry practical skills male and female students find most difficult to perform? Why do they find them most difficult? What gender differences are manifested?

2. What are chemistry practical skills male and female students find easy to perform? Why do they find them easy? What is the gender differences in these perceptions and experiences?

1.6 Hypothesis of the study

Besides the research questions above, the following null hypotheses were tested in this study:

Hypothesis one

There is no significant difference between male and female students in their ability to manipulate the apparatus and equipment during Chemistry practical.
Hypothesis two

There is no significant difference between male and female students in their ability to make observations during the Chemistry practical.

Hypothesis three

There is no significant difference between male and female students in their ability to report results correctly during the Chemistry practical.

Hypothesis four

There is no significant difference between male and female students in their ability to compute, interpret and analyze results during the Chemistry practical.

1.7 Scope

The study sought to find out whether there are gender differences in performance of Chemistry practical skills among senior six students in Kampala District mixed Secondary Schools. The five schools were randomly selected, and in each school, ten senior six students offering Chemistry were randomly selected (five boys and five girls) to perform a quantitative analysis Chemistry practical exercise. The total of fifty students (25 boys and 25 girls) participated in the study.
1.8 Significance

The findings of this study will add to the existing body of knowledge about students’ abilities in practical aspects of Chemistry at Uganda Advanced Certificate of Education (U.A.C.E.) level. Using this knowledge:

i) Teachers of Chemistry and other Science educators may understand better how boys and girls differ in their performance of practical Chemistry skills. This may enable them to devise techniques that may maximize the benefits of training in practical chemical skills for both boys and girls.

ii) UNEB examiners and Chemistry teachers may be able to set examinations that take into account any differences in the abilities of boys and girls in the performance of Chemistry practical skills.

iii) Other researchers may use these findings to guide them conduct further research in order to add more knowledge about gender and performance in Chemistry practical skills.

1.9 Definition of terms

In this study, the following terms and phrases were used in the following contexts:

i) Chemistry laboratory practical

These are experiments performed within the laboratory.
ii) **Gender differences**

These are differences as a result of being either a female or male arising from social and a cultural construction of roles associated with these sex differences.

iii) **Practical skills**

These will also be referred to as process skills. These mean experimental skills such as observation, recording, manipulation, analysis and interpretation.

iv) **Student’s ability in a practical task**

This is the degree of successful execution of an experiment.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature related to this study is reviewed under three sub-topics namely: Gender and general performance; Gender and science performance; and Gender and Chemistry performance.

2.2 Gender and general performance

Gender and its manifestation in various human activities appears to be a strong predictor of human conduct. In education, many differences have been documented between achievements of males and females. Many researchers and educationalists (Maccoby and Jackline, 1974) feel that gender difference is one of the factors that affect academic performance.

In a review of research in the United States, Tyler (1956) reported that in all studies, girls achieved consistently higher than did boys. They were less frequently retarded and were more frequently accelerated through the years of schooling than boys. When achievement tests were used to assess performance rather than using school grades, girls continued to exceed boys in performance in language studies and boys tended to perform better in Mathematics.
It was later found out by Maccoby and Jackline (1974), that gender differences in attainment were well established in areas of Mathematics, spatial and verbal abilities, with boys excelling in the first two and girls in the latter. The report of the International Association for the Evaluation of Educational Achievement (IEA) studies on six subjects other than Science and Mathematics as reported by Walker (1976) showed that in reading comprehensive tests, boys showed lower performance than girls. Boys also did less well in the cognitive Literature test and in English as a foreign language. But in civic achievement tests, boys generally recorded higher scores than girls.

Gender differences in achievement have been shown to arise from societal expectations. In their study, Bank, B. J. (1980) discovered that there was no difference in reading abilities among girls and boys in Israel because of societal expectation of equal responsibility for men and women. However, according to them, the fact that girls consistently did better in verbal tasks would make for feminine superiority in all sorts of school work, involving reading, writing or reciting. According to Tylor (1956), the most plausible explanations for the difference in achievement are differences in attitudes and personality traits, which enable girls to make a better impression on teachers than boys do.

Tobin and Garnett (1987) found out that males tended to be more involved than females in public interactions in whole class settings. For example, males tended to participate in a more overt manner than females by responding to
teachers’ questions by raising their hands when teachers asked questions in a whole class setting.

Welch (1958), while analyzing National Assessment Data in the United States of America between 1981 – 1982, found out that boys achieved at higher levels than girls on concepts such as experimental design, models, hypotheses and errors of measurement. Spear (1989) also carried out a similar study on work related attributes in England. He reported that teachers thought that boys were more original, constructive, experimental and logical than girls. Boys were also judged to be more analytical and better able to understand and apply general principles. He further concluded that work attributed to a boy was generally rated higher for scientific accuracy, richness of ideas and organization of ideas than identical work attributed to a girl. In the same study, Spear observed that girls were seen to be more initiative, persevering, industrious and neat.

Across different cultures and time, the pattern of gender differences in performance may take on surprisingly different directions. In Taiwan, Chou (1990) found out that girls consistently performed better than boys in all achievement variables. While Marsh (1989) reported that girls were able to earn better grades, to spend more time on homework, to be more conscientious in school work and to be slightly more likely to attend College or University.