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Influence of Conceptual Instructional Method on Students' Performance in, and Attitude Towards Chemistry Practical among Secondary School Students in Zaria Educational Zone, Kaduna State, Nigeria

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Abstract

The study investigated the Influence of Conceptual Instructional Method on students' performance in, and attitude towards Chemistry Practical in Zaria Educational Zone of Kaduna State. The target population for the study was 1401 S.S. II Science Students. The subjects in the coeducational schools were pretested and schools that did not differ significantly were chosen for the study. A sample of 100 Students was randomly drawn from two co-educational senior secondary schools, within Zaria Educational Zone. The subjects were divided in to two groups: The experimental group and the control group of 50 students each. The pre-test–post-test quasi-experimental *control group design was adapted. The subjects in the experimental group were exposed to Conceptual Instructional Method, while those in the Control group were exposed to the lecture instructional strategy for a period of six weeks. The instruments developed and validated for data collection are: Chemistry Practical Performance Test (CPPT) with reliability coefficient of 0.73 and Chemistry Practical Attitude Inventory (CPAI) with reliability coefficient of 0.79. Two research questions were stated and two null hypotheses were tested. The data collected were subjected to statistical analysis at 0.05 level of significance. The t-test statistics was used to test the hypotheses on performance, Mann-Whitney U-test was used to test the subjects' change in attitude towards Chemistry Practical. The major findings from the study include the following: The practical performance and attitude of the subjects exposed to Conceptual Instructional Method were significantly higher than their counterparts exposed to lecture method of instruction.*

On the basis of the findings outlined above, it was concluded that, conceptual instructional method enhances senior secondary school students' practical performance in and attitude towards Chemistry Practical. Recommendations were made amongst which include:

Chemistry teachers should incorporate conceptual instructional method for teaching Chemistry Practical at senior secondary school level.

Introduction

Science educators have been advocating the need for science instruction at all levels to focus on enhancing students conceptual understanding, higher levels of performance in scientific thinking, reasoning and problem solving. (Chin & Chia, 2005). This advocacy is inconsistent with various reform initiatives around the globe, for both science and mathematics curricula and classroom practices. For instance, the need to develop students conceptual understanding and scientific literacy by using inquiry and problem-solving experiences and skills acquisition has been emphasized in the United States reform documents of the American Association for the Advancement of Science (AAAS, 2008).

The role of Chemistry in the development of the scientific base of a country cannot be over-emphasized and Nigeria is not an exception (Oloyede, 2010). Chemistry is one of the Science subjects taught at the senior secondary school level. It is one of the core science subjects that students are required to pass in order to qualify for admission into tertiary institutions to pursue science-based programmes like Medicines, Engineering, Pharmacy, among others (Njoku, 2007).

Chemistry students who have inadequate practical knowledge find it difficult to cope with some aspects of the course, which is an indication that understanding of Chemistry Practical affects understanding of the theoretical aspects (Muhammad, 2007). In Chemistry teaching, the importance of harmonizing practical work with theory cannot be over-emphasized. Omolade (2008) states that; if the performance of students is to be enhanced, learners must have deep understanding of basic concepts behind the practical tasks they engage in.

In spite of this important position of Chemistry among other science and science-related disciplines, students' performance has consistently been below expectation and unimpressive (Jegede, 2010). Science education researchers have been concerned with developing ways of facilitating students' understanding of concepts that are fundamental to the understanding of science (Palmer, 2002).

Ibrahim, Erdal and Mustapha (2009) states that; Conceptual instructional method is a process of acquiring a better understanding of concepts. Rettle (2009) states that; good conceptual knowledge can aid problem-solving and enhance academic achievement in Chemistry Practical. The present study is aimed at also investigating students' attitude towards Chemistry Practical. Students' attitude towards a subject affects their understanding of the subject (Timothy, 2005). Therefore when students have positive attitude towards Chemistry Practical, it will enhance good conceptual understanding of the concepts being taught.

Erkus (2003) says that teachers realize the importance of how students feel about science subjects and courses; nevertheless they place little emphasis on affective objectives. The affective domain is often neglected because teachers have difficulty in designing strategies to develop positive attitude among students and documenting their development (Thomas & Kobella, 2002). However, students' achievement also depends on attitudes that allow them to participate in and ultimately benefit from academic instruction in classroom (Liza, 2010). Since the teaching strategy employed by teachers influences the attitude of students towards a subject, as learners who are taught meaningfully have good grasp of concepts which is expected to enhance their performance and thus motivate them to develop positive attitude towards the subject.

Research in chemistry education has continued to seek better approaches to teaching Chemistry Practical in order to bring about meaningful learning and to identify factors responsible for persistent problems of low conceptual understanding among students. (Erlis, Subramanian & Nian, 2004). Njoku (2007) conducted a research that compared students' achievement in the three categories of questions i.e (Qualitative chemical analysis, quantitative chemical analysis and theory of practical) in senior secondary school certificate (WAEC) Chemistry Practical examination. Njoku (2007) found that students scored the highest mark in quantitative chemical analysis and the lowest mark in theory of practical aspect of the examination. Njoku (2007) inferred that students low performance was due to lack of in-depth conceptual understanding of chemical concept behind Chemistry Practical. Njoku further stressed that if teachers teach concepts upon which practical are based, performance in Chemistry Practical may be greatly enhanced. Njoku (2007) then recommended the development of theoretical background knowledge of concepts upon which the practical activities are to be based. Musa (2000) and Bugaje (2010) conducted similar researches and found that, students performed poorly in the theoretical aspects of Chemistry Practical. It is based on this recommendation that this study intends to expose students to the concepts in Chemistry Practical to find out whether it will enhance their performance or not.

Research Questions

This study seeks to answer the following research questions:

1. What is the difference in practical performance of subjects taught Chemistry Practical concepts using conceptual instructional method and those taught the same concepts using lecture method at senior secondary school level?
2. What is the difference in attitude of subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using lecture method of instruction?

Null Hypotheses

$H_{o1:}$ There will be no significant difference in the practical performance between subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using lecture method at senior secondary school level

$H_{o2:}$ There will be no significant change in attitude between subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using lecture method

Methods

A pretest, posttest, quasi-experimental/control groups design is used. Two groups of students participated in the study, i.e., the Experimental and Control groups. The population of the study comprises of S.S. II science students in the 17 public senior secondary schools that offer chemistry in Zaria Educational Zone of Kaduna State Nigeria. The S.S. II students were chosen because in most of the schools the students are exposed to Chemistry Practical at SS II level. The population comprises of single-sex and co-educational schools. There are four male Schools, four female Schools and nine co-educational schools in the population. The total number of students in the population are 1401, comprising of 865 males and 536 females.

One hundred students served as sample for the study. Nine co-educational schools were chosen for the research to ensure that both male and female students were exposed to the same mode of instructions under the same condition. Therefore only the nine (9) co-educational schools were chosen out of seventeen (17) schools in the population and comprises of 684 students out of which 416 are males while 268 are females. The nine schools chosen were pre-tested and ANOVA statistical tool was used to analyse the data.

Two schools that do not differ significantly were chosen and also randomly assigned as experimental and control centres. 20% of students from the sample in each school were used for the study which is in accordance with the central limit theorem by Tuckman (1975) who recommended a minimum of 30 subjects as sample for experimental research.

A pre-test (O_1) was administered to the two groups in order to determine the equivalence of the groups in ability before the commencement of the treatment. The experimental group was given the treatment i.e. they were taught the concepts in Chemistry Practical using Tennyson and Cocchiarella model (1986) of concept teaching. The control group was taught the same Chemistry Practical concepts using the lecture method. At the end of the treatment period, a post-test (O_2) was administered to both groups of students in order to evaluate the effectiveness or otherwise of the treatment for enhancing the learning of Chemistry Practical concepts among SS II students.

The instrument developed and used for data collection are:-

i Chemistry Practical Performance test(CPPT) with reliability coefficient of 0.73

ii Chemistry Practical Attitude Inventory (CPAI) with reliability coefficient of 0.79.

The two instruments were validated by: a Ph.D holder and a senior lecturer in the Department of Chemistry, Ahmadu Bello University, Zaria, a Ph.D. holder and a chief lecturer in department of Chemistry Federal College of Education Zaria, Ph.D. holder a senior lecturer in the Department of Psychology, Ahmadu Bello University, Zaria.

Before the commencement of the treatment, a pretest was administered to both the experimental and control groups. The students' practical skills were tested using the chemistry practical performance checklist (CPPT) while the Chemistry Practical Attitude Inventory (CPAI) was administered to both the experimental and control groups. The experimental group was exposed to conceptual instructional method using Tennyson and Chocchiarella (1986) model of concept teaching. The concepts in Chemistry Practical were taught employing the integrated teaching strategy which involves different methods where applicable such as: practical, discovery, problem solving among others. The teaching of the concepts was done by the researcher.

The control group was taught the same concepts by the researcher using the lecture methods for the same duration. The concepts was discussed and explained verbally using talk and chalk, students wrote notes where necessary and asked questions where they find difficult to understand. The teaching of both experimental group and control groups was guided by the lesson plan. After six weeks period of treatment, a posttest was administered to both experimental and control groups.

Data Analysis, Results and Discussion

The results obtained from the data analysis are presented in tables 1.1 and 1.2 which are used to test the stated hypotheses:

Ho1: There is no significant difference in the practical performance between subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using lecture method at senior secondary school level.

Table 1.1: ***Comparison of Practical Performance of the Post-test mean Scores of the Subjects in the Experimental Group Exposed to Conceptual Instructional Method***

Groups	**N**	**X**	**S.d**	**S.E**	**df**	***t*-value**	***p*-value**	**Remarks**
Experimental	50	34.12	10.95	1.55	98	3.94	0.008	Significant
Control	50	26.86	7.14	1.01				

Significant at p d" 0.05

In Table 1.1 at df 98, the calculated *t*-value and *p*-value at p d" 0.05 are 3.94 and 0.008 respectively. The calculated *p*-value being lower than *p* d" 0.05 set to determine the level of significance. This means that there is significant difference in the practical performance between the subjects in experimental and control groups. It implies that, the subjects taught using conceptual instructional method performed significantly better than those taught using the lecture method of instruction. This is also shown from the mean scores 34.12 for the subjects in the experimental group which is higher than mean scores values 26.86 for the subjects in the control group. Thus, there is statistically significant difference in the practical performance of SSII chemistry students exposed to conceptual instructional method and those exposed to lecture method. Therefore the null hypothesis is rejected.

Ho2: There is no significant difference in the attitude of subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using lecture method.

Table 1.2: ***Comparison of the Attitude Change of the Subjects Taught Using Conceptual Instructional Method***

Groups	N	Mean Rank	Sum of Ranks	Mann-whitney	U-test	P	Remarks
Experimental	50	69.69	3484.50	290.500		0.00	Significant
Control	50	31.31	1565.50				

Significant at p d" 0.05 level

In Table 1.2, the *p*-value of 0.00 was obtained which is lower than *p* d” 0.05 level of significance set for the research and the mean rank values of 69.69 for the subjects in the experimental group is higher than 31.31 for those in the control group. This indicates that subjects exposed to conceptual instructional method shows more positive attitude towards Chemistry Practical than those exposed to lecture method of instruction. It also implies that there is significant difference in the attitude change of the subjects to the learning of Chemistry Practical concepts using conceptual instructional method therefore the null hypothesis is thus rejected.

Discussion of the Results

The results in Table 1.1 showed a significant difference in the mean scores of the subjects in the experimental and control groups. The subjects in the experimental group performed significantly higher than their counterparts in the control group. A similar research was conducted by Sevgi, Nurdane, Yezdan, Ayla and Octlay (2009) in which they evaluated whether a chemistry laboratory course called "Laboratory experiments in science education" based on constructivist instruction enhanced pre-service chemistry teachers' conceptual understanding or not. Results shows that pre-service teachers had good conceptual understanding about Chemistry Practical, also using constructivist instruction as instructional tools was effective in promoting conceptual understanding. The result is also in line with that of Domin (2007) who reported that, the students who were exposed to practical work in the laboratory using conceptual instructional method, performed better than those taught using the traditional method of teaching. The significant difference in favour of the experimental group suggests a greater effectiveness of the conceptual instructional method which was used to teach the subjects in the experimental group. On the other hand, this is in contrast with the students in the control group who were taught the same concepts using lecture method of instruction.

The results in Table 1.2 revealed a significant difference in attitude change of subjects taught Chemistry Practical concepts using conceptual instructional method and those taught using the lecture method of instruction. The *p*-value of 0.00 at 0.05 level of significant which is far less than the *P*-statistics set for the research, further confirms a significant difference between the experimental and the control groups. This attitudinal change can be attributed to the strategy used for the teaching. Olorukooba (2001) used cooperative instructional strategy which is also activity based, to teach Chemistry students.

The result revealed that students developed positive attitude by engaging in group work, the attitude expressed by the experimental group can be described as being favourable due to the educational benefits the subjects derived from the instructional strategy. Conceptual understanding enhances performance which creates interest, positive attitude and desire to participate in classroom activities. These benefits include: conceptual understanding which leads to improvement in practical performance of the subjects in the experimental group.

Conclusions

Based on the findings from this study, it is concluded that conceptual instructional method enhances practical performance as well as attitude of senior secondary school students towards Chemistry Practical. Therefore, conceptual instructional method is viable and has potential to enhance senior secondary school students' practical performance in chemistry and promote acquisition of practical skills.

Recommendations

On the basis of the findings and conclusions reached, the following recommendations are made:

1. The use of conceptual instructional method by Chemistry teachers should therefore be encouraged in all the Nigerian secondary schools.

2. It is also recommended that teacher training colleges, universities and educational institutions should incorporate conceptual instructional method in their curricular at all levels.
3. Professional associations like; the Science Teachers Association of Nigeria (STAN), Chemical Society of Nigeria (CSN) and Research Centres should incorporate conceptual instructional method in their science curricular at senior secondary school level.

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