

The Effects of Teachers' Qualifications on Students Mathematical and Problem Solving Abilities on Mole Concept.

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Abstract

The study was designed to analyze the effects of teachers' qualifications on students mathematical and problem solving abilities. Ex post facto Research design was adopted. The sample of sixty four students (64) selected from four schools in Minna. The major instrument for data collections was problem –solving test on mole concept (PSTMC) and mathematical Ability test (MAT) made up of 36 short answer questions. The PSTMC instrument was validated experts and 10 questions out of 15 were accepted for use. The MAT was not validated by the researcher because it was adopted. Two hypotheses were tested using Analysis of variance statistics (ANOVA) with the aid of computer statistical package for the social sciences (SPSS). It was found that students taught by chemistry teachers with BSc Education performed significantly better than those taught by teachers with NCE and BSC holder. It was recommended that in-service training should be organized for chemistry teachers on regularly in order to keep them abreast with current research trends, techniques in science teaching.

Background to the study

The future of today's society depends on science and technology. Thus, science teaching methods and attitude of pupils and teachers to science teaching and learning should reflect scientific approach. Therefore students of science education should not only be well versed in scientific knowledge but should also be good in problem solving. It is against this backdrop that many science educators now emphasize methods of science teaching which focus not only on regular citation of fact but also on students problem solving skills to meet the present scientific and technological trend (Orji 2000; Asoj 1991; and Bilgin, 2005).

Teaching students to solve problem is a basic activity in science education therefore there is the need to cultivate in students the ability to exhibit higher level of problem solving skills when exposed to appropriate instructions. The use of appropriate instructional strategy will provide opportunities for the learner to interact with materials, ask questions, interpret results, develop skills and consequently promote performance at higher cognitive level. Several researches have shown that teachers are continuously criticized for their lack of problem solving proficiency and this invariably affects students' problem- solving skill (Ajewole, 1990).

In spite of the importance of chemistry in the senior secondary school curriculum, the West African Examination Council (WAEC) showed both low enrolment and poor performance in chemistry (Adeyegbe 1993; WAEC, 1996) This has been attributed to a number of factors among which are, lack of qualified science teachers, lack of equipment, admission of unqualified students and poor classroom management and gender gap in mathematical ability (Balogun, 1994, Igwe, 1994 and Pwol, 1993).

The teacher as the implementer of the curriculum has the greatest influence in the teaching and learning of chemistry subject in senior secondary school. A number of researchers have found positive correlation between teachers qualification and the performance of students in school. (Okonkwò and Igbokwe, 2000). Contrary to this view, Jencks cited by Igwe (1990) did not find any positive correlations and students performance in chemistry. Therefore, the relationship between teachers' qualification, students performance and problem solving skills in chemistry need to be investigated.

Most science educators maintained that the bed-rock of physical sciences such as physics and chemistry is mathematics. Researchers found that students with high mathematical ability perform better than those with low mathematical ability (Adesoji, 1999 and Ajueshi 1985)

Within the last two decades much has been said on the difficulties students of varying ages at secondary school level are having in coping with certain chemistry concepts such as concepts such include mole concept, ionic theory and electrolysis (Huddle, 1996 and Ahiakwo, 1991). Difficulties in understanding some of these chemical concepts have been attributed to lack of organizational skills in approaching the problem, abstract nature of some of these concepts, students mathematical anxiety and instructional methods employed (Bilgin 2005, Reid and yang 2002). Ahiakwo (1991) examined the performance of students in solving mathematical problems related to mole concept in chemistry and found that the specific areas that presented most difficulties were;

1. Fraction (where proportion is the source of difficulty).
2. Manipulation of algebraic expression (where lack of understanding of the proportion of numbers is the source of difficulties).
3. Exponential numbers (where the student visualize very large or small numbers as difficulties).

Statement of the problem

It has been observed that solving quantitative problem is one of the most common difficulties students of chemistry face in Nigerian schools. (lee & Fensham 1996 & Furio et al 2000). Research findings have shown that majority of the students solve problems using only algorithmic method or through trial and error or sometimes involve a solution presented in class to a problem they wrongly assumed to be similar to the one they are solving (Agbeyewa, 1997). The training of chemistry students to possess adequate problem-solving skills could facilitate meeting the present scientific and technological needs of the 21st century. Therefore, this study attempts to investigate the effects of teachers' qualification on mathematical and problem-solving abilities of chemistry students on mole concept.

Objectives of the study

The Objectives of the study are:

1. To determine the extent to which teachers qualification affects problem-solving ability of chemistry students in mole concept
2. To determine the extent to which teachers qualification affects mathematical ability of chemistry students.

Research Questions

To guide the investigation, two research questions were examine

1. Is there any significant difference between the mathematical ability of students taught by holders of National Certificate in Education (NCE), Bachelor of Science (BSC) degree and Bachelor of Science (BSC) in Education?
2. Is there any significant difference between the problem solving abilities of students taught by holders of Nigerian Certificate in Education (NCE), BSC, and BSC in Education?

Hypotheses

The following hypotheses will be tested at 0.05 level of significance.

Hypothesis One (HO₁); There is no significant difference in the mathematical ability of students taught by holders of Nigerian certificate in Education (NCE), Bachelor of science(BSC) and those taught by holders of Bachelor of science (B.SC) Education degrees.

Hypothesis Two (HO₂); There is no significant difference between the problem-solving ability of students on mole concept taught by holders of NCE, BSc and BSc (Ed) degrees.

Instrumentation, validation and reliability of instruments

The research instruments used for this study were as follows:

- I. Mathematical ability test (MAT): The MAT is made up of 36 short answer questions on numbers, numerals and algebra in mathematics adopted from Australian council Educational Researcher Test (ACER). This was revalidated by (igwe 1994) at 0.86 level of reliability
- II. Problem-solving Test on mole concept. The items for the problem solving test on mole concept (PSTMC) is made of 10 essay questions on concept in chemistry. The question were validated by two science educators and an expert in chemistry from the Federal University of Technology Minna. The reliability coefficient of PSTMC was determined to be $r_{xx} = 0.89$ using test-retest method.

Methodology

The study was conducted using an ex post factor design. This design enables the researcher to pick the variables that already exist or occurred for observation (Best and James, 1992). The study analyses the performance of students as taught by teachers with different qualifications. There are sixteen public secondary schools in Minna metropolis out of which three were randomly selected for the study. There are 3620 senior secondary schools (SSS) three students that constitute the population for this study from 16 schools in Minna. Sixty four (64) students were randomly selected from three schools that have all the categories of teachers that constitute the variables for this study. This was determined from a pre-liminary survey of the schools before the actual study began. The sample for the study which represents 20% of total population of the students in the three schools purbbgpositively selected for the study. And they are 320 SSS III students in these schools. The three schools are Government Day Secondary school Tunga, Hill Top Model School, Minna and Government secondary school Minna.

Procedure for data/collection and analysis

A test on PSTMC and MAT was conducted on the topics treated by chemistry teacher on mole concept and the students scores were used for data analysis. The analysis of variance statistics (ANOVA) was used by the application computer statistical package for social science to analyze the data.

Limitation of findings

The limitation for this study is that there are limited numbers of schools with all the teachers having all the categories of qualifications, which constitute variables for this study. This informed the number of schools used for the study.

Findings

The findings of this study are explained and presented in tabular forms below.
Hypothesis one (HO₁); There is no significant difference between the mathematical ability of students taught by holders of NCE, BSc and BSc Education degrees.

Table 1: Mathematical Ability and Teacher's Qualification

| Source of variation | sum of squares | df | Ms | Fcal | Fcrit | Pvalue |
|---------------------|----------------|----|--------|-------|-------|--------|
| Between groups | 132.700 | 2 | 66.350 | 3.392 | 3.15 | .041 |
| Within groups | 1114.950 | 57 | 19.561 | | | |
| Total | 1247.650 | 59 | | | | |

Table 1 shows that $F_{cal} (3.392) > F_{crit} (3.15)$, so the hypothesis is rejected. There is significant difference in the mathematical ability of students taught by holders of NCE BSc and BSc Education degrees

Hypothesis two (HO₂); there is no significant difference in the problem-solving ability of students on mole concept taught by NCE, BSc and BSc Education degrees.

Table 2: Teachers' Qualification and Students Performance in Problem Solving Abilities on Mole Concept.

| Source of variables | sum of squares | df | mean square | Fcal | Fcrit | Pvalue |
|---------------------|----------------|----|-------------|--------|-------|--------|
| Between groups | 864.633 | 2 | 432.317 | 16.144 | 3.15 | .000 |
| Within groups | 1526.350 | 57 | 26.778 | | | |
| Total | 2390.982 | 59 | | | | |

Table 2 shows that $F_{cal} (16.144) > F_{crit} (4.113)$, so the hypothesis is rejected. There is significant difference in the problem solving ability of students on mol concept taught by NCE, BSc and BSc Education teachers

Summary of findings

The findings of the study revealed that:

1. There is significant difference between the mathematical abilities of students taught by NCE, BSc and BSc Education degrees teachers
2. There is significant difference between the problem-solving abilities of students taught by NCE, BSc and BSc Education teachers

Discussion of findings

The study tested two hypotheses on the effect of teachers' qualification on students' mathematical and problem-solving abilities on mole concept. The result in table 1 using one way analysis of variance (ANOVA) of students taught by NCE, BSc and BSc Education degree holders reveals a significant effect. The $F_{cal} (3.392)$ is greater than the $F_{crit} (3.15)$ at 0.05 levels of significance. hence H_{o1} was rejected. The implication is that the qualification of the teacher gives an orientation as to which is best among several factors available in solving problems mostly with students that experience mathematical anxiety and low proportional ability. These students lack the know how involve in solving mathematical problem. It is also important to note that the instructional strategy inherent in a qualified science teacher due to the exposure to various methodologies during training will enhance the use and choice of teaching technique. It is also likely that the learning difficulties in mole concept as identified by Ahiakwo (1991) could be overcome when qualified science teachers are employed. The result of this study is similar to that reported by Okonkwo (2000).

where teachers' with degree in education produced the highest scoring students followed by NCE and BSc degree teachers'.

The result in table 2 shows that the $F_{cal} (16.144) > F_{crit} (3.15)$ at 0.005 level of significance. This means that the hypothesis is rejected. There is significant difference between teacher qualification and students problem solving abilities. The implication is that the qualification of the teacher is a product of the students' performance. This is also seen from the fact that the teacher's qualification is a reflection of the kind of knowledge he/she receives and skills he/she acquires during training. This will certainly come to bear on what he/she teaches in the classroom. The teachers with BSc (ED) produced the highest scoring students followed by NCE and BSc holders. So, those who are trained in education made more impact on the student's performance than those who are not trained in education as far as this study is concerned. The result of this study is also similar to that of Spark and Hirsh (2000) who found out that teachers' with greater content knowledge in a given subject and those with more teaching experience were likely to ask high level cognitive based question. They also observed that such teacher orientation towards seeking information which leads to effective problem-solving compared to teachers with less content knowledge is highly influenced in the teaching and learning of chemistry.

Conclusion

The study focused on the effect of teachers' qualification on mathematical and problem solving abilities of students on mole concept. The mathematical and problem solving abilities of students taught by NCE, BSC and BSC Education teachers were thus found to be significantly different

Recommendations

Based on the findings of this study, the following recommendations are made;

1. Emphasis should be placed on teaching students problem-solving skills for improved performance in chemistry.
2. Mathematical teachers should encourage students to use problem-solving approach in the area of computation so as to make chemistry subject easier to learn.
3. In-service training should be organized for chemistry teachers on regular basis to keep them abreast with the latest development, ideas and how to use new techniques and pedagogy in science teaching.

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