Socio-Demographic Attributes and Aptitude on Grade 9 Students of Central Mindanao University Laboratory High School as Determinants of Chemistry Performance: A Causal Model

Orongan, Maris Jade Q [1] and Manuel B., Ph.D [2]

[1]Graduate Student, School of Graduate Studies, College of Education, MSU-Iligan Instittute of Technology, Iligan City/Faculty, College of Education, Central Mindanao University, Bukidnon, Philippines

[2]Faculty, Department of Science and Mathematics, College of Education, MSU-Iligan Instittute of Technology, Iligan City, Philippines

Abstract

This paper geared to develop a causal model of the socio-demographic attributes and aptitudes on students' performance in Chemistry at the CMU- Laboratory High School. The study employed descriptive-correlational and causal-comparative research designs. Results showed that the High School Admission Test score, type of elementary school graduated and the elementary average grade were significant predictors of the students Chemistry performance while gender, parents' educational attainment and nature of commuting have no effect. The best fitting causal model of high school performance in Chemistry is best anchored on the aptitude levels as manifested by the Admission Test scores and elementary average grade, duly supported with the type elementary school graduated, gender and commuting scheme of students.

Keywords: aptitude, chemistry performance, causal- comparative design, correlational design, descriptive, and socio-demographic attributes.

Introduction

Chemistry as a central science can create an impact on students' lives through a deep understanding of its concepts, principles and theories. However, most students find chemistry as a difficult subject because of its highly conceptual and often used of abstract terms (Woldeamanuel et al., 2014). Thus, the learning performance of the students has been affected.

A number of educational researches have revealed that socio-demographic characteristics (such as gender, parent's educational level and type of schools) can significantly influence the students' performance like Chemistry. In this study, the gender, type of elementary school graduated, nature of

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[1] Corresponding author : -

commuting, father's and mother's educational attainment were identified as predictors towards the Chemistry students' achievements. The ULHS Admission Test score and the elementary general average grades of the students were also considered with respect to the aptitude determinants. These attributes were employed to determine if there is a positive correlation with the Grade 9 students' performance in Chemistry at the Central University Laboratory High School (CMULHS) of SY 2014-15.

According to Ezeudu and Obi (2013), gender is a major factor that influences career choice and subject interest of students. The studies of Ayodele et al. (2014) and Christian (2014) found that the gender has a significant effect on students' academic achievement in Chemistry. However, this result was inconsistent with the findings of Abaje and Alake (2014), Olasehinde and Olatoye (2014), Udousoro (2011) and Tai et al. (2004) who have reported that the gender variable was not remarkable towards students' performance in Chemistry.

It was also discovered by Adeyemi and Adeyemi (2014) that parental creates a major influence on children's academic achievements. Chen (as cited in Udida et al., 2012) stressed that the roles of father's education and mother's education differ across child gender and levels of ability. Findings of Hijazi and Naqvi (as stated in Udida et al., 2012), Saifi & Mehmood (2001), and Demercioglu and Norman (1999) showed that mother's education lies a positive relation with the students' achievement.

Other studies of Olasehinde and Olatoye (2014), Ogini et al. (2013), and Alimi et al. (2012) revealed   that the type of schools attended (either private or public) did not make any difference in the achievement of students in Chemistry. Their results, however, contradict to several studies conAyodele et al. (2014), Olude (2005) and Demercioglu and Norman (1999) who found that there was a statistically significant relationship between school type and students' academic achievement.

On the other hand, Geiser and Santelics (2007) and Martha (2005) reported that the grades were the best predictors of academic performance based on the gathered evidences. Thus, the notion of developing a causal model of the socio-demographic characteristics and aptitude on students' performance in Chemistry was conducted to determine which predictor(s) greatly influence their performance.

Statement of the Problem

1. What are the socio-demographic profile of the high school. students in terms of:

    a. gender;

    b. type of elementary school graduated;

    c. father's educational attainment;

    d. mother's educational attainment; and

    e. nature of commuting?

2. What are the aptitude level of students with respect to:

    a. high school admission test score;

    b. average elementary grade?

3. What is the level of performance of students in high school Chemistry?

4. What relationship exists among student's performance, socio-demographic profile and aptitude of high school students in Chemistry?

5. Which variable singly or in combination best predicts students' performance in Chemistry?

6. What causal model best fits student performance in Chemistry?

Hypotheses

The following are the null hypotheses carried in this study.

1. There is no significant relationship between the socio-demographic attributes and the CMULHS students' performance in Chemistry.

2. There is no significant relationship between the aptitude levels and the CMULHS students' performance in Chemistry.

3. There is no variable singly or in combination that best predicts CMULHS students' performance in Chemistry.

4. There is no causal model that fits on the CMULHS students' performance in Chemistry.

Conceptual Framework

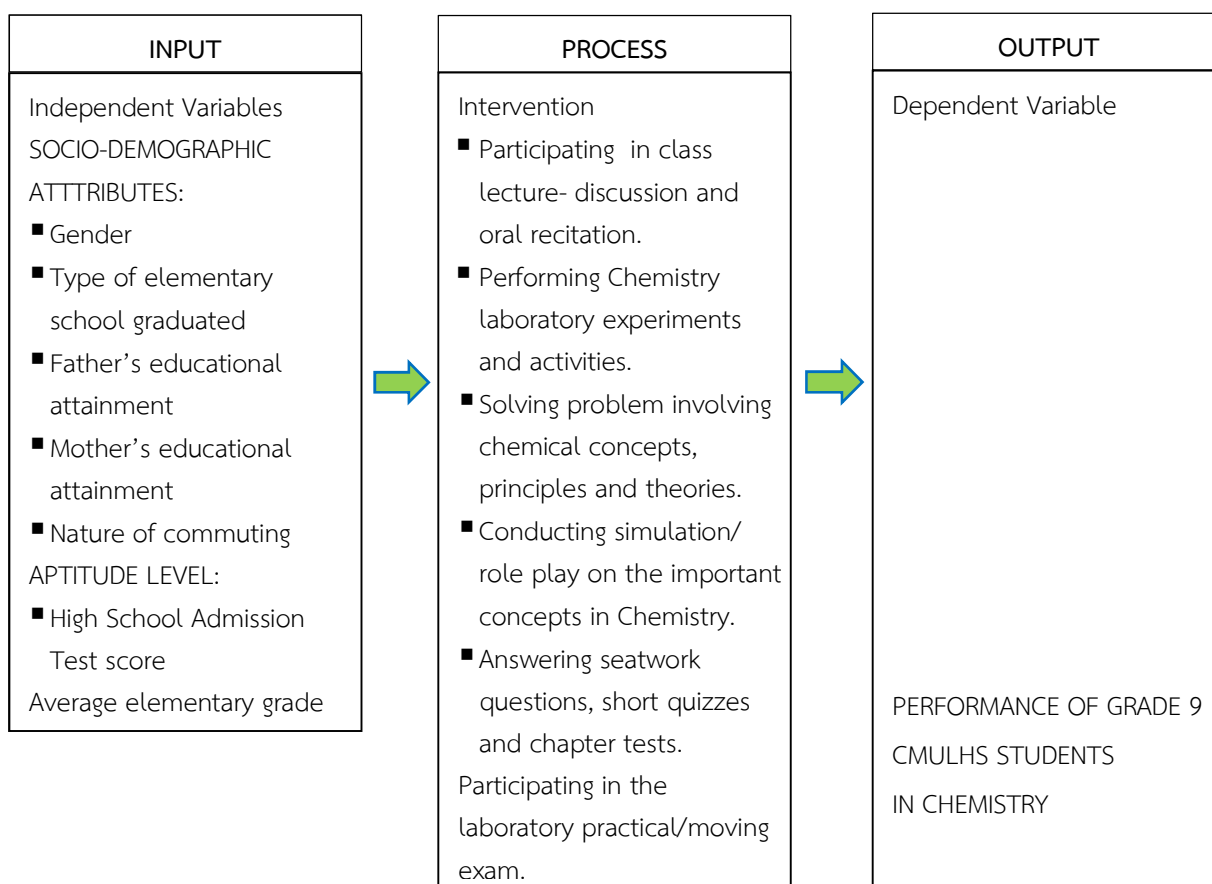**Figure 1** depicts the independent and dependent variables employed in this study.

INPUT	PROCESS	OUTPUT
Independent Variables SOCIO-DEMOGRAPHIC ATTTRIBUTES: ▪ Gender ▪ Type of elementary school graduated ▪ Father's educational attainment ▪ Mother's educational attainment ▪ Nature of commuting APTITUDE LEVEL: ▪ High School Admission Test score Average elementary grade	Intervention ▪ Participating in class lecture- discussion and oral recitation. ▪ Performing Chemistry laboratory experiments and activities. ▪ Solving problem involving chemical concepts, principles and theories. ▪ Conducting simulation/ role play on the important concepts in Chemistry. ▪ Answering seatwork questions, short quizzes and chapter tests. Participating in the laboratory practical/moving exam.	Dependent Variable PERFORMANCE OF GRADE 9 CMULHS STUDENTS IN CHEMISTRY

Figure 1.The relationship variables used in the study.

Research Methodology

Research Design

This study employed the descriptive-correlational and causal-comparative research designs. Descriptive-correlational since the study also described the characteristics and realtionships among variables such as the socio-demographic attributes, aptitude and the level of performance of the Chemistry students. The causal-comparative design was used to determine the best fitting causal models on performance of students in Chemistry.

Data Collection

In this study, secondary data were generated and employed. The data were directly requested from the CMULHS Principal, through the Secretary.

Respondents of the Study

The respondents of the study were the two batches of Grade 9, equivalent to 244 students who had taken Chemistry in their Grade 7 and Grade 8 of SY 2014-2015.

Statistical Techniques Used

1. Descriptive statistics such as mean, frequency counts and percentages were used

2. Correlation analysis and regression analysis were used to determine the relationship and predictors on students' performance.

3. Path analysis was employed to determine the best fitting causal model on performance.

Results and Discussion

Research Question 1: What are the socio-demographic profile of high school students in terms of:

a. Gender

As shown in Table 1, the distribution of student respondents for female constitutes 61.5% and 38.5 % for male.

Table 1. Students' profile by gender.

Gender	Frequency	Percent
Male	94	38.5
Female	150	61.5
Total	244	100.0

b. Type of elementary school graduated

The data in Table 2 presents the students distribution in terms of type of elementary school graduated. 51.2% of the students took their elementary in public and 48.8% in private school.

Table 2. Distribution of students by type of elementary school graduated.

Type of Elementary School Graduated	Frequency	Percent
Private	119	48.8
Public	125	51.2
Total	244	100.0

c. Parent's (Father and Mother) educational attainment

      Table 3 depicts the students educational level attainment of their fathers and mothers which are 83.6% and 86.8%, respectively. This implies that majority of the Grade 9 parents are professionals and provide strong educational foundation to their children.

Table 3. Father's and Mother's Educational Attainment.

Educational Attainment	FATHER		MOTHER	
	Frequency	Percent	Frequency	Percent
High School Graduate	15	6.1	16	6.2
College level	25	10.2	17	7.0
College graduate/ masteral	204	83.6	211	86.8
Total	244	100.0	244	100.0

e. Nature of commuting

      As shown in Table 4, majority of the Grade 9 students were commuters, constituting   67.1% and 32.9% for noncommuter students. Most students prefer to commute in their hoses rther than renting in the boarding houses.

Table 4. Students' distribution by nature of commuting

Nature of commuting	Frequency	Percent
Non-commuter	81	32.9
Commuter	163	67.1
Total	244	100.0

Research Question 2: What are the aptitude level of students with respect to:

1. High school admission test score

From Table 5, most of the students whose ULHSAT score was on the range of 41-60, which constitutes 65.16%. Only 10 students (4.10%) who got a mean percentage score in the range 21-40.

Table 5. Mean ULHSAT percentage score

High School Admission Test Mean Percentage Score	Frequency	Percent
0 - 20	0	0
21 - 40	10	4.10
41 - 60	159	65.16
61 - 80	75	30.74
81 -100	0	0
Total	244	100.00

2. Average elementary grade

In Table 6 shows the distribution of the students average grade in their elementary. About 43.03% of the Grade 9 students obtained an average grade ranging 90-94 as the highest, followed by those students (38.11%) with 85-89. One student elicited an average elementary grade of 75-79 range.

Table 6. Distribution of students in terms of average elementary grade.

Average Elementary Grade	Frequency	Percent
75 - 79	1	0.41
80 - 84	17	6.97
85 - 89	93	38.11
90 - 94	105	43.03
95 - 100	28	11.48
Total	244	100.00

Research Question 3: What is the level of performance of students in high school chemistry?

Table 7 depicts that majority of the students Chemistry grade are on the range of 79-84 with a percentage of 49.18%. A total of 109 students (44.67%) having a Chemistry grade ranging 85-90. Only 15 students (6.15%) have grades within the range of 91-96.

Table 7. Distribution of students' performance in terms of chemistry grade.

Chemistry Grade	Frequency	Percent
97 - 100	0	0
91 - 96	15	6.15
85 - 90	109	44.67
79 - 84	120	49.18
75 - 78	0	0
Total	244	100.00

Research Question 4: What relationship exists among students' performance, socio-demographic profile and aptitude of high school students in Chemistry?

As shown in Table 8, gender, type of elementary school graduated, father's and mother's educational attainment and commuter are not linearly related to performance with r-values of -0.050, 0.027, -0.027, -0.056 and 0.117, respectively. While, the average elementary grade and high school admission test score are significantly correlated to performance with r-coefficients of 0.509 and 0.0.728 (p-value = 0.00), respectively. The results indicate that a positive correlation exist among performance, average elementary grade and high school admission test. In the study of Geiser and Santelics, and Anderson et al. as cited in   Martha (2005), stated that grades were the best predictors of academic performance. Therefore, the better the students' elementary average grade will result to a better performance and the higher the score of the high school admission test will also result to a better students' performance. In contrast, other investigated predictors such as gender and the parents' educational attainment of the student-respondents and the nature of commuting showed a negative correlation on the performance of students in Chemistry.The results of the study corroborate with the findings of Abaje and Alake (2014); Olasehinde and Olatoye (2014); Udousoro (2011) and Tai et al. (2004). There was no significant difference in the students Chemistry performance with respect to gender.

Surprisingly, the education level of the parents negates to the results revealed by Saifi & Mehmood (2011); Udida et al. (2014) and Demercioglu and Norman (1999) on the significant positive relation of the mother's education with the student's achievement.

The findings of the study also revealed that the aptitude level (i.e.high school admission test score and the elementary general average), including the type of elementary school are considered significant predictors of the students Chemistry performance. In the research of Ayodele et al. (2014), the school type was the most potent predictor to students' achievement. This finding also agrees with Olasehinde and Olatoye (2014); Ogini et al. (2013) and Philias and Wanjobi as cited in Adika (2015) who observed that type of school has an effect on the academic performance of the students. In contrary to the findings shown by Olude (2005) and Demercioglu and Norman (1999) who pointed out that the type of schools (either private or public) could not affect the students' achievement in Chemistry.

In addition, the positive determinants on students' performance agree with the findings of Bhattacharyya, 2015); Espenshade; Murshid (2013) and Chung (2010) who revealed that Grade point average (GPA) and admission tests are reliable predictors of academic performance of the students. However, in the research paper of Murshid (2013), stated that the grade point average was most strongly correlated with academic performance, in contrast to the result of the present study. Moreover, the finding of the study corroborates with the results of Olani (2008); Melse, et al. (1996); Shumi (2012 & 2014) as cited in Robi (2015) who discovered that high school result is the most important and significant variable in predicting students' ability.

Table 8. Correlation analysis between performance of students in chemistry and the dependent variables.

Independent Variables	r-value	prob
Socio-demographic Profile		
Gender	-.050	.437ns
Type of elementary school graduated	.027	.671ns
Fathers educational attainment	-.027	.671ns
Mothers educational attainment	-.056	.383ns
commuter	.117	.070ns
Aptitude Level		
Average elementary grade	.509**	.000 **
High school admission test score	.728**	.000 **

ns – not significant; ** $p < 0.01$

Research Question 5: Which variable singly or in combination best predicts students' performance in Chemistry?

As shown in Table 9, two aptitude variables, namely the high school admission test and elementary average grade are the best predictors of performance in students in Chemistry. The r^2 = 0.612 indicates the coefficient of multiple determination which implies 61.2% of the variation of performance was explained by the combination of these two aptitude variables. However, the high school admission test is considered the best predictor variable as reflected by its standard beta weight of 0.590. The result implied that, the higher the aptitude level of the students, the better the students' performance. Thus, the developed causal model for this study showed that the students' performance in Chemistry is anchored by their ULHSAT score, supported by the type of school and the average grade of the students in their elementary level.

Table 9. Regression analysis on performance of students in Chemistry.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	β	Std. Error	Beta		
(Constant)	40.432	4.141		9.763	.000
HIGH SCHOOL ADMISSION TEST SCORE	.250	.020	.590	12.581	.000
AVERAGE ELEMENTARY GRADE	.322	.050	.344	6.484	.000
TYPE OF ELEMENTARY SCHOOL GRADUATED	1.814	.325	.260	5.590	.000
R = 0.782 R^2 = 0.612 F-value= 125.015 P-value = 0.000					

Research Question 6: What causal model best fit/s students' performance?

Model Building:

As shown in Figure 2, the best fitting model on the performance was found after generation of several model tested. Path analysis was employed in determining model parsimony.
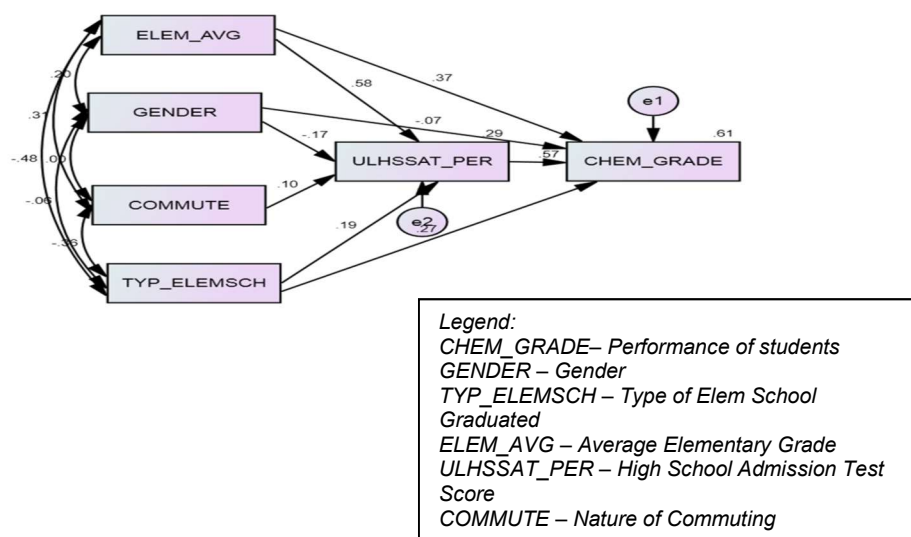
The best fitting causal model:

Legend:
CHEM_GRADE– Performance of students
GENDER – Gender
TYP_ELEMSCH – Type of Elem School Graduated
ELEM_AVG – Average Elementary Grade
ULHSSAT_PER – High School Admission Test Score
COMMUTE – Nature of Commuting

Figure 2. The best fitting causal model on students' performance in Chemistry.

Table 10 presents the direct, indirect and total effects computed in the final Causal Model. The highest total effect was found from the ULHSAT an independent variable having both direct effect to CHEM GRADE with the combined beta weight of 0.572. ELEM AVG and TYP ELEMSCH also influence students Chemistry grade of beta weight of 0.589, 0.316, respectively. This implies also a positive influence.

Table 10. Direct, Indirect and Total Effects of Causal Model

The values generated for the Causal Model is shown in Table 11. Comparing the obtained values in the model with the standard values produces good results. All the standard values of the

Path	Direct Effect	Indirect Effect	Total Effects
GENDER	-.067	0.012	-0.055
TYP_ELEMSCH	.266	0.050	0.316
ELEM_AVG	.372	0.217	0.589
ULHSAT_PER	.572	0	0.572
COMMUTE	0	0.055	0.055

different indices are satisfied. CMIN/DF is 0.460 <2; p-value is 0.497 > 0.05; GFI is 0.999 > 0.95; NFI is 0.999 > 0.95; CFI is 1.000 > 0.95 and RMSEA is 0.000 < 0.05. With the results, this Causal Model is the parsimonious model or the best fitting causal model on students' performance. In this model, the Chemistry performance of students is best anchored on the High School Admission Test Score, which is supported by elementary average grade and type of elementary school graduated.

Table11. Goodness-of-Fit indices of Causal Model

CRITERION INDEX	STANDARD VALUE	CAUSAL MODEL VALUE
CMIN/DF	0< CMIN/DF<2	.460
P-VALUE	>0.05	.497
GF1	>0.95	.999
NFI	>0.95	.999
CFI	>0.95	1.000
RMSEA	<0.05	.000

Conclusion

Based on the findings of the study, the causal model developed for Grade 9 students with respect to their Chemistry performance was anchored on the aptitude level of students as manifested by the high school admission test scores and elementaty average grade. It was then supported by the type of school graduated in elementary, gender as well as the nature of commuting of the students.

With these findings, the students' cognitive skills and their prior academic educational experiences in different types of school graduated in elementary were some of the contributing factors on a better quality performance of students in Chemistry. The fact, many students find chemistry difficult, having described the subject as too complex and abstract which requires analytical and

intellectual ingenuity. (Ben-Zvi et al., 1987; Gabel, 1999; Johnstone, 1991; Nakhleh, as stated in Cardellini, 2012).

Recommendation

The following are the recommendations made based on the findings of the study.

1. A qualitative study may be conducted to strengthen students performance through interviews, or focus groups to validate the quantitative data of the study. This will foster an intensive information about students background that will possibly develop a better academic performance in Chemistry for the K-12 program.

2. Another study may be conducted to other Grade 9 Chemistry students in nearby junior high schools for wider scope to include other variables such as parent's income, students interest and motivation, efficacy, laboratory activities, mathematics grades and type of home environment.

Acknowledgement

Refferences

Agbaje, R. O., & Alake, E. M. (2014). Students' variables as predictor of secondary school students' academic achievement in science subjects. **International Journal of Academic Research and Publications, 4**(9), 1-5.

Abante, Glenda M. 2014. **School Readiness, Classroom Practice and Learning Engagement**: A Causal Model on Kindergarten Pupil's Performance. Unpublished Doctoral Thesis.

Abubakar, R. B., & Oguguo, O. D. (2011). Age and Gender as Predictors of Academic Achievement of College Mathematics and Science Students**. Proceedings of the 2011 International Conference on Teaching, Learning and Change**, 736-742.

Adeyemi, A-M., Adeyemi, S-U. (2014). Personal factors as predictors of students' academic achievement in colleges of education in South Western Niigeria. **Educational Research and Reviews, 9**(4), 97-109.

Adika, L. O. (2015). Comparative Analysis of Social Studies Academic Achievement of Private and Public Junior Secondary Schools' Students in Ibadan North Local Government Area of Oyo State, Nigeria. **Journal of Capital Development in Behavioural Sciences**, **3**(1), 1-161.

Akhtar, Zarina. (2012). Socio-economic Status Factors affecting the Students Achievement: A
Predictive Study**. International Journal of Social Sciences and Education, 1**(2).
Asparin, Ariel A. Problem Solving Abilities and Psychological Attributes of Sophomore
Students: A Causal Model on Mathematics Achievement. Unpublished masteral thesis.

Ayodele M. O., Adedayo J. O., & Ayeni M. F. (2014). Predictive Power of Selected Variables on
Students' Academic Achievement in Integrated Science. **Greener Journal of Educational
Research, 4**(3), 85-90.

Bhattacharyya, P. (2015). A study on consistency of performance of students in combined entrance
examination (assam), board examinations in bachelor of engineering programme.
International Journal of Research in Social Sciences and Humanities, 6(1), 44-52.

Carter, C. S. and Brickhouse, M. W. (1989). What Makes Chemistry Difficult? Alternate Perceptions,
Journal of Chemical Education, 66(3), 223-225.

Cardellini, L. (2012). Chemistry: Why the Subject is Difficult? **áreas emergentes de la educación
química**, 232, 6, Retrieved from http:www.educacionquimica.info/include/
downloadfile.php?pdf=pdf1320.pdf.

Chen, Q. (2009). Family Background, Ability and Student Achievement in Rural China - Identifying the
Effects of Unobservable Ability Using Famine- Generated Instruments.
http://repository.upenn.edu/gansu papers/26.

Christian, Mathew. (2014**). Learning Strategies, Age, Gender and School-location as Predictors of
Students' Achievement in Chemistry in Rivers State, Nigeria**. Research on Humanities and
Social Sciences, **4**(21), 123-123.

Demircioglu, H. & Norman, N. Effects of some variable on chemistry achievement and chemistry-
related altitudes of high school students. Hacettepe University, Egitim, 1999, 16-17; 40-44.

Espenshade, J. T and Chung, C. Y. (2010). Standardized Admission Tests, College Performance, and
Campus Diversity. Office of Population Research Princeton University, 1-41.

Hijazi, T. & Naqvi, R. (2006). Factors effecting student's performance: A case of private colleges.
Bangladesh. **Journal of Sociology**, **3**(1), 1-10.

Kyoshaba, M. 2009. **Factors affecting academic performance of undergraduate students at
Uganda Christian University.** Unpublished Masteral Thesis.

Murshid, Khalid R. (2013). The predictive value of individual admission criteria on academic
performance in a Saudi medical college. **Journal of Taibah University Medical Sciences**,
8(1), 18–23.

Oginni, A.M., Awobodu, Alaka, M.O and Saibu, S.L. (2013). School factors as correlates of students'
achievement in chemistry. **International Journal for Cross-Disciplinary Subjects in
Education (IJCDSE)**, Special Issue, **3**(3), 1516-1523.

Okereke, Chinwe. (2011). Influence of gender, school location and the use of play-simulation on
school achievement in chemistry.JORIND 1(9). Http://www.transcampus.org/journals.

Olude, A.S. (2005). **Effects of school type on students' achievement in chemistry**. Unpublished B.Sc. Ed Project Lagos State University, Lagos.

Robi, Yoseph Shumi. (2015). Determinants of Freshman CGPA: High School Result, Entrance Exam Result and EGSECE GPA**. International Journal of Psychology and Behavioral Science**, **5**(3), 121-127.

Saifi, S. & Mehmood, T. (2011). Effects of socio-economic status on students achievement. **International Journal of Social Sciences and Education**, **1**(2), 119-128.

Tai, R.H., Sadler, P.M., Loehr, J.F. (2005). Factors Influencing Success in Introductory College Chemistry. **Journal of Research in Science Teaching, 42**(9), 987-1012.

Udida, L.A. Ukwayi, J.K., Ogodo, & Agwanyang F. (2012). Parental Socioeconomic Background as a Determinant of Student's Academic Performance in Selected Public Secondary Schools in Calabar Municipal Local Government Area, Cross River State, Nigeria. **Journal of Education and Practice**, **3**(2), 129-135.

Woldeamanuel, Atagana, A. and Engida T. (2014). What Makes Chemistry Difficult? **African Journal of Chemical Education**, **4**(2), 31-43.