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Gender Differences in Secondary Schools Students' Achievement in Chemistry

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Abstract: This study focused on gender differences in students' achievement in Secondary School chemistry. The study was a cross- sectional descriptive survey employing correlational methods to investigate gender differences in chemistry achievement levels of girls and boys. A total of 386 students responded to a five-item, chemistry Achievement Test (CHAT) comprising descriptive, mathematical and spatial ability items. The students also responded to the Attitude Sale (AS). The teachers filled the Chemistry Teachers' Questionnaire (CTQ) on the reasons for poor performance of students in Chemistry and their possible solutions. The validity and reliability of the instruments were enhanced by a pilot study and the adoption of some already validated items. A reliability coefficient of at least 0.8 was acceptable for the study. Quantitative data obtained from the CHAT were analyzed using Statistical Package for Social Sciences (SPSS).The study revealed the following findings; Gender was strongly associated with Chemistry achievement ($r= 0.9880$, $\alpha > 0.001$). As a result, boys' schools performed better than girls schools. Boys had a stronger affinity and interest towards Chemistry.

Keywords*: Gender, Chemistry, CHAT, SPSS, Secondary School, Students*

I. INTRODUCTION

The study of Chemistry is important in all aspects of life. Women's struggle to participate fully in most education systems has had along and often bitter history. Women are underrepresented in science compared to other subjects (Kelly, 1981). The difference in representation of males and females in the scientific community is linked to achievement patterns at secondary school level. In addition, girls generally underachieve in Mathematics and Sciences as compared to boys (Comber and Keeves, 1973). This review is structured according to those components, which as will be shown, are believed to contribute in one way or another to the manifestation of gender differences in science (chemistry) achievement among students.

In Nigeria, Chemistry is a key subject for selective advancement in science and technology and needed for most careers in the education system. These careers include the health sciences (nursing, laboratory technicians, and doctors) and engineering. Conditions, which prevail in the education set-up, however, discourage good performance from both boys and girls in science and by extension to chemistry. Works done by Orodho, (1996) have identified a lack of adequate instructional resources and equipment, poor teacher preparation and remuneration, uninspired curricula and a negative attitude by all stakeholders in education. Even after many attempts have been made to counter these factors, including spirited gender awareness efforts by governments as well as intervention by NGO's, gender disparity in Chemistry performance still persists. This means that the real cause of gender disparity and poor performance in Chemistry have not been identified and therefore necessitating more research. It is in view of this gap, that the researcher felt that gender difference in students' achievement in Chemistry needs further extensive investigation so as to bring about tangible improvements.

II. FACTORS, WHICH INFLUENCE THE LEARNING OF SCIENCE (CHEMISTRY)

The following factors influence the learning of science (chemistry) in both boys and girls:

A. Spatial ability and performance in science

The most promising intellectual factor that has influence and may partially explain the male's superior performance in science and mathematics is spatial ability. Spatial ability continues to be the intellectual area in which the strongest and most consistent significant sex differences are found (Haertel et al, 1981). However, the differences are small and many times, variation among girls or boys is greater than the variation between sexes. Though small, there is consensus that there is male superiority in performance on such tasks. According to research, there is a strong relationship between visual-spatial ability and success in science. According to Kelly (1978), when 3-dimentional models were used in teaching general chemistry, final grades improved. Levy and Levy (1978) report that visualization and spatial orientation skills are significantly correlated with final grades in engineering courses since sex-related differences in spatial ability favor boys, this factor gives males and advantage in the study of science, especially in the physical sciences. Girls showed weakness across the framework on questions featuring spatial related ability. Such questions included rotational motion, angles, 2 or 3 – dimensional reproduction or interpretation and graphical skills.

B. Motivational Orientations

Sex differences in science performance vary with age levels. The greatest difference is at adolescent age level, which has been explained in part by pre-adolescent boys' attempts to enhance their manliness by achieving in science. It is worth of note that this pattern in sex differences in achievement with respect to age level is paralleled by the motivational orientation of boys and girls.

Sex differences in attitudes, aspirations and other motivational orientations towards science are large in some subject areas than others. Females have more positive attitudinal orientation towards biological sciences while male towards the physical sciences (Comber and Keeves, 1973). Girls have a positive orientation towards biology because it requires less of Math's and spatial ability. Biology also deals with life's processes, which are related to maternal role, thus biological knowledge is often perceived by females as inevitable in the fulfillment of their motherhood duties. Biology also revolves around the verbal propensities of girls and thus serves as a vehicle for girls increasing interest. Males' positive orientation towards physical sciences has been attributed to the "out of school learning". Many activities in physical science can be learnt outside the

classroom, and boys have more opportunities to develop positive attitudes in these areas (Kelly, 1981). It is primarily the acquisition of proficiency in a subject that leads to positive attitudes in that subject. Therefore, boys will hold a more positive attitude towards physical science. Low performance of girls in physical science may be due to low attitudes.

C. Resources and performance in science (Chemistry)

The types of schools are important for successful learning of science. The secondary system has national, provincial, district, local and private schools. A major characteristic of the schools in the higher level is their enormous resources. These facilities diminish drastically as we go down the type of school hierarchy in Nigeria. Associated with low physical resources is teacher quality. Quality teachers with long teaching experience are concentrated in national schools. Though teaching experience does not necessarily 'cause' higher achievement in science (chemistry) as was found by Comber and Keeves, (1973).

In the new curricula, which stress the process of science and emphasize the development of higher cognitive skills the laboratory acquired a central role, not just as a place for demonstration and confirmation but as the core of the science learning process. The laboratory gives the student appreciation of the spirit and method of science, promotes problem solving, analytic and generalization ability and provides students with some understanding of the nature of science. Given that chemistry is essentially a practical subject, any learner who misses out on the practical due to lack of resources is disadvantaged. In fact in Kenya there is a regulation that, no pass in practical, no passes with a credit in the examination.

D. Teacher characteristics and performance in chemistry

As teachers, play an important role in teaching science no one will doubt their influence on their student's acquisition of knowledge. Just how teachers and the way they teach chemistry affects the generation, constitution or reduction of gender differences in Chemistry achievement has to be considered. Knowledgeable teachers are less likely to pass on misconceptions, are more confident in imparting information, use less time for preparation, and are able to present a wider range of examples and analogies which may help students to learn and understand a certain topic more easily. Only in some cases does teaching experience produce higher science achievements.

Differences have been shown between male and female teachers with respect to their classroom behavior, expectations of achievement of students, or teaching behavior. If teachers tend to show gender – stereotypical behaviors in the classroom, one would probably see this as an effect of the science teacher being male or female, thereby following his or her own gender-typical role in teaching. For Kelly (1978), there is no empirical evidence that female science teachers produce better results with girls. Infact more secondary school science teachers were found to be male (Keeves and Kotte, 1991).

E. Teaching and learning styles

According to Kelly (1978), science is presented in schools in a way suited to boys that to girls. Science curricular are said to be another source of perpetuation of sex stereotyping in schools. Reinforcement of sex-appropriate behaviors results in young girls becoming passive, quite and caring and boys active and alert. The conceptual development of girls is thus, narrowed towards passive reception of information whereas broader, inquiring style is encouraged in boys. Many science subjects are presented in ways which advantage boys, although few teachers would admit to consciously discriminate against girls or other sections of their class. The quality of interaction of science teachers with girls is inferior to that of boys.

A more verbalized approach is likely to be effective when teaching girls. For both boys and girls, discovery-oriented approach is effective when considering high level of cognitive skills. For those teachers who use more of the conventional instructional approaches, a blend with experiential components may increase the level of performance.

According to Walberg (1991), three major approaches are used to instruct students optimally in science; Learner autonomy in science, activity based teaching and original source papers.

F. Socio-Economic Background

It has long been known that the socio-economic status of the home has a substantial influence on students' achievement in science (Husen, 1967). Data from both FISS and SISS, revealed a major influence of the family status. Common criteria used for establishing the socio-economic situation of the home were father and mother's education and occupation, the use of dictionaries, or the number of books at home (Comber and Keeves, 1973). Indeed to assess the educational and occupational status of the home renders major problems when these are intended to be compared across schools. This becomes especially true when searching for suitable indicators reflecting the economic status of the home. Despite the differences to measure the socio-economic status of the home, Duncan (1989) was able to show the important effect of socio-economic status on science across many developed and developing countries.

Duncan (1989), in a very comprehensive analysis of data from Botswana; using the FISS test instruments found socio-economic status to be related to achievement in science for boys rather than girls. Further to this, an important factor for the effectiveness of the socio-economic situation of the home in developing countries must be seen in the overall enrolment pattern.

While there is some indication that in the contexts of money, developing countries socio-economic status seems to favour boys, in that their achievement (in science) is influenced only somewhat positively, much stronger positive effects have been found for male students in industrialized countries (Heynemann and Loxley, 1982).

III. RESEARCH METHODOLOGY

A. Design of the study

The study design used is a cross-sectional descriptive survey. It was chosen because it involves collecting data in order to answer questions concerning the current status of the subjects of the study. It is also suitable to assess attitudes and opinions about events, individuals or procedures (Gay, 1992). The study had four phases. Phase I involved proposal preparation and the development of research instruments. Phase II was the piloting of the research instruments with an intention to refine and validate them. Phase III was the actual data collection from the sample population. The last phase involved the analysis of data

collected after which conclusions and recommendations were made.

B. Location of the study

The study was carried out in Nenu, Abia State, Nigeria. Nenu has a population of 603,422 persons and an area of 1,395km^2. Private and public secondary schools have been established to cater for this large population.

C. Target population

The study comprised some stratified randomly selected public secondary school students and some chemistry teachers in Nenu.

D. Sampling and sample size

1. Sample description

The primary sources of information in the study were:

i. Form three students in the stratified randomly selected secondary schools in Nenu. Form one and form two was considered not adequately exposed to the secondary school chemistry curriculum. Form four students are considered to be busy preparing for WASC examinations. Form three class was therefore judged ideal for the study, as the learners will have made a decision to take chemistry at WASC level.

ii. Some secondary school chemistry teachers in the randomly sampled schools and classes. They were used in the survey, as they were considered instrumental to the implementation of the chemistry curriculum.

2. Sample selection techniques

This section explains how the sample was obtained. Various sampling techniques were used to select different samples as explained below.

i. District: Nenu was selected purposively. It was used as it is assumed it has its population comprising a large number of ethnic communities that speak different tribal and ethnic languages and assumes a variety of socialization modes (Rukangu, 2000).

ii. School category: The study was restricted to public secondary schools

iii. School type: Stratified sampling technique was chosen because it guarantees desired representation of relevant sub-groups thus increasing the efficiency of the population estimate (Gay, 1992).

iv. Individual schools: Stratified sampling technique was used to select the schools according to their school type and their performance in the last three years' WASC examinations in Chemistry. This stratification was done with the view that gender differences in students' achievement in Chemistry may vary with type and performance of schools. The stratification by the school type was as follows: -

(a) Boys' schools
(b) Girls' schools
(c) Mixed schools

These strata were further classified according to schools' previous performance in WASC examination as follows: -
(i) Good performing with mean grade of C- and above
(ii) Poor performing with mean grade of D+ and below.

(e) Chemistry teachers: Purposive sampling was used to select Chemistry teachers. Those teaching form three were chosen and where there was more than one teacher, professional experience was used as a criterion for selection of the teachers.

(f) Students: Simple random sampling technique was used to select the sample of students for the study. The names of students in each class register were written down on pieces of paper and put in a basket. The required number of students was picked randomly from the container. Each time the piece of paper was returned in the basket before the next student was selected.

3. The sample size

This section describes the methods that were used in determining the sample size used in the study. This includes the number of schools, students and teachers involved in the study.

i. Number of schools: Nenu has 62 public secondary schools. Since it is a small population, 20% of it will be adequate to constitute a sample in a study of this nature (Gay, 1992). Thus, 12 public secondary schools were considered in the study as shown in Table 1

Performance criteria of schools	Type of Schools (No.)			
	Boys	Girls	Mixed	Total
Good performing	2	2	2	6
Poor performing	2	2	2	6
Total	4	4	4	12

Source: Education Office, Umuahia

ii. Number of respondents (Students)

The sample of respondents was determined using the formula adapted from Rukangu (2000) and Mugenda (1999). Thus: $n=Z^2pq$, where, n= sample size, f is the function of variable x
d^2
Z= coefficient of the standard score in a normal distribution of f(x) (1.96).
P=proportion of the secondary school students who need specific conducive environment in order to master the chemistry content and achieve in the subject. The proportion was taken to be 0.5.
q is1 −p
d = significance level to this study, which was taken to be 0.05
This calculation yielded 386.2 students. For practical reasons, 386 students were involved in this study. The sampling grid is shown in Table2

Table 2: Sampling grid for students

School Type	Enrolment	Sample Students
Girls	3,419	50
Boys	4,605	76
Mixed	15,128	256
Total	23,152	386

Source: Umuahia Education office, Abia State

E. Research instruments

A cross-sectional descriptive survey employing correlation methods was used in order to achieve the objectives of the study. According to Cohen and Manion (1992), the collection of data in survey method typically involves one or more of the following data-gathering techniques.
(i) Structured or semi-structured interviews
(ii) Standardized tests of attainment or performance
(iii) Self-administered or postal questionnaire
(iv) Attitude scales.
In response to the above, the present study used three sets of instruments:
a) Standardized tests of attainment or performance.
This was affected by administering Students' Chemistry Achievement Test (CHAT)
b) Self-administered or postal questionnaires
In this approach a Chemistry Teachers' Questionnaire (CTQ) was used.
c) Attitude Scales
An Attitude Scale for the students was also used.
The above instruments were found appropriate for this kind of study as outlined below.

(a) Standardized Tests of Attainment

An achievement test, (CHAT) was found appropriate for this study because it was considered an important tool in correlation research like this one (Gay, 1992)

(b) Self-Administered Questionnaire

The CTQ questionnaire was preferred because it is the best form of survey in an educational enquiry (Cohen and Manion 1994). In addition, a questionnaire has the following advantages:
(i) Less expensive (Davidson, 1970)
(ii) It permits for collection data from a large sample (Mugenda and Mugenda, 1999)
(iii) It allows the anonymity of the respondent.
(iv) Its more efficient in that it requires less time to administer (Gay, 1992)
(v) It is fairly reliable (Cohen & Manion, 1994)

(c) Attitude scale

The attitude scale (AS) was preferred because it permits collection of data from a large sample and is fairly reliable.
The instruments were used because of the following purposes: -
(i) Students' Chemistry Achievement Test (CHAT). It was aimed at determining the gender differences in student's achievement in Chemistry. It emphasized three abilities: Descriptive ability, spatial and Mathematical abilities.

(ii) Chemistry Teachers Questionnaire

The questionnaire for the teachers mainly sought information on the reasons why girls generally perform less well than boys in Chemistry and on the ways in which the performance of girls could be improved. In addition, the questionnaires attempted to document the academic and teaching qualification of the teachers, their teaching experience, workload and resources available for teaching Chemistry.

(iii) Students' Attitude Scale

This instrument mainly sought information on the students' attitude towards learning chemistry and their perceptions regarding the level of help that students' had access to private tuition and their career aspirations.

1. Validity and Reliability

i. **Validity**: Content and construct validity of the research tools were enhanced at the design stage. This strengthened content and construct validity. This stage was followed by a pilot study whose main purposes were to check the appropriateness of the language used in the tools and to conceptualize them for predictability and reliability.
ii. **Reliability:** Since the student's Chemistry Achievement Test (CHAT) items had dichotomous scores with varied levels of difficulty, its reliability coefficient was determined using Kuder – Richardson (Formula 20) estimates. This was determined using the formula adapted from Sattler (1988). Thus,

$$\alpha = \left(\frac{n}{n-1}\right)\left(\frac{1-\sum s^2}{\delta^2}\right)$$

Where, α = Reliability coefficient
n = Number of items in the tool
δ^2 = Variance in the obtained test scores
$\sum s^2$ = Sum of variances of the single items

2 Piloting of the instruments

The drafted instruments were piloted in one mixed public secondary in Nenu district in order to refine them and enhance their validity and reliability. The items in the instruments appeared not to have any flaws and thus were retained.
The refined instruments were then administered to the sample respondents in the main study. The process of refinement was necessary due to the following reasons:

i. Determine the difficulty of the items in the instruments.
ii. Check the suitability and level of language used.
iii. Estimate the time allocation for the items and
iv. Enhance the validity and reliability of the items.

3 Administration of the research instruments

The pilot study was conducted in one public mixed Secondary school in Nenu in the month of January. Thirty (30) students (15 girls and 15 boys) were randomly selected and the CHAT and AS were administered to them. This number was sufficient in order to discover the major flaws in the questionnaires (Sudman, 1976). One chemistry teacher was given the CTQ to fill. The data collected at that stage were analyzed and the results used for appropriate amendment of the instruments. The actual administrations of the research instruments and data collection were conducted in the first term of the school calendar, in the months of January and February 2006. It was preceded by the researcher's preliminary visits to the schools sampled out for the study.

The instruments were administered with the assistance of chemistry teachers. The study was conducted after school so as not to interfere with students' class time.

F. Variables

The following are the main independent variables used in this study. These variables influenced the dependent variables as explained below

i. **Student-related variables:** These included gender, their general ability and attitudes.
ii. **Teacher-related variables:** These variables included gender, academic and professional background,

teaching load and teaching experience. Others included main resources used when teaching Chemistry

iii. **School-related variables:** The school-related variables included school type and resource availability.

The main dependent variables used in this study are achievement in Chemistry and future aspirations in a science related course.

G. Ethical Considerations

The researcher sought permission from the Western Provincial Director of Education's office to do research in the schools. In each school, permission was sought from the head teacher before involving students and teachers.

IV. DATA ANALYSIS, PRESENTATION, AND DISCUSSION

A. Methods of Data Analysis

Analysis of data was based on research questions. Data germane to the study were both quantitative and qualitative. Quantitative analysis involved presentation of statistical data in form of frequency distribution tables whose explanation was mainly based on descriptive and inferential statistics. Quantitative data were analyzed using Pearson product –moment correlation co-efficient, student t-test and one –way ANOVA. Pearson product moment correlation coefficient was used to determine the relationship between students' scores in the attitude scales and their scores in the chemistry achievement test. Students 't' –Test was used to compare the means in students' performance of CHAT between the genders. One-way ANOVA (Analysis of Variance) was used to compare the variance in student performance in the CHAT with school type. The statistical significance of the results were then examined at α= 0.05 statistical significance level.

Quantitative analysis considered the inferences that were made from the opinions of the respondents. This analysis was narratively presented and where possible in tabular form. Specific analysis for the various variables is presented and discussed in the next sections.

B. Student related variables

In this section emphasis is given to identify and evaluate the effects of students attitudes thought to influence chemistry achievement. Further to this, a student's interest to obtain further chemistry training or to take up a science-related occupation is also examined.

1. Gender differences on the attitudinal scales

Examining data from the FISS study, Comber and Keeves (1973) were able to show that attitudes had different effects depending on the level of schooling. While attitudes towards science (and by extension to chemistry) and other school-related attitudes are developed during childhood and the years of elementary education, they are shaped considerably during secondary schooling. Though this was neither new nor surprising, it was unclear from previous research to what extend gender was influential in this formative process. Students were requested to a number of likert-type items regarding their attitudes towards chemistry. Five response categories were, in general, used: Strongly agree, agree, not sure, disagree and strongly disagree. The scoring scheme employed involved the scoring of a favourable response to an item as '5' a not sure response as '3' and an unfavourable response as '1' The scoring was reversed for negative items. High values indicate a positive or favourable attitude whereas low values represent a negative or unfavourable attitude. Table 3 presents the results on the attitudinal scales.

Table 3 Statistics for Attitude Scales Interest in chemistry

Gender	N	Mean Score	SD	SE of mean	Mean difference	t-value	df	2-tail sig
BOY	206	17.29	6.727	0.2645	1.14	4.31	384	*0.000
GIRL	180	16.15	7.655					
Ease of learning chemistry								
BOY	206	16.59	6.264	0.2610	0.6	2.29	384	*0.000
GIRL	180	15.99	7.456					
Career interest in chemistry								
BOY	206	19.01	6.123	0.225	0.46	2.05	384	*0.000
GIRL	180	18.55	6.155					
Beneficial aspects of chemistry								
BOY	206	18.41	6.346	0.2620	0.51	1.94	384	*0.000
GIRL	180	17.90	7.524					
Non- harmful aspects of chemistry								
BOY	206	18.21	8.124	0.2820	0.41	1.45	384	*0.000
GIRL	180	17.80	8.352					

*Significant at α = 0.05

D. Achievement in Chemistry

1. Differences between Boys and Girls in Chemistry Achievement.

The study involved 206 boys and 180 girls. Table 4 shows the scores, frequencies and means obtained in the CHAT by gender.

Table 4: Students' scores in the CHAT by gender

Ge	T	Scores and frequency								MEAN	
	M	0	1	2	3	4	5	6	7		
B	X	25	14	22	16	15	18	42	54	4.3009	
	Y	2	12	12	45	33	41	30	51	4.4531	
	Z	3	9	15	42	36	40	19	42	4.3952	13.1492
G	X	14	12	13	6	17	12	34	72	4.9252	
	Y	3	24	30	32	33	37	12	9	3.3440	
	Z	5	20	32	13	32	37	33	8	3.8333	12.1029

Pearson correlation coefficient, r = 0.9882 (α 0.001)*
*Significant at α = 0.05
Legend; Ge = gender, B= boys, G girls, X= Descriptive ability test, Y= Mathematical ability test, Z= Spatial ability test, T= test, M=Marks

On computing the Pearson product moment Correlation coefficient (r) of the scores obtained from the boys and girls, a value of 0.9882 at α 0.001 was yielded. This shows that the r-value is significant at 0.05 significant levels. Thus, there is a strong positive correlation between gender and student's performance in the subject.

From table 4, it can be noted that boys obtained higher mean scores in both mathematical and spatial ability tests. For the verbal ability test (X) the boys and girls obtained mean scores of 4.3009 (n=206) and 4.9252 (n=180) respectively. For the mathematical ability test (Y), boys attained a mean score of 4.4531 and girls, 3.3440. For the spatial ability test (Z), boys attained a mean score of 4.3952 and girls, 3.8333. In order to test whether there is a significant difference between students' gender and performance in chemistry in the three sections of the CHAT, students 't'-values were computed using SPSS program. The results of the descriptive ability test, mathematical and spatial ability tests are presented in table 5.

Table 5: Student's t-value for the Chemistry tests

Descriptive ability Test (X/ 7)								
Gender	N	Mean score	SD	SE of mean	Mean difference	t-value	df	2-tail sig
Boys	206	**4.3069**	2.7076	0.189	-0.6243	-2.21	384	0.0000*
Girls	180	**4.9252**	3.2542	0.243				
Mathematical ability test (X/7)								
Boys	206	**4.4531**	2.1071	0.147	1.1087	5.48	3.84	0.0000*
Girls	180	**4.3440**	2.0273	0.151				
Spatial ability test (X/7)								
Boys	206	**4.3952**	2.1703	0.151	0.5622	2.30	384	0.0000*
Girls	180	**3.8330**	2.5942	0.193				

* Significant at $\alpha = 0.05$

From table 5, it can be noted that, the absolute t-values for the verbal ability test, mathematical ability test and spatial ability test, 2.21 (P>0.001), 5.48 (P>0.001) and 2.30 (P>0.001) respectively are significant. Thus, there was a significant difference between the gender of student and performance in chemistry achievement test. Boys performed significantly higher than girls did except for the descriptive ability test. This has been the case in national examinations. This could be attributed to the proposed differential functions to each of the two hemispheres of the cortex. The left hemisphere, which matures at an earlier age in girls than in boys, would rather perform tasks of sequential information processing (verbal information) and hence gender differences were found in favour of girls on verbal abilities. Furthermore, right hemispheric functions of the brain seen to mature at an earlier age in boys than in girls and hence gender related differences in spatial and mathematical ability were largely in favour of the boys. It could also be attributed to the environment-cultural hypothesis or socialization theory. The above sex differences could be a result of societal or cultural expectations for boys and girls. As a result, the high rate of socialization brings about superiority of girls in descriptive ability tasks and vice versa. This implies that girls need to be given special attention while being taught mathematical and spatial ability aspects of chemistry. In addition tests should be balanced and follow a specification grid so that it does not test on one ability area.

CONCLUSION

In this research, consistent and sizeable gender differences were detected across the five attitude scales examined. It was the boys who voiced a stronger acceptance of Chemistry. Boys were more interested in Chemistry, found learning chemistry related tasks easier, showed a more pronounce interest in starting a career in Chemistry On average; boys had a stronger affinity and interest towards chemistry and rated Chemistry to be more beneficial than their female classmates. It would therefore appear justified to summarize that on overage, boys had a stronger affinity and interest towards Chemistry. This agrees with Comber and Keeves (1973) who found that males have more positive attitudinal orientations towards the physical sciences. Kelly (1981) also, proposed the 'attitude hypotheses. Girls perform less well than boys in science because girls have less favorable attitudes towards science.

From the aforementioned findings it can be concluded that there, is a positive correlation between students' gender and achievement in chemistry.

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