Available Online at http://www.journalajst.com

ISSN: 0976-3376

ASIAN JOURNAL OF
SCIENCE AND TECHNOLOGY

Asian Journal of Science and Technology
Vol. 10, Issue, 01, pp.9151-91560, January, 2019

RESEARCH ARTICLE

MULTILEVEL ANALYSIS OF HIGH SCHOOL STUDENT'S ACHIEVEMENT IN PHYSICAL SCIENCE IN KAFFA, SHEKA AND BENCH MAJI ZONES, SOUTH WEST ETHIOPIA

[1]*Tesfaledet Tsegay, [2]Beyene Abetie and [3]Tsegaye Tadesse

[1]Msc in Biostatistics, Department of Statistics, Mizan Tepi University, Ethiopia
[2]Msc in Quantum Optics, Department of Physics, Mizan Tepi University, Ethiopia
[3]Msc in Physical Chemistry, Department of Chemistry, Mizan Tepi University, Ethiopia

ARTICLE INFO

Article History:
Received 22nd October, 2018
Received in revised form
19th November, 2018
Accepted 24th December, 2018
Published online 30th January, 2019

Key words:
Physical Science,
Multilevel analysis, South West Ethiopia.

ABSTRACT

The impact of student level, classroom level and school level on student academic achievement have been of great interest for the last four decades all over the globe. This study examines student, teacher and school related factors that limit high school student's achievement in physical sciences in Sheka, Bench Maji and Kaffa zones, SWE.A cross-sectional survey was conducted on a total of 1300 high school students from five district in nine respective schools we selected by using multistage stratified sampling techniques. A designed questionnaire was used to obtain data on background information, student level, classroom level and school level. The outcome variables was physical science scores obtained by averaging students' continuous assessment scores collected from school records and by delivering common examination for all. Multiple linear regression and multilevel linear regression were used to analyze the data. The results of multiple linear regression showed that variables like more study hours, mother educational level, being male, positive interest towards learning physical science, parent support, school resource and satisfactory equipped class for laboratory illustration had positive effects on the achievement of students in physical science. In contrary variables like absent from class and spent more time arrived to school had negative impacts on physical science achievement of students. The multilevel analysis showed that the variance of the random component related to the intercept term was found to be statistically significant implying difference in student academic achievement among the selected schools.

Citation: ***Tesfaledet Tsegay, Beyene Abetie and Tsegaye Tadesse*, 2019.** "Multilevel Analysis of High School Student's Achievement in Physical Science in Kaffa, Sheka and Bench Majizones, South West Ethiopia", *Asian Journal of Science and Technology*, 10, (01), 9151-91560.

INTRODUCTION

Ethiopia's long-term vision is to become a country where democratic rule, good-governance and social justice reigns, upon the involvement and free will of its people and once extricating itself from poverty and becomes a middle-income economy[Ministry of Finance and Economic Development (MoFED) September 2010 Addis Ababa].Realization of sustainable development is not possible without strong national and technological capabilities. Ethiopia adopted a new National Science, Technology and Innovation (STI) Policy in 2012. The policy sets a vision to see Ethiopia entrenching the capabilities which enable rapid learning, adaptation and utilization of effective foreign technologies by the year 2022/23[Education Sector Development Program IV (ESDP IV) 2010/2011 – 2014/2015 2003 EC – 2007 EC , Federal Ministry of Education August 2010 ,Addis Ababa].Policy directions and strategies have also been defined for each of the critical issues, which include technology transfer, human resources development, manufacturing and service enterprises, research, financing and incentive schemes, universities, research institutes, TVET institutions and industry linkages, intellectual property system, national quality infrastructure development, science and technology information, environmental development and protection, and international cooperation [Abebayehu Mamo *et al.*, 2013].Education is a fundamental right and the basis for progress in every country. Parents need information about health and nutrition if they are to give their children the start in life they deserve. Prosperous countries depend on skilled and educated workers. The challenges of conquering poverty, combating climate change and achieving truly sustainable development in the coming decades compel us to work together. With partnership, leadership and wise investments in education, we can transform individual lives, national economies and our world [Ban Ki-Moon, 2002]. Moreover education and technological skills enable people to create, share and utilize knowledge.

***Corresponding author:** **Tesfaledet Tsegay Mena,**
Msc in Biostatistics, Department of Statistics, Mizan Tepi University, Ethiopia.

Different study reveals that the human resource capacity that exists on the continent does not have the required capability to utilize technological knowledge in an innovative way, efficiently and effectively so as to contribute significantly to economic growth and development. Achieving the vision of transforming Ethiopia into a middle-income country in 2025 demands transformation of the economy through application of science and technology as instruments to create wealth. In line with the key priorities of the current Growth and Transformation Plan, a large demand is expected for middle and high level human resources. It is therefore critically important to emphasize science and technology so as to produce capable citizens who can contribute to make the country competitive in the increasingly knowledge-based global economy. To achieve the expected learning outcomes in science education, the Ethiopian government has now shifted its attention to improve quality of education with general education quality Improvement Package programs that have been positively influence students' achievement. The importance of physical science, particularly chemistry and physics in the technological development of a nation cannot be under estimated. However, there are challenges that recent education reforms proposed changes in the school curriculum, mode of delivery, teacher education programs and the assessment techniques. The Ministry of Education also reported that the quality of teaching learning process in Ethiopian schools is very low [MOE Annual Reort, 2002; Mo, 2008]. Different studies reveal that the Ethiopian schools seem unsuccessful in their efforts to improve the teaching learning of science and students' science achievement [Temechegn, 2002]. In the average mark for grade 8 Chemistry national exams was 40.1 in 2004 and 34.7 in 2007. The average mark for physics in the respective years was 35.2 and 32.2 [USAID-AED, 2008]. The percentage of students who scored 50% and above from those registered to the general school leaving examination for grade 10 in 2010 was 17.1 for chemistry and 10.1 for physics. From the result for University Entrance Exam result of the same year, the percentage of students who scored 50% and above was 44.4 for chemistry and 16.7 for physics [Education Sector Development Program IV (ESDP IV) 2010/2011 – 2014/2015 2003 EC – 2007 EC, Federal Ministry of Education August 2010, Addis Ababa].Therefore, the main aim of this study was to explore student, teacher and school related factors that limit high school student's achievement in physical sciences in Sheka, Bench Maji and Kaffa zones, South West Ethiopia.

It is on the basis of the study tries to test a multi-level; student and school level factors for providing a causal explanation of secondary school students' achievement in physical science. Based on the stated problem, the study attempts to provide answers to the following questions.

- To what extent do student intake-characteristics explain the variability in physical science achievement?
- To what extent do school characteristics explain the variability in physical science achievement?
- To what extents will the multi-level characteristics taken together, predict student's achievement in physical science?
- What proportion of the variance of student's achievement in physical science in these three zones selected school is situated at the student and school level?
- Do teacher quality (as measured by the evaluations score), class size, and teacher experience impact on student learning gains in physical science?

The study may be helpful to achieve the main objectives of science education in Ethiopia, general secondary and preparatory schools should look for all factors that are related to the students' academic achievement in physical science subjects. Accordingly, the study will be significant in the following regards:

- This study would help Zonal Education Offices to identify ways to improve students' achievement in science and formulating policies pertaining to resource allocation in the improvement of science education;
- It helps students to be competent in a complex scientific and technological world through better involvement in physical science education.
- It enables school principals to improve the effectiveness of teaching learning process in the school by providing more than expected supports and resources;
- It initiates science teachers and laboratory technicians to evaluate their professional support to improve the students' academic achievement.

MATERIAL AND METHODS

This study was conducted in Sheka, Kaffa and Bench Maji zones, three of the 13 zones in south nation nationality people region. The purpose of this study was on the achievement in physical science of high school and preparatory school students; the ninth, tenth, eleventh and twelfth grade. The main groups of interest in this study are student populations (since by-products of the selection methods districts, schools and classes, also can be considered as populations).Thus, the source population were all students who are learning in high school and preparatory, teachers on teaching physical science subjects and school principals as May/June 2015. The study was cross-sectional survey with multi-stage sampling design method. At first, second and third stage, sample of districts, schools and class in these zones of secondary school and preparatory school students was consider, respectively. Therefore, a three-stage cluster sample design was used, with districts as the first stage, schools at the second stage and intact classes as the third stage. In this study, the two zones (Kaffa and Bench Maji each has 11 districts) and Sheka zone only has three districts and hence 25 districts are considered in order to draw the primary stage sampling units. In order to draw school samples that are representative of the student populations, the researcher was ask to provide vital information about all schools where sample grade students was tested. Given the nested nature of the sampling units, listing all classes(along with the class sizes) within sampled schools that agreed to participatein the study could be the only requirement for building the class sampling frame.This list included all regular classes and note that within sampled classes, all students should be listed.

Sample Size and Sampling Techniques: In conducting this researches that require taking a sample, we always have the stage of deciding the sample size. The decision is important because taking too large sample implies waste of resources while too small sample reduces the usefulness of the results. There are different ways of estimating the population variance for sample size determination. These are taking the variance from pilot survey, previous research work and by guesswork (Cochran, 1977). Accordingly, since the dependent variable is continuous and we cannot find the population parameters (μ,σ), then we can determine the sample size from their estimators by conducting pilot survey. For conducting a pilot survey, 60 students were selected randomly from Tepi secondary and preparatory school.

Let N be the total number of students in the study area (population size)

Let Y_i be the average point of students with $\bar{y}=\frac{\sum_{i=1}^{n} y_i}{n}, and\ s^2=\sum_{i=1}^{n}\frac{(y_i-\bar{y})^2}{n-1}$, so the sample size will be determined by the following formula:

$$n=\begin{cases} n_0\ if\frac{n_0}{N}<5\% \\ \frac{n_0}{1+\frac{n_0}{N}}\ if\ \frac{n_0}{N}\geq 5\% \end{cases}$$

Where, $n_0=\frac{z_{a/2}^2 s^2}{d^2}*deff$, s^2 =Variance of average point of sample students', z= theoretical value corresponding to the 5% level of significance, set as 1.96, d= marginal error determined by the investigator, set as 0.05n= the required sample size and N= population size

The selected pilot question is: What is your average point in the previous year?

Response	N	Mean	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic
Average point	60	67.82	0.6714	0.4508

Thus, $n_0=\frac{z_{a/2}^2 s^2}{d^2}*deff=\frac{(1.96)^2}{(0.05)^2}*0.4508*1.8=1247$

Since $\frac{n_0}{N}=\frac{1247}{52901}=2.35\%<5\%$ the required sample size will be equal to $n_0=n=1247$

It is common practice in surveys to increase the sample size by an amount equal to the anticipated non-response rate. This assures that the actual number of interviews completed in the survey was closely approximate the target sample size. The degree of non-response in surveys varies widely by country. In the calculation exercise below, we allow the anticipated non response rate to be 10 percent. Then 10% of the given sample size is 125 and the total sample size included in the study will be 125+1247=1372.

It is always best to have as many clusters in the PSU as possible.

The reason for this is that the fewer the number of respondents in each PSU, the lower will be the clustering effect which increases sample variance and effectively reduces our estimating power. WHO requires an absolute maximum of 50 respondents per PSU, and ideally would suggest 20-30. This means that for a sample size of 5000 respondents, 100-200 clusters should be taken into the sample. Calculating that, roughly, one six of the total number of PSU clusters in a country will be randomly selected in to the survey sample, the sampling frame should consist of 500-1000

PSU clusters (WHO). Generally, WHO suggested two basic concepts about the determination of primary sampling unit.

- The number of PSU should be large, the number of PSUs in the sampling frame should be at least 5 times larger than the number of PSUs randomly selected into the survey sample.
- Sometimes, a PSU size in each stratum varies greatly. In this case, it may be desirable to further stratify PSUs by size, and to select the PSUs with probability proportional to size

Therefore, there are 25 districts in these three zones so that randomly four districts will be selected as a primary sampling unit. Thus, Mizan-Aman and Semen Bench from Bench Maji and Chena from Kaffa, and Yeki district from Sheka zone are included in the study. Since clusters are often of unequal size, sampling weights are necessary to be able to reconstruct population estimates from our sample estimates.

- $Weight\ (cluster\ k)=\frac{1}{probability\ selection\ (cluster\ k)}, k=1,2,3,\dots,25.$

Thus, the weights of each sampling unit (PSU) in the above table would be presented as follows:

District/ cluster	1	2	• • •	25
Weight	$1/PS1$=16.67	$1/PS2=22.22$	• • •	$1/PS25=25.19$

Study Variables: The response variable is physics and chemistry scores obtained by summing students' continuous assessment scores collected from school records and by delivering common examination for all selected students. Continuous assessment is the total score from all quizzes and assignments during the first academic term, and the examination is taken at the end of the second semester. Because different schools use different proportions of the continuous assessment and examination scores to calculate final scores, we adjust them across all schools so that continuous assessment and examinations each account for 50% of the total score for each course. The rest of 50% evaluated from the average of examination. Both measures are continuous, and high values indicate high achievement in the subject.

Independent Variables:

- Background characteristics: sex, age, religion, family income, father's and mother's educational level, Parent support
- Student Level characteristics: Number of books at home, study hours, absent from school, mother's educational level, Time spent for study, Interest towards learning physical science
- Teacher related characteristics: Teacher gender, teachers interest towards their profession, teaching experience, Teacher's evaluation, teachers' commitment to their job, standard of lectures and presentations, assessment and teachers' interest towards the course they have been teaching
- School level characteristics: accessibility and quality of library resources, equipped class for laboratory illustration, School location, school with electricity, school with clean drinking water, school with toilet facility and school climate.

Data processing: The analysis was carried out in three sections. In the first section, results of descriptive statistics for different student and school related characteristics are presented; in the second section, we identified and examined different student and school related factors associated with academic achievement of student in physical science among student in Sheka, Kaffa and BM using multiple linear with help of SPSS software. Finally multilevel modeling was used to identify factors affecting students' academic achievement and to distinguish the variation in achievement across selected school using MLwiN software.

Linear regression analysis: Linear regression is a statistical technique which had been designed to assess the extent of relationship between a continuous dependent variable and explanatory variables. A linear model relating the response variable Y_I to several predictors has the form

$$\mathrm{y_i = \beta_o + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots\ldots + \beta_{(P-1)} X_{(P-1)i} + e_i}\ \text{Where} i = 1, 2. . . , n.$$

$$y_i = \beta_0 + \sum_{j=1}^{p-1} \beta_j X_{pi} + e_i$$

The subscript t denote the observational unit (i=1, 2, …, n) from which the observations on y and the (p□1) independent variables are taken. There are p parameters β_j, j = 0, 1, 2. . . , (p□1), to be estimated when the linear model includes the interceptβ_o. 2.3.2 Multi-level hierarchical linear modeling (HLM). This study looked the effects of teachers and schools after controlling for student-level factors. An appropriate procedure for doing this is hierarchical linear modeling or HLM [Raudenbush, 1992]. Moreover, multilevel linear regression model is applied in educational research since many problems in education are multilevel characteristics. Thus, it is used as a standard approach to handle such nested structure of educational data [Goldstein, 1991].In the analyses several models will be test each adding successively a new group or layer of variables. The first will be involved by fitting a variance-components model to estimate the amount of variance due to the effects of students (level 1) and within schools (level 2) by running the models without any explanatory variables. The second model introduced a group of student background variables comprising sex, and family size, birth place of parents, and family formation. The final model added several school-level factors including school size, average class size, the type of school community, time dedicated to science teaching, and school climate, student absenteeism and level of behavioral disturbances.

The empty model: The empty two- level model for a continues outcome variable refers to a population of groups (school) and specifies the probability distribution for dependent variable$Y_{ij}$is given by $Y_{ij} = \beta_0 + U_{oj} + \epsilon_{oij}$without taking further explanatory in to account. Where β_0 is is interpreted as the overall average of academic achievement of student in physical science, U_{oj} is level two error and ϵ_{oij} is level one error.The empty model is used for different purpose such as to decompose the total variance, to estimate the interclass correlation and to measure how much of the variation is explained by the model with no predicators included. The total variance is decomposed as the sum of the department-level and student-level variances $Var(Y_{ij}) = Var(U_{oj}) + Var\ (\epsilon_{oij}) = \sigma_U^2 + \sigma_\epsilon^2$the variance$\sigma_U^2$ *and* σ_ϵ^2estimate the variation among schools and among students, respectively. It is, therefore, possible to decompose the variance at two levels to assess how much of the variation is due to students themselves and how much is due to schools.Additionally, empty model provides an estimate for the intra-class correlation. It is calculated as school-level variances divided by the total variance of student achievement defined as: ICC= $\rho = \delta_u^2/(\delta_u^2 + \delta_e^2)$

The Random Coefficients Model: used to assess whether the slope of any of the explanatory variables has a significant variance component between the groups. The random coefficient model is given as follows:

$$Y_{ij} = \underbrace{\beta_0}_{\text{Over all mean}} + \underbrace{\beta_0 X_{1ij} + \cdots + \beta_m X_{mij} + \epsilon_{ij}}_{\text{student level}} + \underbrace{\beta_{m+1} X_{(m+1)j} + \cdots + \beta_n X_{nj} + U_j}_{\text{school level}}$$

Where

y_{ij} is an achievement of the student *i* associated with school

ϵ_{ij} is random effect for student *i* and school j which is normally distributed with mean zero and variance σ^2.

U_j islevel two variance, m student-level explanatory variables and n − m department-level explanatory variables.

Hence, the proportions of variance explained by the final model at student level and school level, respectively are: $\frac{\sigma^2_{\epsilon(empty)} - \sigma^2_{\epsilon(final)}}{\sigma^2_{\epsilon(final)}}$ and $\frac{\sigma^2_{u(empty)} - \sigma^2_{u(final)}}{\sigma^2_{u(final)}}$ where $\sigma^2_{(final)}$ and $\sigma^2_{(final)}$ are variances of empty and final models, respectively.

RESULTS AND DISCUSSION

Result of descriptive statistics: A total of 1300 student attained secondary and preparatory school in Sheka, Keffa and BM were included in the study. The initial sample consisted of 1372 students of grade 9-12. Out of this 1300 (94.8%) of students with complete measurement related to school and exam were selected for the analysis and others were excluded due to incompleteness and inconsistency of data on the variables which are considered as important for the analysis. From the sampled student, the average performance of student in physical science score was about 46.0%. The major socio- demographic and school related characteristics of the students are presented in Table 1. Out of 1300 student 61.6% and 38.4% were male and female, respectively. The average age of student was about 17.5 years old. Similarly from the sample student 411(31.6%) of them didn’t have interest for physical science. From the sampled student about 62.5% of the student has been absent from school frequently per week.

Determinants of Academic Achievement: A Multiple Linear Regression Analysis: The most important determinant of students’ academic achievement in physical science were identified using stepwise selection method in multiple linear regressions. In this model, Study time per day in hour., Number of physical science books at home , Absent from school (0=No; 1=Yes), Students Sex(0= Female,1= Male), Mother educational level (0=Illiterate 1=Literate), time spent to arrive school, Homework per week for physical science , Teacher evaluation in last semester, Parents support (0=No; 1=Yes) , Schools facilities (0=No 1=Yes), School resource (0=No 1=Yes) and Equipped class for laboratory illustration(0=Unsatisfactory, 1=Satisfactory)were found to be determinants of students’ academic achievement in physical science in Sheka, BM and Kaffa zone 9^{th} -12^{th} grade students at 5% level significant. From the results in Table 2 using SPSS multiple linear regression models in stepwise selection method it can be seen that variable absent from school, students sex, mother educational level, time spent to arrive school, teacher evaluation in last semester, parents support, schools facilities, school resource and class size for laboratory illustration are highly significant ($p < 0.05$), but age of the student, teacher experience and school location are not significant and remove from the model. The adjusted R^2 is high and F-value indicates that the multiple linear regression model is significant in genera

The result showed that student academic achievement was highly significant for Study time per day in hour. The academic achievement score was increased by about 3.292 for each unit increase in Study time per day in hour controlling all the other variables in the model. Parent support is also a significant factor associated with physical science academic achievement of students. As compared to the reference category (not have parent support), the student who get support from parents were about 3.571 unit more in their academic achievement, controlling for other variables in the model. Similarly, mother’s education status showed a statistical significant association with student academic achievement in physical science. The students whose mother educational status is literate were higher by 2.424 units score in physical science than those students whose mother is illiterate. Absenteeism from school also showed a statistical significant association with physical science academic achievement. The students who absent from school were 4.254 units lower than those students who do not absent from school controlling for other variables in the model. Sex was also another significant factor associated with physical science academic achievement of students. As compared to the reference category (female), male student were about 2.554 higher in their physical science academic achievement, controlling for other variables in the model. From the result of multiple linear regression among three zones, Student from Bench Maji score 1.69 unit more as compared to the other two zones, controlling for other variables in the model.

In contrary students from Weshenk secondary school score 2.485 less as compared to the other selected school in three zone, controlling for other variables in the model. Schools facility is also a significant factor associated with academic achievement of students in physical science. As compared to the reference category (school provide less facility for student), student comes from school provide better facility were about 1.201 unit more in their academic score, controlling for other variables in the model. Similarly student comes from school have Equipped class for laboratory illustration were about 5.066 unit more in their academic score in physical science, controlling for other variables in the model.

ANOVA to Test Mean Difference among Department: In the multilevel analysis, a two-level structure is used with students as the first-level units and school as the second-level unit. This is basically with the expectation that there would be a difference in the physical science academic achievement of students among the schools. In this part, we test if there are differences in the mean physical science academic achievement of students among schools before proceeding to multilevel model analysis. We can carry out a mean test for schools mean differences, i.e. a test of the null hypothesis

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7 = \mu_8 = \mu_9$ (No differences among the Schools).

H_1: At least there is difference between two school

Table 1. Socio- demographic and school characteristics of the students in Sheka, Kaffa and BM Southwest Ethiopia, May/June, 2015

Variable	Categories	Frequency	Percentage (%)
Sex	Female	499	38.4
	Male	801	61.6
Father education level	No education	464	35.7
	Primary and above	836	64.3
other education level	No education	646	49.7
	Primary and above	654	50.3
Absent	Yes	812	62.5
	No	488	37.5
Father occupation	Farmer	725	55.8
	Other	575	44.2
Interest towards learning physical science	Interested	411	31.6
	Not-interested	889	68.4
School location	Rural	431	33.2
	Urban	869	66.8
School Electricity	Yes	1186	91.2
	No	114	8.8
School clean drinking water	Yes	807	62.1
	No	493	37.9
School toilet facility	Yes	637	49
	No	663	51
Equipped class for lab	Satisfactory	490	37.7
	Unsatisfactory	810	62.3
Class size for lecture	Satisfactory	784	60.3
	Unsatisfactory	516	39.7
School resource	Satisfactory	868	66.8
	Unsatisfactory	432	33.2

Table 2. Results of Multiple Linear Regression Models for predicting physical science academic achievement of students in Sheka, Keffa and BM zones, SWE, May/June 2015

Variable	β	Std. Error	t	Sig.
Student level				
(Constant)	12.281	1.037	11.843	.000*
Students' sex	2.554	.476	5.366	.000*
Mother educational level	2.424	.485	4.997	.000*
Absent from school	-4.254	.545	-7.801	.000*
Study time per day in hr.	3.292	.834	3.947	.030*
Number of chemistry and physics books at home	.407	.148	2.749	.006*
Times spent to arrive at school in hours	-2.446	.649	-3.768	.000*
Interest towards learning physical science	3.114	.538	5.788	.000*
Parent support	3.571	.530	6.738	.000*
Homework per week for physical science	.245	.079	3.101	.002*
Teacher evaluation in last semester	1.154	.137	8.423	.000*
Student from Bench Maji	1.697	.603	2.814	.000*
School level				
Student from Chena	2.555	.982	2.601	.009*
Student from Weshenk	-2.485	.875	-2.840	.005*
Schools facility	1.201	.218	4.843	.004*
Schools resource	2.564	.248	10.339	.000*
Equipped class for lab	5.066	.382	13.262	.000*
F		15.65		.000*
R^2		0.897		
R^2 adjusted		0.804		
D.W		1.980		

*Significant (p<0.05)

Table 3. Multilevel model without explanatory variable analysis

	Coefficient	S.E	Z-value	P-value
Fixed part				
β_0 = intercept	8.361	0.3725	10.69	0.000*
Random part : Variance component				
Level-two variance				
$\sigma_u^2 = \mathrm{Var}(U_{oj})$	1.859387	0.46213	4.01655	0.02031*
Level-one variance				
$\sigma_\epsilon^2 = \mathrm{Var}(\epsilon_{oij})$	8.204	1.204	6.81	0.00123*
ICC(ρ)	0.18			
Over all fit: -2*log(likelihood) Chi- squared based statistics, 2 df		9344.604(1300 of 1300 cases in use)		0.000*

*significant at 5% level

Table 4. Summary of Multilevel linear Regression Model Selection Criteria based on Deviance Based Chi-square Test

Model Selection Criteria	Liner regression model	Multilevel model without explanatory variable	Multilevel Random Coefficient Model
-2*log likelihood	9412.525	9344.604	9199.513
Deviance based χ^2 test	47.04	114.624	145
p-value	0.000*	0.000*	0.0186*

*significant at 5% level

Table 4.11. Results in random Intercept and Fixed Coefficient Linear Regression model

		Coefficient	S.E	Z-value	Sig,
Constant		11.566	1.451	7.971	.000*
Fixed effects Covariate					
Students' sex	Male	2.486	.502	4.952	.000*
Mother educational level	Literate	2.662	.473	5.627	.000*
Absent from school	Absent	-4.061	.628	-6.466	.000*
Study time per day in hr.		3.022	.809	3.735	.032*
Times spent to arrive at school in hours		-2.454	.610	-4.023	.000*
Interest towards learning physical science	Interested	3.706	.593	6.249	.000*
Parent support	Support	4.120	.628	6.561	.000*
Teacher evaluation in last semester		1.117	.156	7.160	.000*
School level					
Schools facility	Satisfactory	1.821	.267	6.820	.000*
Schools resource	Satisfactory	2.590	.314	8.248	.000*
Equipped class for laboratory	Satisfactory	4.902	.332	14.765	.000*
Random effect		Variance component	S.E	Z-value	P-value
Level-two variance: $\sigma^2_{u(final)} = \mathrm{Var}(\mathrm{U_{oj}})$		1.063	0.240	4.43	.000*
Level-one variance: $\sigma^2_{\epsilon(final)} = \mathrm{Var}(\epsilon_{\mathrm{oij}})$		7.341	.974	7.54	.000*
Over all fit		9199.513(1300 of 1300 cases in use)			

*significant at 5% level

The F-test was used to test for differences between the schools means. The F-test statistic gives Fcal=32.708, df (8, 1291), P.value=0.00<0.05. Thus, there is evidence for heterogeneity among the schools with respect to physical science academic achievement. We conclude that there are real variation between schools in the mean physical science academic achievement students.

Multilevel Linear Regression Model without Explanatory Variables: The results of fitting multilevel linear regression model without explanatory variables (empty model) are presented in Table 3. It is observed that the level one and level two variance were significant indicating that student and school difference contributed for the variation in physical science academic achievement of students.

The variance σ_e^2 and σ_0^2 estimate the variation among students and among schools, respectively. It is, therefore, possible to decompose the variance into student level and school level variance to assess how much of the variation is due to students themselves and how much is due to schools. The sources of variation in the model are students and schools. Also, the multilevel model without explanatory variable analysis provides an estimate for the intra -class correlation. It is calculated as school-level variances divided by the total variance of student physical science achievement defined as

$$ICC = \frac{\delta_u^2}{\delta_u^2 + \delta_e^2} = \frac{1.86}{8.204 + 1.86} = 0.185$$

From the result given above 82% of the variation in student physical science academic achievement was accounted for individual student differences. While 18% amount of variation associated with schools.

Multilevel Random Intercept and Fixed Coefficient Linear Regression Analysis: The significance test in table 4 implies that a Multilevel Random Coefficient Model is better than a multilevel model without explanatory variable, which showthat the Multilevel Random Coefficient Model is better than the multilevel model without explanatory variable in predicting physical science academic achievement of students among the selected schools. The analysis of multilevel linear regression revealed that academic achievement of students varied among schools. To identify the effect of explanatory variables a multilevel regression model with random intercept and fixed explanatory variables were estimated using ML win software.

From the random effect part the level-one and level-two variances of the multilevel random intercept and fixed coefficient linear regression mode $\sigma^2_{\epsilon(final)} = \mathrm{Var}(\epsilon_{\mathrm{oij}})$ and $\sigma^2_{u(final)} = \mathrm{Var}(\mathrm{U_{oj}})$as found to be significant (p< .000) , which implies that individual students and school difference contributing for the variation of academic achievement of students from the random intercept and fixed coefficient model. In addition Father educational, absent from school, Study time, Parent support, Teacher evaluation and Homework per week for physical science from student level variables and Schools facility, Schools resource and equipped class for laboratory illustration from school level were also found to be significant determinants of variation in achievement of student's in physical science.

Discussion of the result

This study was an attempt to identify some determinants of academic achievement of student in physical science based on the data collected from May 20 to June 30, 2015 on Sheka, Kaffa and BM zone selected schools. The results which are obtained are discussed as follows: The descriptive analysis of the study revealed that from the sampled students, the average performance of student in physical science was about 46.0 in Sheka, BM and Kaffa Zones. This is consistent with the finding reported by OliNegassa's shows that total mean result achievements of standard tests in science for the high schools were 45.36% for SNNPR [OliNegassa, 2014].

The analysis also showed that mother's education status was another important variable which showed a statistical significant association with student academic achievement in physical science. The students whose mother educational status is literate were higher by 2.424 units than those students whose mother is illiterate, controlling for other variables in the model. This result supported by a study done in Indonesia and Pakistan showed that there was a positive relationship between the level of mother education and student [Suryadarma *et al.,* 2014; Hijazi, 2006].The study revealed that parent support is also a significant factor associated with physical science academic achievement of students. As compared to the reference category (not have parent support), the student who get support from parents were about 3.571 unit more in their academic score. This finding is similar to previous reports in Berthelot showed that student with parents involved in school performed better than those with non-involved parents [Rumberger, 2004]. In this study student absent from school also showed a statistical significant association with their physical science academic achievement. The students who absent from school were 4.254 units lower than those students who do not absent from school. This result is in line with study done in United States of America showed that high student absenteeism rates were found to affect the achievement of students' that attend regularly by disrupting the existing learning groups [Zamudio, 2004].

The model also revealed that male student were about 2.554 higher in their physical science academic achievement as compared to female student. Although the finding of this study is not consistent with the findings of the studies that examined Turkish students' achievements on international exams, found that Turkish girls did better than boys [Yilmaz, 2009], but current study is consistent with many earlier research [Langen *et al.,* 2006; Tesfaye Semela, 2005; Kahle, 2004]. The reasons for this may be because of female students are more disadvantaged than male students in terms of family background, tradition, work load in home, poor attitude and low access to limited educational resources. The data in this study showed that student comes from school provide better facility were about 1.201 unit more in their academic score. Similarly student comes from school have equipped class for laboratory illustration were about 5.066 unit more in their academic score, controlling for other variables in the model. This result is in line with a study done in Malaysian and Singaporean students using multilevel analysis [Mohammadpour, 2012].This may due to total resources devoted to education or resources per student affect education outcomes. The multilevel analysis showed that variation in physical science academic achievement is around 18% due to between school variations the rest 82% left for first level factor (among student).

This result is in line with meta-analysis of 168 studies, found that 19% of variance lies between schools [Bosker, 1997]. Similarly another multilevel study by Stephanetremblay *et al.,* (2001) revealed that individual student characteristics accounted for the majority of the variation in test scores, 33% of the total variation was associated with the schools. In contrary a study conducted in on first year secondary school students in Central Uganda show that 84.3% of the total variationwas associated with the schools [Henry Nsubuga, 2015].

Conclusions and Recommendation

In conclusion this study was designed to identify factors affecting the academic achievement of students in physical science based on the data collected from May10 - June 30, 2015 on Sheka, Kaffa and BM zone high schools. Multiple linear regression and multilevel linear regression models were used. The results showed that the importance of using student-level and school-level factors simultaneously in order to understand the variation in students' academic achievement in physical science. The results of multiple linear regression showed that variables like more study hours, literate mother, being male, positive interest towards learning physical science, parent support, school resource and satisfactory equipped class for laboratory illustration had positive effects on the achievement of students in physical science. In contrary variables like absent from class and spent more time arrived to school had negative impacts on physical science achievement of students. In multilevel linear regression analysis, the random parts of the intercept and the coefficients provided additional information. In empty without random intercept and with random intercept model the overall variance of the constant term was found to be significant, which indicates the existence of differences academic achievement of student in physical science across the schools.

From the results and the discussion we made the following relevant policy implications and recommendation:

- Accessibility and quality facilities to the students (library, laboratory, toilet facility and source drinking water) need to be provided by the school in order to increase the physical science academic achievement of students.
- To improve the female students' performance in physical science, the schools must arrange tutorial and other supportive programs to fill the gap.

- In order to minimize the effect of distance and absent from school Government and other concerned bodies should build additional high and preparatory school in study area.
- It is necessary to provide education to women as students of educated mother showed a better performance in physical science.
- More research need to be carried out in this particular study area on the factors associated with academic achievement of student in physical science and other intervention mechanism.

Acknowledgement

We would like to express our special gratitude to all manager of women and children affaires officers of the two zones for their important directions, preparing the available data, encouragement and support from the initial to final level during this study. Moreover my special thanks have goes to Mizan -Tepi University, especially Institute of Research and Community Development Support office for providing me a chance for completing this community based research and financial support.

REFERENCES

Ban Ki-Moon, United Nations Secretary-General

Bosker, R.J. and Scheerens, J. 1997. A self-evaluation procedure for schools using multilevel modelling. Tijdschriftvoor Onderwijs research, 20(2), 154-164.

Cochran, W. G. 1977. Sampling techniques (3rd ed.). New York: John Wiley & Sons

Education Sector Development Program IV (ESDP IV) 2010/2011 – 2014/2015 2003 EC – 2007 EC , Federal Ministry of Education August 2010 ,Addis Ababa]

ESA, United Nations Secretariat Statistics Division /STAT/AC.93/ 03 November 2003

Goldstein, H. 1991. Nonlinear multilevel models with an application to discrete response ata. *Biometrika*, 78, 45–51.

Henry NsubugaKiwanuka and Jan Van Damme, Wim Van Den Noortgate, Dickson NkafuAnumendem and SperanzaNamusisi 2015. Factors affecting Mathematics achievement of first-year secondary school students in Central Uganda

Hijazi, S. and Naqvi, S. 2006. Factors affecting student's performance: A case of private colleges, Bangladesh e-Journal of Sociology.

IFS-AAS Project on Developing an Enabling Scientific Equipment Policy in Africa Ethiopia Country Study (Final Report) By AbebayehuMamo, MSc Abebe Mekuriaw, MSc FrehiwotWoldehanna, PhD,July 2014,Addis Ababa ,Ethiopia]

Kahle, J. B.2004. Will girls be left behind? Gender differences and accountability. *Journal of Research in Science Teaching*, 41(10), 961-969.7

Langen, A, V, Bosker, R., &Dekkers, H. (2006). Exploring cross -national differences in gender gaps in education. Educational Research and Evaluation, 12 (2), 155-177

Ministry of Finance and Economic Development (MoFED) September 2010 Addis Ababa]

MoE ANNUAL REORT 2002 E. C

MoE, 2008. Educational statistics annual abstract: Education Sector Development Program Planning and Policy Analysis Department at Ministry of Education. Addis Ababa, Ethiopia.

Mohammadpour E. 2012. Factors accounting for Mathematics achievement of Singaporean eighth graders.

OliNegassa, Adama Science and Technology University, Ethiopia , 2014 Ethiopian students' achievement challenges in science education: implications to policy formulation.

Raudenbush, S. and Bryk, 1992. Hierarchical Linear Models. Newbury Parks, CA: Sage

Rumberger RW. Palardy GJ 2004. Multilevel models for school effectiveness research. Stéphane Tremblay, Nancy Ross and Jean-Marie Berthelot (2001).

Suryadarma, D., Suryahadi, A. and Sumarto, S. 2004. Improving student performance in public primary schools in developing countries: evidence from Indonesia, World Bank.

Temechegn, E. 2002. Reflection on African science education for the new millennium: The case of the Ethiopian chemistry curriculum for beginners. International Journal of Science Education, (24), 941-953.

TesfayeSemela 2005. Higher Education Expansion and the Gender Question in Ethiopia: A Case Study of Women in a Public University, Assistant Professor, Department of Rura l Development and Family Science, Awassa College of Agriculture, Debub University

Tremblay S., Ross NA., Berthelot JM. 2001. Factors affecting grade three student performance in Ontario: a multi-level analysis. *Education Quarterly Review.,* 7: 25-36

USAID-AED 2008. Review of the Ethiopian Education Training Policy and its Implementation, Addis Ababa. Ethiopia Early Grade Reading Assessment: Data Analysis Report: Language and Early Learning- Ministry of Education/USAID.

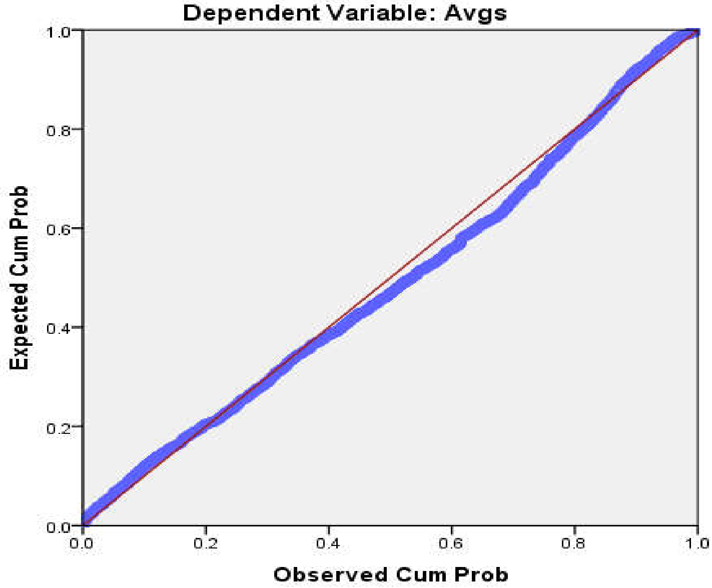
Yilmaz, H. B. 2009. Turkish students' scientific literacy scores: multilevel analysis of data from program for international student assessment. Unpublished doctoral dissertation. Ohio State University, Columbus, OH.

Zamudio, G. 2004. Student mobility: the relationship between student population stability and academic achievement. (Unpublished doctoral dissertation), University of Arizona, Arizona.

Appendix

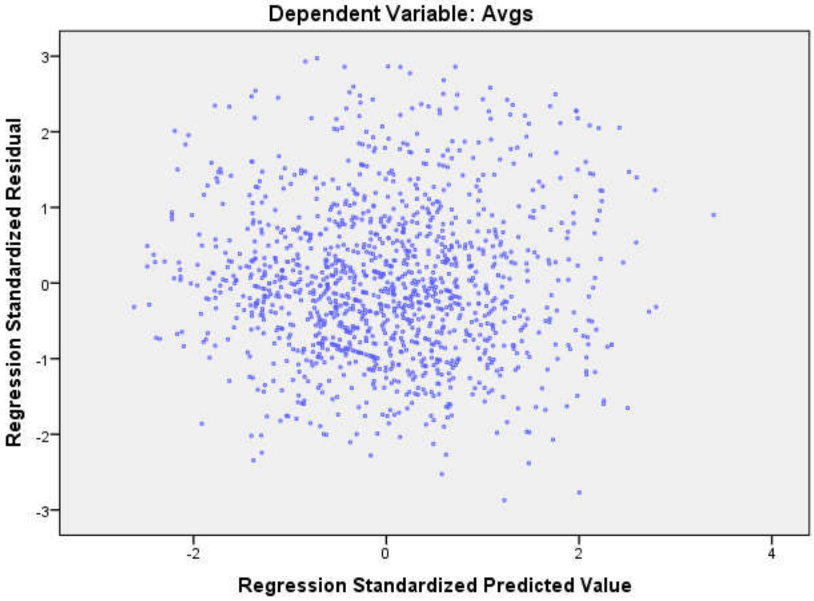
Normal P-P Plot of Regression Standardized Residual

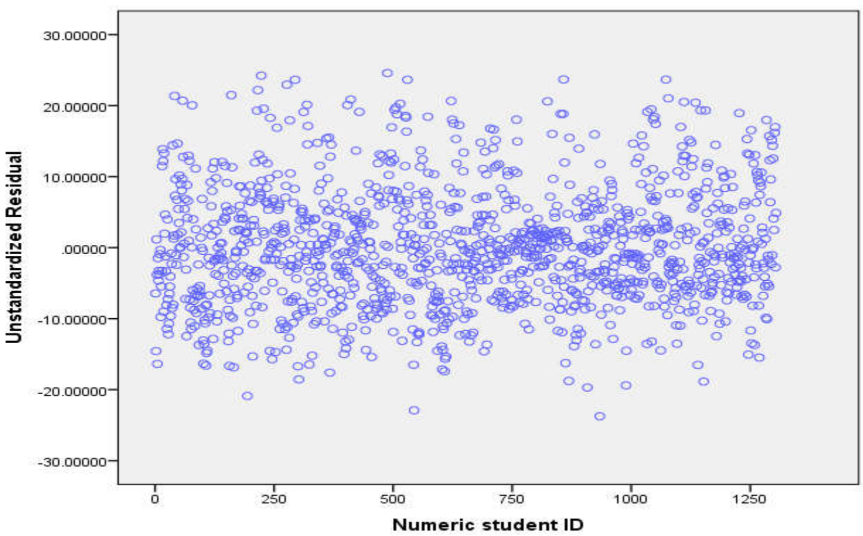
Dependent Variable: Avgs



Scatterplot

Dependent Variable: Avgs





****