

# EFFECTS OF TEACHERS' QUALIFICATION ON GENDER MATHEMATICAL AND PROBLEM - SOLVING ABILITIES OF SECONDARY SCHOOL CHEMISTRY STUDENTS IN NIGER STATE, NIGERIA

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## **Abstract**

*The effects of teachers' qualification on mathematical and problem-solving abilities among male and female secondary school chemistry students were investigated in Niger State. An ex-post factor research design was adopted for this study. The instruments used were problem -solving test on mole concept (P S T M.C) and Mathematical Ability test (MAT) with reliability coefficients of 0.89 and 0.86 respectively. The MAT instrument was adopted. 120 students selected randomly using hat- draw method were used as sample for the study. Two hypotheses were tested using Analysis of variance statistic (ANOVA). From the study it was found that there was no significant difference between Male and Female Chemistry students' Mathematical ability based on the teachers' qualification (NCE, B Sc Ed and B Sc (Hons) degrees). However, significant difference exists between Male and Female students' Problem-solving ability in Chemistry Learning. Based on these findings it was recommended that science teachers particularly in coeducational schools should be gender sensitive in carrying out their activities.*

## **Background of the Study**

The development of every society hinges on science and technology. For individual to become fully integrated and contribute meaningfully to the development of the modern world in areas such as Education, Transportation, Information and Communication Technology, Agriculture, Commerce and Industries the person must be equipped with scientific knowledge and skills. This calls for every individual to be scientifically literate in present age of science and technology. Reforms in science education in the last decade have been "Science for All" (Barton 1998). In pursuit of the goals of "Science for All" the Nigerian government has placed emphasis on scientific literacy and the need to achieve equity and excellence in science classrooms. The government therefore, in conformity with the world trend, through official policies made science as core subject in primary, Junior and Senior Secondary Schools. Other laudable programmes and policies undertaken by government of Nigeria to promote scientific literacy include Girls into Science & Technology (GIST), Gender and Science and Technology (GASAT) etc. These programmes are evidence of government strong commitment to the cause of Women Education in science and technology.

In spite the efforts aimed at improving Science, Technology and Mathematics (STM) education in Nigeria, the benefit has not been the same for male and female students in the learning of chemistry. Research findings have indicated poor enrolment rates and poor performance in Chemistry among female students (Iliya 2000 & Njoku 2002). Studies have revealed the reasons for the differences in achievements between male and female students. For instance, Samba (1990) and (Jegade, 1996) found the difference as arising from socio-cultural factors. Some linked the differences to the way science is being taught in the classroom (Baker and Leary 1995; Mari, 2002).

Researchers in chemistry education have found that most female students solve problems significantly better than their male counterparts (Mari and Shaibu, 1997). Ahiakwo (1988) found that girls performed significantly better than the boys in their problem - solving ability. However, the study by Inyang and Hanna (2000) did not find any significant difference between male and female in their problem solving ability. Njoku (2002) found that male students often perform better than

female students in problem-solving. This he attributed to uncondusive classroom environment for girls due to intense sex role stereotyping and apparent boys domination of science classroom. Adesoji, (1999), and (Adesoji and Fisuyi, 2001) found that the gender difference in mathematical ability has declined. Similarly, significant gender group difference in mathematical ability was observed in favour of boys (Onocha and Okpala 1995 and Oyedeji, 1996). The study conducted by (Okonkwo, 2000) in respect of the relationship between teacher qualification and students' achievement in mathematics revealed that teachers with first degree in mathematics produced higher scoring students than those with NCE in Mathematics.

Nevertheless, problem solving connotes the ability to apply scientific skills to solve any problem a person is confronted with. This is a basic activity in science education practice. Mathematical ability is the ability to solve problems that have mathematical expressions. There are a lot of problems to be solved in Chemistry which requires the application of scientific skills such as observation, classification and recording etc. Some of which involves the manipulation of mathematical expressions especially in teaching concepts such as the mole concept, stoichiometry and the gas laws etc (Orji, 2000). The performance of students of Chemistry in solving mathematical problems related to concepts such as mole were found to be low as a result of difficulties encountered in solving problems that have to do with fraction in which proportion is the source of difficulty, algebraic expression in which lack of understanding of the proportion of numbers is the source of difficulties, and exponential numbers where the students visualize very large or small numbers as difficult (Ahiakwo, 1991).

### **Statement of the Problem**

Reports of poor performance of students in Chemistry (WAEC, 2007) and the fluctuating findings about Male and Female students' Mathematical abilities, Problem-solving abilities (Ahiakwo, 1991; Inyang and Hanna, 2000; Njoku, 2002) and the influence of teachers' qualification in mathematics achievement motivated this study to investigate the effects of teachers' qualification on the application of mathematical and problem-solving abilities among Male and female Chemistry students in Niger State.

## Objectives of the Study

The study is to achieve the following objectives.

1. To find the effects of teachers qualification on Male and Female Mathematical ability of Chemistry students.
2. To find the effects of teachers qualification on Male and Female Problem-solving ability of Chemistry students.

## Research Questions

To guide the investigation, two research questions were examined.

1. What are the effects of teachers with NCE, teachers with B Sc Ed and teachers with B Sc (Hons) degrees on Male and Female Chemistry students' Mathematical ability?
2. Are there any differences in the effects of teachers with NCE, teachers with B Sc Ed and teachers with B Sc (Hons) degrees on Male and Female Chemistry students' Problem-solving ability?

## Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

1. **Hypothesis One ( $H_{01}$ ):** There is no significant difference between Male and Female Chemistry students' Mathematical ability due to teacher qualifications.
2. **Hypothesis Two ( $H_{02}$ ):** There is no significant difference between Male and Female Chemistry students' Problem-solving ability due to teacher qualifications.

## Instrumentation, Validation and Reliability

The research instruments used for this study are as follows:

1. **Mathematical Ability Test (MAT):** The MAT is made up of 36 items. This consists of short answer questions on numbers, numerals and algebra in mathematics which are aspects that are involved in solving Chemistry problems that has to do with mole concept. It was adapted from Australian Council Educational Research Test (ACERT) and revalidated by Igwe (2002) in Nigeria. Its reliability coefficient was found to be 0.86. This instrument by (Igwe, 2002) was adopted for this research in Niger State, Nigeria therefore requires no further revalidation.
2. **Problem - Solving Test on Mole Concept (PSTMC):** Is made up of 10 essay items on mole concept in chemistry which covered areas that has to do with mass - volume relationship, Avogadro's law of

number of molecules and ideal gas equation etc. It was validated by two science educators and an expert in chemistry from Federal University of Technology Minna. The reliability coefficient was determined to be  $r_{xx} = 0.89$  using test retest method.

## Methodology

The study was conducted using ex-post factor design. This design enables the researcher to pick the variables that already exist or occurred for observations (Best and James, 1992). The population for the study is all the sixteen (16) public Senior Secondary Schools in Minna Metropolis. The choice of public Schools was informed by the fact that they have more Science teachers than the private schools. From this population three co-educational schools were purposively selected because they have male and female students learning Chemistry in the same environment. The selection of the schools was also informed by the fact that the three schools have N.C.E, B. Sc, and B.Sc. Ed degree holders who teach chemistry in the schools and all these are the variables required for this study. The population of Senior Secondary School Class two Science students in the three schools used for the study is two hundred and six (206), Seventy (70) from Government Day Secondary School Tunga; Sixty (60) from Govt. Secondary School Maitumbi, Minna while Seventy Six (76) from Government Day Secondary School, Minna respectively. A sample size of 120 Chemistry students was selected randomly using hat-draw method. Forty (40) students were selected from each of the three schools respectively. The data collected from MAT and PSTMC through a posttest was analysed using analysis of variance statistic (ANOVA) at 0.05 level of significance with the aid of a Minitab Computer statistical package.

## Results

The findings of this study are explained and presented in the tables below.

**Hypothesis One (Ho,):** There is no significant difference between Male and Female Chemistry students' Mathematical ability due to teacher qualifications.

**Table 1: ANOVA on the Difference between Male and Female Chemistry Students' Mathematical Ability due to Teachers with NCE, Teachers with B Sc Ed and Teachers with B Sc (Hons) Degrees**

Source Variation	Sum of Squares	df	Ms	Fcal	Fcrit
Between groups	152.061	2	76.0301.947	3.23	.156
Within group	1600.667	41	39.041		
Total	1752.727	43			

P<0.05

Table 1 above indicated that  $F_{cal} (1.947) < F_{crit} (3.23)$  ( $P < 0.05$ ), hence, the hypothesis is not rejected. This means there is no significant difference between Male and Female students Mathematical abilities in Chemistry Learning as taught by teachers with NCE, teachers with B Sc Ed and B Sc (Hons) degrees.

1. **Hypothesis two ( $H_{o2}$ ):** There is no significant difference between Male and Female Chemistry students' Problem-solving ability due to teacher qualifications.

**Table 2: ANOVA on the Difference between Male and Female Students Problem-Solving Ability due to Teachers with NCE, Teachers with B Sc Ed and Teachers with B Sc (Hons) Degrees**

Source Variation	Sum of Squares	df	Ms	Fcal	Fcrit
Between groups	404.679	2	202.339	5.172	3.23
Within group	1603.867	41	39.119		
Total	2008.545	43			

P<0.05

Table 2 above indicated that  $F_{cal} (5.172) > F_{crit} (3.23)$  ( $P < 0.05$ ), hence, the hypothesis was rejected. This means there is significant difference between Male and Female students Problem-solving ability in Chemistry Learning as taught by teachers with NCE, teachers with B Sc Ed and B Sc (Hons) degrees.

## Summary of Findings

The findings of the study revealed that:

1. Male and Female Chemistry students do not differ in their Mathematical ability whether taught by NCE teachers, teachers with BSc Ed or BSc (Hons) degrees.
2. Male and Female Chemistry students differ in their Problem-solving ability based on what have been taught by teachers with NCE, teachers with BSc Ed and BSc (Hons) degrees.

## Discussion of Findings

This study revealed that there was no significant difference between Male and Female Chemistry students' Mathematical ability based on the teachers qualification. The significant gender difference in students' mathematical ability discovered by Okpala and Onocha (1995) is not visible in this study and could be as a result of the lesser complexity of mathematical applications in Chemistry. So, male and female students are capable of solving mathematical aspect of Chemistry irrespective of their teachers' qualifications.

However, hypothesis two shows that  $F_{cal} (5.172) > F_{crit} (3.23)$  at 0.05 alpha level of significance. This means there is significant difference between Male and Female students Problem-solving ability in Chemistry Learning as taught by NCE teachers, teachers with BSc Ed and BSc (Hons) degrees. This is an indication that teachers' qualifications have significant effect on gender problem - solving ability in Chemistry learning. It equally implies that significant difference exists between the problem - solving ability of male and female students. A lot of facts could be inferred as to the reason for this difference. Some experts, such as (Samba, 1998) and (Jegede, 1996) saw the difference as arising from socio-cultural factors while (Baker and Leary, 1995) and (Mari, 2002) linked it to the way science is being taught in the classroom. The present study agrees with the findings of (Mari and Shaibu, 1997) and (Ahiakwo, 1988) that girls performed better than the boys when it comes to problem - solving in chemistry.

## Gender Consequences on Chemistry Learning

There are a lot of consequences on both male and female learning of chemistry as far as this study is concerned. Having found that there is no significant difference between Male and Female students' Mathematical ability in Chemistry Learning based on the teaching done by NCE teachers,

teachers with B Sc Ed and B Sc (Hons) degrees; it could imply that there are no many problems in the application of mathematical inferences in learning chemistry by the students of Niger State Senior Secondary Schools. So, both the female and male students are coping very well with the mathematical content of chemistry.

The difference discovered in the problem-solving ability of male and female Chemistry students is capable of enhancing either male or female gender having access to higher education as a result of better ability to solve chemistry problems and consequently pass it at any examination. By this, a particular gender type is likely to dominate access to higher education than the other. The difference is also likely to provide government the necessary information required for curriculum development and planning in the area that requires adequate attention in order to motivate and encourage a particular gender type in the learning of chemistry.

## Recommendations

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

1. Science teachers particularly in co-educational schools should be gender sensitive so that undue preference is not accorded the female gender in their teaching as a result of the feeling of female stereotyping. This will assist them to avoid paying special attention to the females to improve their problem-solving ability in chemistry to the detriment of the males.
2. There should be science clubs in schools where both sexes have equal right and access to participate in competitions within and outside the school. Through this forum they could organize seminars with the assistance of the school chemistry teacher to enlighten them more on some difficult aspects of chemistry.
3. Science fairs should also be encouraged and be organized by schools. Students could work together or individually to produce science projects for exhibition. This is capable of motivating chemistry learning.
4. Science teachers should continue to undergo training and retraining in their subject areas in order to boost effective handling/teaching of students in the simplest way that would ensure meaningful learning of chemistry.

## Conclusions

The study concludes that teachers qualifications such as the Nigeria Certificate in Education (NCE), Bachelor of Science Education (B Sc Ed) and Bachelor of Science (B Sc)(Hons) degrees have effects on both male and female mathematics abilities and problem-solving abilities in Chemistry learning. It was found that there was no significant difference between Male and Female students' Mathematical abilities in Chemistry Learning based on the teaching done by NCE teachers, teachers with B Sc Ed and B Sc (Hons) degrees. And that there was significant difference between Male and Female students' Problem-solving abilities in Chemistry Learning based on what the teachers with the same qualifications have taught.

## References

- Adesoji F. A. (1999); Mock Examination Results and Students Gender as correlates of performance in senior school certificate examination in Mathematics. *Ibadan Journal of Educational Studies*, 1106-114
- Adesoji F. A. & Fisuyi, M. O. (2001); Analysis of problem solving difficulties of students in volumetric Analysis According to Gender. *Ibadan Journal of Educational studies* (1) 106-117,
- Ahiakwo, J. M. (1988). Cognitive style and students problem solving behaviour in Chemistry. Unpublished Ph.D Thesis University of Ibadan.
- Baker, D & Leary R. (1995). Letting Girls speak out about science. *Journal of Research in Science Teaching* 3(1), 3-27.
- Barton A. C. (19988). Teaching Science with homeless Children: Pedagogy Representation and Identity. *Journal of Research in Science Teaching* (35(4) 379-394.
- Best, J. Wand Kahn, J.V (1992) *Research in Education*, Sixth Edition, Prentice-Hall of India Private Limited New Delhi -110 001
- Ezekannagha, G. N. and Ifeakor, A. C. (2001) Promoting female enrolment and learning outcome in Chemistry: The Role of women Educators. *42nd Annual Conference Proceedings of Science Teachers Association of Nigeria* 251 - 254.
- Igwe, I. O. and Akinsola, M. K. (2002); The relative effects of Metacognitive strategy of framing on students Achievement in selected Difficult Chemistry Concepts. *Journal of Science Teachers Association of Nigeria Vol. (37) 20-28.*

- Iliya, H. (2000). Impediments to female aspiration to career in Science and Technology: Implication for guidance and counseling. *Journal of Science and Technology education for National Development* 123-137
- Inyang, N.E. U & Hannah E. (2000); Influence of Ability and Gender Grouping on SSS Chemistry students' Achievement on the concept of Redox Reactions. *Journal of Science Teachers Association of Nigeria*. Vol. 35 (1 & 2) 36-42.
- Jegade, O. J. and Olajide J. (1995). Wait-time Classroom Discourse and the Influence of Socio-cultural factors in Science Teaching. *Science Education* 79 (3) 233-249,
- Mari, J.S. (2002); Gender related differences in Acquisition of Formal reasoning schemata: Pedagogic Implication of teaching chemistry; using process-based Approach.
- Njoku, Z. C. (2002): Enhancing Girls Acquisition of Science process skills in co-educational schools: An Experience with sex grouping for practical chemistry. *Journal of Science Teachers Association of Nigeria*. 37(1 & 2) 69-75
- Okeke, E. A. C. (2002). Women in Science Technology and Mathematics Education in Nigeria. Keynote Address 42<sup>nd</sup> Annual Conference. *Proceeding for Science Teachers Association of Nigeria* 3-11
- Okonkwo, S. C. (2000): Relationship between some school and teacher variables and student's achievement in mathematics. *Journal of Science Teachers Association of Nigeria* Vol. (35) 43-49.
- Okpala, N. P. and Onocha, C. O. (1995). Student Factors as a Correlate of Achievement in Physics Education. *A Journal of the British Institute of Physics* 6 (361-365)
- Orji, A. B. C (2000) Comparability of Two Problem Solving Models in Facilitating Students Learning Outcomes in Physics. *Journal of Science Teachers Association of Nigeria*. 35(1&2) 25-30
- Samba, R. M. (1998); The Efficacy of a Conceptual Change Strategies in Remediating Identified Students Misconceptions in Biology. Unpublished Ph.D Thesis submitted to Department of Education A.B.U. Zaria
- Shaibu, A. M. and Mari J. S. (1997): Gender Related Differences in the understanding of Science Process Skills among Junior Secondary School Students in some Nigerian Schools. *Journal of Science Teachers Association of Nigeria* 26 (2) 47-59.