BIJE – Bichi Journal of Education
ISSN(Print): xxxx-xxxx ISSN(Online): 2734-3375
Vol.10 No. 1 2010; pp: 152-159
Publisher: School of Education, F.C.E (T) Bichi.
URL: https://bijejournal.com/BIJE

A COMPARATIVE STUDY OF TWO METHODS OF TEACHING THE MOLE CONCEPT.

ONU A. DAVID
DEPARTMENT OF CHEMISTRY, F. C. E. ZARIA

ABSTRACT

The research work attempted to compare lecture and guided discovery methods in teaching the mole concept to secondary school students. The research aimed at finding the effect of the two methods of teaching mole concept to students and if either of the two methods is capable of enhancing the interest of males or females above the other. To achieve the objectives two hypotheses formulated in the null form were tested and analyzed a = 0.05. The study was experimental. The mole concept was taught to the experimental group using guided discovery method while the control group was taught using the lecture method for one week. Both groups were pre- and post-tested using Quantitative Item Test (QIT) instrument to collect data. The findings from the study shows that guided-discovery teaching method is a more effective method in teaching mole concept and the method enhanced the interest of male and female students equally. Recommendation was made that teachers should be trained in the skill of designing and administering creative guided discovery method for the teaching the concept to students.

Introduction

The mole concept is a prerequisite fundamental knowledge in chemistry. It is used as the practical unit of quantity or measurement (Mills et al, 1993) and it is the key to mass relationships in a chemical change. That the mole concept is so fundamental in chemistry is succinctly captured by Kolb (1978) in Furio et al., (2002).

> *"there is probably no concept in the entire first year chemistry course more important for students to understand than the mole and one of the main reasons the mole concept is so essential in the study of chemistry is stoichiometry"*.

The importance of this concept is further underscored by the avalanche of literature on the problems of its teaching and learning (Johnstone et al, 1971, Cervellati et al., 1982, Nelson, 1991, Furio et al., 2002, Longo, 2007). In an excellent review of literature, Furio et al., (2002) showed that students have great difficulty in handling mole concept owing mainly to the abstract and theoretical nature of the concept (Larson 1997). The difficulty this concept poses to learners is widely acclaimed both nationally and internationally (Ingle and Shayer, 1971, Khang and Sai, 1987, Njoku, 2003). Hence many studies have been focused on how to tackle the problem of teaching this concept. In a study at Singapore on secondary school students, Khang et al (1987) posited that teachers should make use of every opportunity to train students to "think in mole or number of particles". In the US, Krishnan and Howe (1994) found the misconceptions and incomplete understanding of the mole concept among second year secondary education and first year university students. In Nigeria, Njoku (2003), Adesoji and Babatunde (2005) in their own work on the subject matter of mole concept, recommended creative approach and use of expressive teaching behavior to teach the concept respectively. A comparative study of teacher centered traditional method and conceptual change method carried out in Istanbull, Turkey, Uce (2009) advocated the use of the conceptual change method to teaching the concept. Other studies include Longo (2007) who suggested using a Socratic dialogue to teach mole concept to adult learners and Yalcinalp (1995) extolled Computer-Assisted Supplementary Instruction to facility teaching of the concept. Eniayeju (1990) however suggested that the mole concept be taught with all necessary practical activities. Given the key position mole concept occupy in chemistry and the universal difficulty it is posing to both teachers and students, the search for ways to simplifying the concept and enhance learners thorough grasp of it is imperative. This study is part of such effort. In this study the comparative approach to teaching the concept using the inquiry and lecture method are explored.

Statement of the problem

Strong proponents of the effective teaching of science argue that students should experience science as a process of extending understanding. This implies that how science is communicated from teacher to learner is important if the expected outcomes are to be achieved. Research findings show that children exposed to different levels and types of teaching methods perform differently (Ajewole, 1990, Otuka, 1991). Therefore, establishing an effective teaching method for any particular concept will enhance the desired learning outcome.

Hypotheses:

The following hypotheses are formulated in the null form.

HOI: There is no significant difference in performance between groups taught the mole concept using the lecture method and guided discovery method.

HOII: There is no significant gender difference in the performance of students taught mole concept using guided discovery or lecture method.

Research Design

The design for the study was a pre-test- posttest experimental design using intact groups (Van-Dalen, 1973, Morgan and Krejcie, 1970). After assigning the experimental and control groups a pre-test was administered. The groups were assigned by tossing a coin. The experimental group (H) was instructed using the guided-discovery teaching method while the control group (T) was instructed using the lecture method. The topic, mole concept was taught for one week to the two groups respectively. The pre and post tests for the two groups were the same. After one week of teaching the post-test was administered to both groups.

Population, Sample and Sampling Technique

Out of a population of one hundred and fifty-five students, one hundred and twenty-one students were sampled (Morgan and Krejcie, 1970) using stratified random sampling technique. This technique was adopted to ensure the sample is representative of the various level of ability of the students (Ali, 2006). The study involved two co-educational schools, randomly chosen from Zaria. The students mean age is 14 years and they are all SS1 students, since the mole concept is an SS1 curricular.

Instrumentation

The instrument for the study was a quantitative test items (QTI) drawn from mole concept. The quantitative question was chosen because it is capable of testing several abilities (Abdullahi 1982). The content of the pre and post-test are the same and the examination lasted for one hour. The test items were validated by experts in science education in the Faculty of Education, Ahmadu Bello University, Zaria. The purpose of validating the test items was to ensure that the instrument was capable of measuring what it was intended to measure. The reliability of the instrument ($r = 0.78$) was determined using Pearson Product Moment Correlation Coefficients Statistic. Sambo (2005) stated that reliability value from 0.55 is accepted for achievement test instrument. The researcher personally taught the mole concept and

administered the tests in the two schools. The teaching of the topic and administering the test items by the researcher could have removed any possible bias or difference arising from using different teachers. The scores of the test items provided the data for this research.

Results and Analysis

The t-test statistics was used to analyze the data at a significance level a =0.05 this level was used as the basis for acceptance or rejection of each hypothesis.

Table 4.0 Pre-test performance of the group

	N	**Mean**	**Std.dev**	**t**	**a**	**df**
Experimental	54	3.00	2.56	0.041	0.05	52
Control	67	2.96	2.23			
				^{t}critical 1.97		

From the result obtained, there was no significant difference in the performance of the group. This implies that the students in both schools were equivalent with respect to their initial knowledge of mole concept.

Hypothesis 1

To test for hypothesis 1, scores from the post-test for the two schools were analyzed (Table 4.1).

Table 4.1. A t-test analysis to compare the performance of experimental and control groups in post-test.

	N	**Mean**	**Std.dev**	**^{t}ratio**	**a**	
Experimental	54	11.19	8.78			df=52
				2.82	0.05	
Control	67	7.07	7.28			
				tcal. = 2.82 ^{t}critical = ^{1}.97		

The result in table 4.1 shows that the students in the experimental groups taught with the guided discovery method ‘performed’ better than those in the control group. The t-statistics analysis shows that, at a = 0.05 significance level, there is significant difference between guided discovery and lecture methods of teaching mole concept.

Hypothesis II

To test hypothesis II, the post test scores of males and females in the experimental group were analyzed, the results are presented in table 4.2.

Table 4.2: Comparison of post-test performance of males and females in the experimental group.

Gender	N	Mean	Std dev.	t	a	df= 52
Male	38	10.18	8.39			
				1.297	0.05	
Female	16	13.56	9.57			
Total	54	tcritical = 2.00				

The mean scores obtained from the post-test for males and females in table 4.2 are 10.18 and 13.56 respectively. The value of t_{cal}. is 1.297 while the critical value of t is 2.00, it is not significant at a = 0.05 level. It shows that the performance of the students is not influenced by gender.

Discussion:

The result of the pre-test in Table 4.0 shows that the students were at the same level in knowledge before the treatment was administered. This means that no group had prior advantage in terms of knowledge of mole concept before they were treated to the two methods of teaching. It shows that the two groups for the treatment were drawn from the same population. The posttest result in Table 4.1 shows that significant difference exists in the performances of the experimental group and control group. The experimental group, taught by the guided discovery method was observed to perform better than the control group who was taught by the lecture method. From the result of the pre-test treatment coupled with the fact that the researcher personally taught the students in the two groups suggest that the observed difference in performance of the two groups could be due to the method of teaching. The activities employed in the guided discovery could have helped the students gained better understanding of the lesson. This result shows that the guided discovery method might be a better tool for teaching mole concept. This finding agrees with Eniayeju (1990) who suggested that the mole concept be taught with all necessary practical activities, guided discovery method provides a means for the needed activities. In a related work Adesoji and Babatunde (2005) reported that students exposed to expressive teaching behavior performed better than their counterparts exposed to conventional teaching behavior. The greater involvement /interaction

(students-students, students-teacher) provided for by the guided- discovery teaching method will to a great extent help students employ processes of science, construct meaning and link current information with already existing one. The method is very useful in enhancing the understanding of mole concept. A method that fosters conducive class room environment and positive class room interaction and participation is known to enhance achievement in chemistry (Babalola, 2002; Smith, 1995).

The t-test analysis of the result obtained in table 4.2 (t_{cal} = 1.297, $t_{critical}$ = 2.00) showed no significant difference in achievement between the male and female exposed to guided discovery method of teaching. This finding agrees with Adesoji and Babatunde (2005), Inyang and Jegede (1991), Shaw and Doan (1990) and Balogun (1994) who asserted that gender had no effect on students' achievement in science. The observed lack of significant difference in achievement between males and females exposed to guided-discovery method of teaching mole concepts shows that given equal opportunities higher attainment in mole concept is not gender bias, provided both gender possess equivalent subsume upon which higher learning should build. The result from this study implies that guided-discovery approach to teaching can promote meaningful grasp of mole concept to both male and female students.

Conclusion and recommendation

This paper has presented and discussed the results of the comparative study of lecture and guided discovery methods in teaching mole concept. From the finding it can be concluded that the use of guided inquiry greatly helped in improving the quality of instruction as demonstrated in higher achievement in the experimental group. The method too did not promote gender difference in achievement. Therefore, the use of this method is recommended for teaching mole concept to secondary school students. For teachers to be effective in using this method it is recommended that they are trained and retrained in designing/administering inquiry based learning activities so that mole concept can be taught with a lot of activities. Further similar studies should be replicated on a wider scale to compare finding.

References

Abdullahi, A. (1982): Science Teaching In Nigeria, Atoto Press Ltd, Ilorin.

Adesoji, F.A. And Babatunde, A.G. (2005): Expressive Teaching Behavior: Bridging the Gender Gulf in Secondary School Chemistry Achievement, *International Journal of African & African- American Studies*, IV (1), 54-61.

Ajewole, A. G.(1990): Effects of Guided-discovery and Expository Instructional Methods on students Transfer of Learning, *Journal of Science Teachers Association of Nigeria*, 26(2), 59-66.

Ali, A.(2006): Conducting Research in Education and the Social Sciences, Tashiwa Network ltd., Enugu, p.124

Babalola, J.O.(2000): Instructor- Expressiveness, Student Locus Of Control And Cognitive Entry Behavior As Measures Of Students' Achievement In And Attitude Towards Biology, Unpublished Ph.D Thesis, University Of Ibadan.

Balogun T.A.(1994): Gender Issues In The Teaching Of Science, Technology And Mathematics In Erinosho, S.Y(Ed), Perspective On Women In Science And Technology In Nigeria: Sam Bookman Educational And Communication Services.

Casserly, P.L. (1983): Encouraging Young Women To Persist And Achieve In Mathematics, *Children Today*, Jan/Feb 1983, 8-12.

Cervellari, R., Montushi, A., Perugini, D., Grimellini-Tomasini, N. And Pecorini- Balandi, B. (1982): Investigation of Secondary School Students' Understanding of the Mole Concept in Italy, *Journal of Chemical Education*, 59, 852-856.

Eniayeju, P.A. (1990): Seeking Meaning in Mole Ratio Instruction, *Journal of Science Teachers Association of Nigeria*, 26 (2), 93-100.

Furio, C., Azcona, R. And Guisasola, J.(2002): The Learning And Teaching Of The Concepts 'Amount Of Substance' And 'Mole': A Review Of The Literature, *Chemistry Education:Researh And Practice In Europe*, 3 (3), 277-292.

Ingle, R.B. And Shayer, M.(1971):Conceptual Demands In Nuffield O-Level Chemistry, *Education In Chemistry*, 8, 182-183.

Inyang , N And Jegede, O.J.(1991): Development, Validation And Standardization Of Integrated Science Achievement Test For JSS, *Journal of Science Teachers Association of Nigeria*, 27 (1), 21-29.

Johnstone, A., Sharp, D. And Morrison, J. (1971): Topics Difficult In Chemistry *Education in Chemistry*, 8, 212-213.

Khang, G.N. and Sai, C.L. (1987): Secondary School Students' Difficulties in Learning the

'Mole Concept'- A preliminary Study in Singapore, *Asia Pacific Journal of Education*, 8 (1), 80-88.

Kolb,D.(1978): The Mole , *Journal Of Chemical Education,* 55(11),728-732.

Krishnan, S.R.A and Howe, A.C. (1994): The Mole Concept Developing an Instrument to Assess Conceptual Understanding, *Journal of Chemical Education*, 71,653-655.

Larson, J.O.(1997): Constructing Understanding Of The Mole Concept: Interactions Of Chemistry Text, Teacher And Learners, Paper Presented At The Annual Meeting Of The National Association For Research In Science Teaching, 70th, Oak Brook, IL, March 21-24, Japan, Accessed On Line Htt://Www.Eric.Ed.Gov

Longo, K.J. (2007): Using a Socratic Dialogue to teach the Mole Concept to Adult Learners, *J.Chem.Educ.* 84 (8), 1285.

Mills, I.M., Cvitas, T., Homann, K., Kallay, N and Kuchitsu, K. (1993): IUPAC Quantities, Units and Symbols in Physical Chemistry, Oxford: Blackwell.

Morgan, D.W. and Krejice, R.V.(1970): Determining Sample Size for Research Activities in Education and Psychological Measurement, Vol. 30, p.608.

Nelson, P.G. (1991): The Elusive Mole, *Education in Chemistry*, 28(4), 103-104.

Njoku, C. Z. (2003): Teaching the Mole Concept Creatively: A realistic Approach towards Students' Mastery of Chemical Calculations, *The Nigerian Teacher Today*, 11(1), 109 - 119.

Otuka, J.O.E.(1991): The Laboratory Think and Do Approach to Science Instruction, *Journal of Science Teachers Association of Nigeria,* 27(1),163.

Sambo, A.A.(2005): Research Method in Education, Stirling Horden Publishers Nig. Ltd.

Smith, H.A. (1995): Non-Verbal Classroom Behavior. Torstein Hussen and T. Neville Postle Waite (Eds.): The International Encyclopedia of Education, 2nd Edition, 4171-4175.

Uce, M. (2009): Teaching the Mole Concept using a Conceptual Change method at College Level, *Education*, accessed online, www.search.com 0n 22/06/2010.

Van-Dalen, D.B. (1973): Understanding Educational Research: An Introduction, N.Y. MC Graw Hill Company.

Yalcinalp, S., Geban, O. and Ozkan, I. (1995): Effectiveness of Using Computer Assisted Supple mentary Instruction for Teaching the Mole Concept, *Journal of Research in science Teaching*, 32, 1083-1095