

Multilevel Analysis for Identifying Factors Influencing Academic Achievement of Students in Higher Education Institution: The Case of Wollo University

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Abstract

Education is a process by which man transmits his experiences, new findings, and values accumulated over the years, in his struggle for survival and development, through generations. Accordingly, one of the aims of education is to strengthen the individual's and societies' problem solving capacity, ability and culture starting from basic education and at all levels in each field (FDRGE, 1994). The general objective of this study is to determine the key factors influencing students' academic achievements measured by CGPA of students. The data for the study Data were obtained through questionnaire method that covers various factors related to students' academic achievement including educational and socio-demographic backgrounds of pupils and their parents, economic background of parents, lecturers' characteristics and general university facilities. The data collection instrument (that is questionnaire) was prepared in English. Students included in the sample were selected using systematic random sampling technique from those representative departments and batch's. The analysis used multilevel linear regression to analyze the data in order to identify determinants of both school and department variation in students' academic achievements measured by CGPA of students. University entrance Exam result, sex, mother education level, father education level, drug use, number of assessments, and group study status were found to be determinants of academic achievement in the total sample of students. In contrast, sexual partner and teacher education level were not significantly related the academic achievement of students. In conclusion, to increase the success of students and reduce variability of academic achievement both between college/school/institute and departments, there is clear need of promoting group work and put efforts for its effectiveness. In addition, both college/school/institute and departments should give great attention in supporting female students.

Keywords: Academic achievement, Sample size, Multilevel, Regression, Hierarchical, Wollo University

1. Background

Education is a process by which man transmits his experiences, new findings, and values accumulated over the years, in his struggle for survival and development, through generations. Accordingly, one of the aims of education is to strengthen the individual's and societies' problem solving capacity, ability and culture starting from basic education and at all levels in each field (FDRGE, 1994).

Academic performance is generally a pedagogical terminology used while determining learners' success in formal education and which is measured through reports, examinations, researches, and ratings with numerous factors or variables exerting influences. Essentially, the national policy on education has identified students' performance at Higher Education Institutions (HEIs) based on the Cumulative Grade Points Average (CGPA) results of the courses taken by the individual. In line with this, students are eager in all concerned to know the final grade point or exam scores because they can be confidential to graduate as their CGPA determine eligibility for continuing higher education in Ethiopia.

Examination of student achievement has always been an interest to the education community. For instance it gives information to governmental and non-governmental organizations working in the areas of giving care, support and treatment for education quality to make a policy and plan strategy on the area and gives benefit for undergoing radical political and social changes and carrying out education sector reforms. It is also believed that results of the research will be used as a basis for further study in the area.

With this regard, factors like gender, home resources, motivation, students attitude and self-confidence as students factors and classroom composition, technology use and teacher centered instruction as teachers factors were examined as the leading causes for students academic achievement towards science streams (Aypay, Erdogan and Sozer, 2007; Kaya and Rice, 2009 and Yilmaz, 2009).

Moreover, lecturers have concentrated on diagnosing text books used, teaching method and personality, difficult concepts, curriculum contents, among others as influencing students' performance. However, educational researchers have identified poor motivation, poor study habit, poor attitude, poor adjustment, and lack of self-concept, among others as possible causes of poor academic achievement (Okegbile, 2007 and Telila, 2010).

Tesfye Semela (2005) analyzed Higher Education Expansion and the Gender Question in Ethiopia: A Case Study of Women in a Public University at Debu University. The results show that of the total of 27,209

enrolled between 2000/01 and 2004/05 academic years at undergraduate degree programs, only 19.2% were women. Similarly, the average proportion of women graduates over the same period was 11.7%. Women attrition (due to academic reasons) was found to be about 35.1% in the 2003/04 academic year. The qualitative results indicated that women equity is affected by factors related to socio-psychological, academic and guidance and counseling support, health and financial problems.

Many reasons have been attributed for the high failure, dismissal, dropout rates and poor academic performances in HEIs; some people traced that the high failure rate to student inability to comprehend and balanced the principles of some courses such as, Mathematics and sciences related. There are clear indications that students vanishing or loss of interest to study basic sciences in general Physics and Mathematics and in particular their current study field. Others are of the view that the abysmal students' performance is due to loaded curriculum (there is too much to be taught within a short time). Again some people suggest it on lack of proper supervision on the part of university administration and family control in student's carelessness. Likewise, some raise that gender stereotype has also great influential effect.

However, most of the studies in Ethiopia focused on the single level analysis that reflects the presence of all or some of the factors identified above and others may have resulted in the poor academic performance of students at HEIs. It can be said that no study was carried out on multilevel analysis for identifying factors influencing academic achievement of students in Ethiopian HEIs. Thus this study was undertaken with objectives to obtain the multilevel factors that are predictors for the academic performance of students measured in CGPA at Wollo University with the hope that the results would contribute to existing knowledge.

2. Method

2.1. Study Area

The study was conducted in Wollo University (WU), North Wollo Zone, Dessie, in Amhara regional state. The target population for this study was WU students registered in the 2012/2013 academic calendar as regular both in Kombolcha and Dessie campuses.

2.2. Sampling Design, Procedure and Sample Size

Cross-sectional study with multistage simple random sampling design was conducted. The main purpose of sampling is to reduce sampling error. Hence, in determining the appropriate design and required sample size there are a number of issues/points one has to take into account. Some of the issues are: objective of the research, design of the research, cost constraint, degree of precision required for generalization and etc. Accordingly, there are two distinct campuses which are non-overlapping and relatively homogeneous groups in WU. The campuses are Dessie and Kombolcha and we included both the campuses in this study. All the colleges, schools and institutions in each campus were also included. Similarly departments which have a minimum of second year student considered and second year and above students was selected randomly as primary units (respondents) representing their batch with respect to their department. Accordingly, the sample size determination formula

$$n = \frac{Z_{\alpha/2}^2 S^2 / E^2}{1 + \frac{Z_{\alpha/2}^2 S^2 / E^2}{N}}$$

is adopted for this study (Cochran, 1977), where Z is the upper $\alpha/2$ points of standard

normal distribution with $\alpha=0.05$ significance level, which is $Z_{\alpha/2} = 1.96$. $s^2 = 0.534$, the sample variance obtained from the pilot study of 52 students, and the degree of precision E is taken to be 0.03. Accordingly, the sample size using the given formula, with population size $N= 6553$ regular students for the current study become $n = 925$. Next, we carried out sample size allocation using proportional allocation to each department and to each batch.

2.3. Data Collection

Data were obtained through questionnaire method that covers various factors related to students' academic achievement including educational and socio-demographic backgrounds of pupils and their parents, economic background of parents, lecturers' characteristics and general university facilities. The data collection instrument (that is questionnaire) was prepared in English. Students included in the sample were selected using systematic random sampling technique from those representative departments and batch's. Taking the lists of students from the respective departments and batch's from registrar office of the university, then a list of names of the sampled students was prepared.

Data collection was carried out using trained data collectors under the supervision of the researchers who worked closely with them. Before the questionnaire was administered, the purpose of the study was

discussed with the respective college or school deans and department heads. Having reached an agreement, the date and time of data collection were decided.

On the day of data collection, students included in the sample were seated in rows in the hall assigned before, as if they were in the examination to maintain privacy. A brief orientation was given by the researcher on the purpose of the study and how to respond to both parts of the questionnaire. They were also told that individual respondents would not be identified as giving particular answer and confidentiality was guaranteed. After filling out of the forms, the data collectors checked and collected the questionnaires. Finally after fully checked they submitted to the researchers.

2.3.1. Variables in the Study

The outcome or response variable used in this study is the current CGPA result as measurement of individual's performance. The set of explanatory or independent variables included are students with social/family characteristics, and college/departments at the university with lectures characteristic variables which are: *Social/family characteristics*: father education level, sex, mother education level and group study. *Personal factors*: university entrance exam result, drug use, sexual partner. *Learning environment*: number of assessment and teacher education level.

2.4. Analytic Method

The statistical analytic method used in this study was multilevel analysis. The multilevel regression model has become known in the research literature under a variety of names, such as 'random coefficient model' (de Leeuw and Kreft, 1986; Longford, 1993), 'variance component model' (Longford, 1987), and 'hierarchical linear model' (Raudenbush and Bryk, 1986, 1988). Statistically oriented publications tend to refer to the model as a mixed-effects or mixed model (Littell, Milliken, Stroup, and Wolfinger, 1996). The models described in these publications are not *exactly* the same, but they are highly similar, and we will refer to them collectively as 'multilevel regression models'. They all assume that there is a hierarchical data set, with one single outcome or response variable that is measured at the lowest level, and explanatory variables at all existing levels. Conceptually, it is useful to view the multilevel regression model as a hierarchical system of regression equations.

Multilevel linear regression model is applied in social research, especially in educational research due to an increasing awareness that many problems in education are multilevel characteristics. Thus, it is used as a standard approach to handle such nested structure of educational data (Goldstein, 2010). It is a generalization of regression model which can be used for a variety of purposes including prediction, data reduction and inference from observational studies (Raudenbush and Bryk, 1992).

Multilevel data analysis involves the modeling and analyses of data that have a hierarchical nature. For the particular situation in the context of our consideration where students (level-1 subjects/units) within department are (level-2) units and departments within college/ institute/ school are (level-3) and the appropriate hierarchical model is the three-level linear regression.

3. Result of Multiple Multilevel Linear Regressions

The result of multilevel linear regression presented in Table 1a given below showed that the likelihood of academic achievement was highly significant for university entrance exam result. The academic achievement was increase by about 0.003 for each unit increase in university entrance exam result controlling all the other variables in the model.

Number of assessment is also a significant factor associated with academic achievement of students. As compared to the reference category (four or more assessments per semester), the student who get less than four assessments were about 0.0688 unit less in their academic score, controlling for other variables in the model. Drug use also showed a statistical significant association with academic achievement. The students who do not use drug were 0.2207 units higher than those students who use drug controlling for other variables in the model. Sex is a significant factor associated with academic achievement of students. As compared to the reference category (male), female student were about 0.2066 lower in their academic achievement, controlling for other variables in the model.

Mother's education level is another important variable which showed a statistical significant association with academic achievement. The students whose mother education level primary, high school and certificate or diploma were higher by 0.0941, 0.0429, and 0.1008 units than those students whose mother have no formal education, controlling for other variables in the model. Father's education level is also another important variable which showed a statistical significant association with academic achievement. The students whose father education level high school, certificate or diploma and first degree or above were higher by 0.0555, 0.0369, and 0.2039 units than those students whose father have no formal education, controlling for other variables in the model.

The result we obtained from academic achievement of students also shows that group study affect the

student's academic achievement. The estimated coefficient of study group where the student was not study in group were about 0.0675 unit less in academic achievement as compared to student who study in group while controlling for other variables in the model.

In the Table 1b below, the value of $Var(V_{0k})$ and $Var(V_{8k})$ are the estimated variances of intercept and slop of group study at college level, respectively. While, $Var(U_{0jk})$, $Var(U_{1jk})$ and $Var(U_{8jk})$ are the estimated variances of intercept, slop of sex, and slop of group study at department level, respectively. In Table 1b given below the values of results of hierarchical 3-level analysis for academic achievement are obtained only from the estimated variance of intercept, slope of group study and slope of sex are variables which results in variation of academic achievement in Wollo University.

The result of college level (level-3) estimated variance of intercept and slop of group study p-values are small, suggesting that intercepts and slope of group study vary significantly across colleges, that is, there is only a significant variation in the effects of the group study across the colleges in terms of academic achievement. Finally, the variance of interaction between intercepts and group study also put its effect on variation in academic achievement among students of Wollo University.

Similarly, the result of department level (level-2) estimated variance of intercept, slop of sex and slop of group study p-values are small, suggesting that intercepts, slop of sex and slope of group study vary significantly across departments, that is, there is only a significant variation in the effects of the group study and sex across the department in terms of academic achievement. Finally, the variance of interaction between intercepts sex and group study also put its effect on variation in academic achievement among students of Wollo University.

Table 1a Multiple Multilevel Linear Regression Result

Covariate	Estimate	S.E.	Z-value	P-value
Intercept (x_0)	1.8131	0.1398	12.96924	0.0000*
Sex (x_1)				
Female	-0.2066	0.0322	-6.41615	0.0000*
Male (ref.)				
Entrance result (x_2)	0.003	0.0003	10	0.0000*
Drug use (x_3)				
No	0.2207	0.0564	3.913121	0.0001*
Yes (ref.)				
Teacher education level (x_4)				
BSc	-0.0379	0.0378	-1.00265	0.1580
MSc and BSc are proportional	-0.0426	0.0342	-1.24561	0.1065
MSc or above (ref.)				
Get at least four assessments (x_5)				
No	-0.0688	0.0286	-2.40559	0.0081*
Yes (ref.)				
Mather education level (x_6)				
No formal education (ref.)				
Primary	0.0941	0.0381	2.469816	0.0068*
High school	0.0429	0.0189	2.269841	0.0116*
Certificate or diploma	0.1008	0.0319	3.159875	0.0008*
First degree or above	0.1354	0.0917	1.476554	0.0699
Father education level (x_7)				
No formal education (ref.)				
Primary	0.0162	0.0366	0.442623	0.3290
High school	0.0555	0.0077	7.207792	0.0001*
Certificate or diploma	0.0369	0.0107	3.448598	0.0003*
First degree or above	0.2039	0.0699	2.917024	0.0018*
Group study (x_8)				
No	-0.0675	0.0281	-2.40214	0.0081*
Yes (ref.)				
Sexual partner (x_9)				
No	0.0392	0.0445	0.880899	0.1892
Yes (ref.)				

* Significant ($p < 0.05$)
 ref. =reference category

Table 1b Results of the hierarchical 3-level analysis

Random Part	Estimate	S.E.	Z-value	P-value
Random coefficient:				
Level-3 variance and covariance				
$\sigma_{\eta}^2 = \text{var}(V_{0k})$	0.0071	0.0025	2.84	0.0019*
$\sigma_{\xi}^2 = \text{var}(V_{8k})$	0.0234	0.0035	6.68571	0.0000*
$\sigma_{08} = \text{cov}(V_{0k}, V_{8k})$	0.1064	0.0312	3.41026	0.0003*
Level-2 variance and covariance				
$\sigma_{\eta}^2 = \text{var}(U_{0jk})$	0.0134	0.006	2.23333	0.0131*
$\sigma_{\eta}^2 = \text{var}(U_{1jk})$	0.2301	0.087	2.64483	0.0041*
$\sigma_{\xi}^2 = \text{var}(U_{8jk})$	0.223	0.079	2.82278	0.0024*
$\sigma_{18} = \text{cov}(U_{1jk}, U_{8jk})$	-0.088	0.1102	-0.7985	0.2119
$\sigma_{08} = \text{cov}(U_{0jk}, U_{8jk})$	0.1281	0.0632	2.0269	0.0211*
$\sigma_{18} = \text{cov}(U_{1jk}, U_{8jk})$	-0.0702	0.0271	-2.5904	0.0048*
Level-1 variance				
$\sigma_{\epsilon}^2 = \text{var}(\epsilon_{0ijk})$	0.1676	0.0079	21.2152	0.0000*

*Significant (p<0.05)

3.1. Discussion

The results of the analysis presented in this study, identified factors that are significantly associated with academic achievement of students. This paper is important to improve academic achievement of students by ensuring the effective implementation of a limited number of significant factors.

The results of this study indicated that the variation in academic achievement among Wollo university student accounted for both college/institute/school and department level differences. An interesting finding of this study is not only that achievement of Wollo university students differed from college/institute/school to college/institute/school, but it also differed substantially from a department to another department within a college/institute/school. According to Anderson (1991), both college/institute/school and department effectiveness depends to a great extent on teacher effectiveness. Teachers have absolute veto power over innovation and change even in the most highly centralized educational system. Therefore, what happens in classrooms could be accounted for this great difference in students' achievement.

Sex of the student had a great effect on academic achievement of Wollo university students where female students performed lower than those of male students. Although the finding of this study is not consistent with the findings of the studies that examined Turkish students' achievements on international exams, For instance, Yilmaz (2009) found that Turkish girls did better than boys, it is consistent with many earlier research (Langen, Bosker, & Dekkers, 2006; Tesfaye, 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.

Mothers and father educational level are the two most influential factors for academic achievement of students in Wollo University. Mothers and fathers educational level have positively and strongly associated with student's academic achievement. This result is consistent with many other research findings around the world (Considine and Zappala, 2002; Sentamu, 2003; Kwesiga, 2002). One possible explanation for this finding is probably that the student's inspired by their parent academic achievement and academic feedback on their academic journey. They also found that these parents provide higher levels of psychological support for their children through environments that encourage the development of skills necessary for success at school.

Teacher's educational level and having sexual partner are the two factors which not found to be statistically significant. In contrast, drug usage is found to be statistically significant. That is, students who do not use drug are better in their academic achievement as compared to those who use drug. In this study, group work is another important factor which positively affects the students' academic achievement. Form the finding students' who study in group perform much better than students who do not. One possible explanation for this finding is probably that when the student's study in group, they raise questions and discuss with a group and bring solution for questions in a courses, which can improve their potential.

Number of assessment in a given semester will have effect on academic achievement. The finding of this study showed students who got less than four assessments are lower in their academic achievement than those who got at least four assessments. This result is consistent with finding of Idowu & Esere, (2009). The rationale behind this is, when students get more assessments, it gives chance to correct their mistake and contribute positive point to academic achievement.

University entrance exam result has positive effect on student's academic, which is a student with better university entrance exam result more successful than student with low university entrance exam result. A result

confirmed by Anderson, Benjamin and Fuss (1994) who found that students who performed well in high school also performed better in college. In addition, the results is also consistent due to the fact that, that students who had previously performed well continue to do so because they have a strong potential to easily catch up with university work and they are motivated to do so (Durr, 1997).

4. Conclusion and recommendations

There are various factors inside and outside school that contribute for the academic success of students. This study only focused on some of the factors that influence the student's achievement scores. The key aspect for the educators is to educate their students effectively so that they may be able to show quality performance in their academics. To achieve this objective it is necessary for the educators to understand better about the factors that may contribute in the academic success of students. From the finding of this study we conclude that group study, sex, mothers' education level, fathers education level, university entrance exam result, drug use and number of assessment are factors which affect student's academic achievement at Wollo University. On the other hand, sexual partner and teachers' education level do not have effect on the academic achievement of student. Finally, based on the study findings and the conclusions, the following recommendations are derived: The university management, colleges/schools/institutes and departments should give weight to promoting group work and its importance to the students. Furthermore, the university bodies also prepare tutorial and other support programs for female students to contract the gap. Finally, in collaboration with police and the community who live around the university, the management should take measure on those people who sale drugs around the university to reduce students' vulnerability to drug.

References

- Anderson, L. W. (1991). *Increasing teacher effectiveness*. Paris: UNESCO.
- Anderson, G, Benjamin, D, & Fuss, M. (1994). Determinants of success in university introductory economics courses. *Journal of Economic Education*, (spring), 25.
- Aypay, A., Erdogan, M., & Sozer, M. A, (2007), Variation among schools on classroom practices in science based on TIMSS-1999 in Turkey, *Journal of Research in Science Teaching*, 44,1417-1435
- Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models*. Newbury Park, CA: Sage.
- Cochran, W.G. (1997). *Sampling Techniques*. (3rd ed.). John Wiley and Sons, Inc. New York.
- Considine, G. & Zappala, G. (2002). Influence of social and economic disadvantage in the academic performance of school students in Australia. *Journal of Sociology*, 38, 129-148.
- Durr, J.C. (1997). Factors affecting student performance in principles of macroeconomics.
- Endawke, (2009). *Quality of Higher Education in Ethiopian Public Institutions*. Forum for Social Studies, Addis Ababa University Press.
- FDRGE. (1994). *Education and Training Policy*, St. George Printing Press.
- Getnet D., (2008). Using "plasma TV" broadcasts in Ethiopian secondary schools: A brief survey, The University of Melbourne. *Australasian Journal of Educational Technology*, 24(2), 150-167.
- Goldstein, H., (2010). *Multilevel Statistical Models (4th Edition)*, WILEY SERIES IN PROBABILITY AND STATISTICS, University of Bristol, UK, A John Wiley and Sons, Ltd., Publication.
- Idowu, A.I. & Esere, M.O. (2009). Assessment in Nigerian schools: A Counsellor's Viewpoint. *Edo Journal of Counselling*, 2(1), 17-27.
- Kahle, J. B, (2004), Will girls be left behind? Gender differences and accountability. *Journal of Research in Science Teaching*, 41(10), 961-969.
- Kwesiga, C.J. (2002). *Women's access to higher education in Africa: Uganda's experience*. Kampala: Fountain publishers Ltd.
- Kaya, S., & Rice, D, C, (2009). Multilevel effects of student and classroom factors on elementary science achievement in five countries. *International Journal of Science Education*, 32 (10), 1337-1363.
- 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
- Longford, N.T. (1987). A fast scoring algorithm for maximum likelihood estimation in unbalanced mixed models with nested random effects. *Biometrika*, 74, 817-27.
- Longford, N.T. (1993). *Random Coefficient Models*. Oxford, Clarendon Press.
- Okegbile, A. (2007). *Achievement in School Core Subjects, Students' Adjustment and Study Habit Factors: A Predictive Approach*, Faculty of Education and Arts; Niger State, Nigeria, Babangida University, Ilorin *Journal of Education*, Vol. 27.
- Sentamu, N.P.(2003). *School's influence of learning: A case of upper primary schools in Kampala & Wakiso Districts*. Uganda Education Journal , 4.
- Snijders and Roel J. Bosker, (1999). *Multilevel Data and Multilevel Analysis: An introduction to basic and advanced multilevel modeling*, SAGE Publications, London _ Thousand Oaks _ New Delhi.

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- Telila, L.(2010). Review of Some Recent Literature: Identifying Factors That Affect Ethiopia’s Education Crisis, Ee-JRIF, Vol 2, No 2 2010 - Education Issue: pp. 56-68.
- Tesfye Semela (2005). Higher Education Expansion and the Gender Question in Ethiopia: A Case Study of Women in a Public University, Assistant Professor, Department of Rural Development and Family Science, Awassa College of Agriculture, Debub University.
- 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.