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Student's performance as cause-effect phenomena: A multilevel approach

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Abstract

This study was commenced upon to examine the influences of different factors related to student's level and school level on student's academic performance among secondary school certificate (SSC) students in Charsadda district of Khyber Pakhtunkhwa province, Pakistan. The data were collected through a well-designed questionnaire from the 10th grade students (984 girls & 1148 boys) of 48 different schools through multistage sampling method. A survey was conducted for gathering information about different factors related to student's academic performance. Three hypotheses were framed according to three research queries raised. The research queries were tested by using multilevel regression model. The findings shows that, the academic performance of male and female students are significantly ($t = -6.16$ and $p = 0.000$) different from each other and student's performance of public schools is significantly ($t = -15.60$ and $p = 0.000$) better than private schools. Further, it is observed that at student level age, gender, mother education, family type and family income have significant effect on student's academic performance and at school level the effect of class size, school type and school standard are found highly significant. Therefore, it is recommended that government should make arrangements to minimize the number of students per teacher and the concerned authorities has to work amicably to solve the issues of gender gap, economic and family problems.

Keywords: Multilevel, education, Charsadda, Pakistan

1. Introduction

Education plays a vital role in the human and country development at all stages. There are key determinants that affect the education level which ultimately translate into human and country's development. Quality education ensures the achievement of knowledge and required skills that enable individuals to enhance the productivity and improve their living standard and access to basic needs. This increase in productivity further translate towards new sources of earning which also further enhances the economic growth of a country (Saxton, 2000) [22]. Student performance is a key component of quality education that result in better outputs in the long run. Student intellectual performance measurement has received substantial consideration in previous research literature, it is a challenging aspects of academic literature. Student performance are affected by many factors including social, mental, economic, environmental and personal factors. These factors strongly influence on the student intellectual performance, but these factors vary from person to person and country to country.

During the last decade in Pakistan, the enrolment at primary, secondary and higher level has been increased substantially. Literacy for all (LFA) is a project initiated by government of Pakistan in 2005 which encourage the overage people to engage in getting primary education. Similarly, some other projects were also initiated to increase the literacy rate in our country. The government of Pakistan, with the support of international organizations also start providing monthly stipend for female students in the rural areas to motivate the parents and the female students to enrol in primary education that further leads in increasing the overall education level. The students' performance plays an important role in producing the best excellent graduates who will become great leader and manpower for the country thus responsible for the country's economic and social development (Ali *et al*, 2009) [1]. According to (Blevins, 2009) [3] and (Parri, 2006) [18] defining and measuring the quality of education and the student performance is not a simple process and the complexity of this process increases due to the changing values of quality attributes associated with the different stakeholders' view point.

However (Ballatine, 1993) [5] explored that there are many factors which affect the quality and output of education.

The academic performance of student measure through numerous ways like, their test result, CGPA or marks and GPA. Around the word maximum number of the researcher used GPA or marks to measure the student academic performance like (Broh, 2002) [4], (Stephen & Schaban, 2002) [24], (Darling, *et al.* 2005) [7] and (Galiher, 2006) [11]. Also a number of researcher, measure student performance through the result of previous year or specific subject (Hake, 1988) [14], (Tho, 1994) [25] and (Hijazi & Naqvi, 2006) [12]. The academic performance of student's influenced by numerous factors other than their individual characteristics like school, class and teacher characteristics and many more. However mostly these factors are tested in different researches age, gender, geographical belongingness, ethnicity, marital status, socioeconomic status (SES), parents' education level, parental profession, language, income and religious affiliations. These are usually discussed under the umbrella of demography. Numerous research reports and papers are available in the literature at national and international level providing evidences about these factor by using different statistical methods.

Some previous research of Hattie (2005) [13], Nye *et al.* (2004) [17], Blatchford *et al.* (2002) [2], Goldstein *et al.* (2000) [10], Finn and Achilles (1999) [9], McGiverin *et al.* (1989) [16] and Slavin (1989) [21], shows the effect of number of students in class on classroom processes which include teacher student's interaction and classroom interaction. Results showed that, the amount of time spent on dealing with individual pupil and instruction increases with small size of class and decreases as class size increases. The study of Worley (2007) [27] revealed that teacher-student relationships, student's relationship with parents, motivation, socio-economic status, and peer influence can affect the students GPA. However Rock and Stricker (1995) [20] analyzed the effect of students and school characteristics on Graduate Record Examinations (GRE). The findings disclosed that, the student's characteristics have no significant effect and parent's education have significant effect on student's achievements. Also Dayioglu and Turut-Aşik (2007) [6] analyzed data from Middle East undergraduate students and concludes that gender differences have significant effect on academic performance. Urien (2003) [26] investigated that the effect of family background, discipline and personal characteristics have positive effect on student's performance.

The study of (Farooq *et al.*, 2011) [8] indicated that parent's education and socioeconomic status play a key role in improving student's academic performance, they also confirmed that the performance of female student's is much better than male student's. According to (Hijazi & Naqvi, 2006) [12] a number of studies are carried out to explore different factors affecting student's academic performance, however they revealed that mother education and attendance is the two successive factors. The positive effect of single family type were investigated by (Qaiser *et al.*, 2012) [19] on student's academic performance. These and many others studies at national level like, (Irfan & Shabana, 2012) [15], (Sattar & Ghulam, 2012) [23] and (Zahid, 2012) [28] displayed the effect of age, gender, family type, family size, family income, parents education, parents envelopment, class size, school size, school type etc. factors on student's academic performance by using classical multiple regression, logistic regression, independent sample t-test, chi-square test and

disregarding the actual hierarchal structure of the data and the problem of dependency of observation in data. Consequently, the current study was designed to determine the impact of age, gender (male=0, female=1), mother education (educated=0, uneducated=1), family type (single=0, joint=1) and family monthly income in Pakistani rupees (up to 25000, up to 35000, up to 45000 and above 45000) at level one and class size, school type (public=0, private=1) and school standard categorized (good, normal and low) at level two on student's academic performance by considering the actual hierarchal structure of the data.

2. Objectives of the Study

This study is carried out in order to fulfil the following objectives:

1. Determine the impact of level one and level two factors on student's academic performance.
2. Compare the academic performance of male and female students.
3. Equate the academic performance of public and private sectors schools.

3. Methodology

A well-defined questionnaire was considered to accumulate the anticipated information from the students of secondary school certificate (SSC) level. Multiple stage sampling method was used to identify students for compiling data. For this purpose data were collected from male and female students of different private and government schools of Charsadda district in two stages. In first stage 48 clusters (schools) are selected randomly from 191 total clusters and in second stage 2132 students were chosen randomly from selected clusters. Descriptive statistics mean and standard deviation are used, for comparison of categories in each factor student t-test and ANOVA are used. However for further exploration the actual nested or hierarchal structure of the data were captured. Most appropriate method for nested data the multilevel regression is used to identify the impact of different factor related to individual or students and related to schools characteristics on student's academic performance. The following research hypotheses were formulated and tested at .05 level of significance on the basis of objectives of the research.

H₁: To check whether the fixed β's of the corresponding explanatory variables in the model possesses significant value.

H₂ : There exists no significance difference between the performance of male and female students.

H₃ : There exists no significance difference between public and private schools.

The data were analysed through MLWin version 2.1 and SPSS version 20.00.

The multilevel regression model used in the study

$$Y_{ij} = \beta_{0j} + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \\ + \beta_7 X_7 + \beta_8 X_8 + e_{ij} \\ \beta_{0j} = \gamma_{00} + u_{0j} \\ e_{ij} \sim N(0, \sigma^2) \\ u_{0j} \sim N(0, \sigma^2)$$

4. Theoretical Framework

The following figure 1 represents the nested structure of the data, factors related to students or individual (level one) and factors related to school (level two) also our work more precisely.

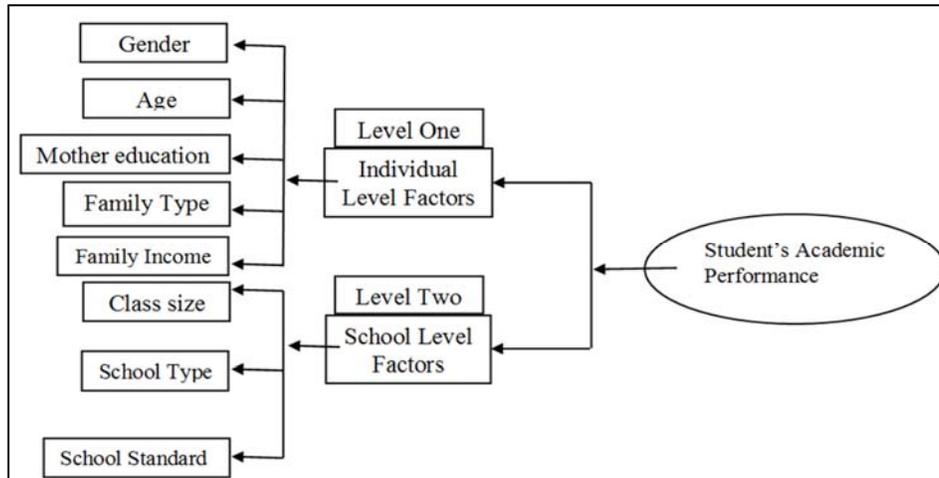


Fig 1: Structure of the Data

5. Results and Discussion

Table 1 presents the estimated mean, standard deviation and percentage sample size of different factors categories related

to student's academic performance and their comparison through t-test.

Table 1: Compression of different categories using t-test

Variables		Obtained Marks		Percentage size	t-value	P-value
		Mean	Standard Deviation			
Gender	Male	20.95	7.16	53.84	5.67	0.000
	Female	19.23	7.20	46.15		
Family Type	Single	19.95	7.96	35.10	5.07	0.000
	Joint	18.43	7.60	64.90		
Mother Education	Educated	19.99	7.33	60.80	4.11	0.000
	Un Educated	18.42	7.91	39.20		
School Type	Public	20.25	7.83	47.00	10.26	0.000
	Private	18.07	7.02	53.00		

It is evident from table 1 that male students averagely secured 20.95 points marks with standard deviation 7.16 and female students averagely obtained 19.23 points marks with standard deviation 7.20. However there mean difference 1.72 is found statistically significant $t(2130) = 5.67, p < 0.05$. Similarly student's living in single family system achieved 19.95 points marks having standard deviation 7.96 and student's living in joint family system obtained 18.43 points marks with standard deviation 7.60. The mean difference of both categories is recorded 1.52 and found highly significant $t(2130) = 5.07, p < 0.05$. Furthermore, student's having educated mother secure averagely 19.99 points marks and student's having uneducated mother secure 18.66 with standard deviation 7.33 and 7.91 respectively. A mean

difference of 1.57 were observed and found highly significant $t(2130) = 5.13, p < 0.05$. However the factor school type related to level two i.e. school level shows that, students from public schools on the average obtained 20.25 points marks and students from private schools gained 18.39 points marks averagely with standard deviation 7.83 and 7.02 respectively. The average difference is recorded 2.18 and found statistically highly significant $t(2130) = 10.26, p < 0.05$.

Table 2 represents the estimated mean, standard deviation and percentage sample size of different factors categories related to student's academic performance and their comparison through ANOVA.

Table 2: Compression of different categories using ANOVA:

Variables		Obtained Marks		Percentage size	F-value	P-value
		Mean	Standard Deviation			
Family Monthly Income	Up to 25000	19.40	7.60	30.90	61.57	0.000
	Up to 35000	19.57	7.50	51.10		
	Up to 45000	20.10	7.90	13.30		
	Above 45000	21.61	6.67	4.60		
School Standard	Good	20.58	7.08	50.53	102.48	0.000
	Normal	18.94	6.55	40.71		
	Low	17.77	6.65	8.77		

Table 2 revealed that, student's belong to low income families (up to 25000) secured 19.40 points marks, belong to families having monthly income (up 35000) obtained

19.57, from families having monthly income (up 45000) gained 20.10 and students from families having monthly income (above 45000) secure 21.61 points marks with

standard deviations 7.60, 7.50, 7.90 and 6.67 respectively. A mean differences of these categories are found statistically highly significant with F-value = 61.57, $p < 0.05$. The factor school standard related to level two or school shows that, students from good standard schools obtained averagely 20.58 points marks, normal standard secured 18.94 and low standard achieved 17.77 point marks with standard

deviations 7.08, 6.55 and 6.65 respectively. Mean difference of these categories are found statistically significant through ANOVA F-value = 102.48, $p < 0.05$.

In order to obtain the objectives of the study and to test the null hypothesis related to objectives, Table 3 represents the estimated results of multilevel regression, t-test and p-values for each considered factor of level-one and level-two.

Table 3: Multilevel regression

Variables	coefficients	Standard error	t-value	p-value
Level one Variables				
intercept	25.390	0.560	45.33	0.000
Age	-0.286	0.029	-9.86	0.000
Gender (female)	-0.672	0.109	-6.16	0.000
Mother education (uneducated)	-0.155	0.049	-3.16	0.001
Family type (joint)	-0.239	0.047	-5.08	0.000
Family income: Up to 35000	0.004	0.053	0.075	0.940
Up to 45000	0.158	0.050	3.16	0.001
Above 45000	0.923	0.118	7.82	0.000
Level two Variables				
class size	-0.102	0.009	-11.33	0.000
School type (private)	-1.982	0.127	-15.60	0.000
School Standard: Normal	-1.036	0.162	-6.39	0.000
Low	-1.282	0.268	-4.78	0.000
Error terms: Level one	1.055	0.033		
Level two	0.858	0.037		

It can be read from Table 3 that, intercept = 25.390 which is the averagely obtained marks of each students and recorded significant $t = 45.33$, $p = 0.000$. Results revealed that age has negative effect on student's performance as one year increase in age decreases the academic performance of students by 0.286 points. Also the associated high value of $t = -9.86$ and minimum value of $p = 0.000$ shows that age has significant effect on student's academic performance. The factor gender coefficient demonstrate a negative value -0.672 for female students comparative to male students indicates that the academic performance of female students is 0.672 points less than from male students. Furthermore, the observed values of $t = -6.16$ and $p = 0.000$ confirms that the academic performance of male and female students are significantly different and gender has significant effect on student's academic performance. Additionally this also confirm our hypothesis H_2 of no significant difference in the academic performance of male and female is rejected. The positive effect of mother education on student's academic is detected, as the coefficient for mother education has a negative value -0.155 for the academic performance of those students having uneducated mother comparatively to those students having educated mother. However the attendant large negative value of $t = -3.16$ and the least value of $p = 0.001$ indicates that the effect of mother education on student's academic performance is statistically significant. It is observed from the results that, joint family system has negative effect on student's academic performance as students living in joint family system obtained 0.239 points lower marks as compare to student's academic performance living in single family system. Also the effect of family type on student's academic performance is recorded statistically highly significant with values of $t = -5.08$ and $p = 0.000$. Further it is observe that family income has positive effect on student's academic performance as increase in family income rise the performance of student's. The minimum family income category (up to 25000 income/month) is considered base for the rest of categories and found positive

effect of income, though no statistically significance difference is observed in student's performance having monthly family income up to 25000 and up to 35000. However highly significance differences in student's academic performance is observed between base family and families having monthly income up to 45000 and above 45000 with $t = 3.16$, $p = 0.001$ and $t = 7.82$, $p = 0.000$ respectively. At level two or school level the impact of factors, class size, school type and school standard is observed. Class size shows negative and highly significant effect on student's academic performance according to the recorded values of $t = -11.33$ and $p = 0.000$. As class size increases the performance of students decreases and vice versa. Results revealed that student's from public schools secured more marks as compare to students from private schools and the effect of school type on student's academic performance is found statically significant with $t = -15.60$ and $p = 0.000$. The positive and significant effect of school standard is observed during the study as students from good standard school obtained maximum marks as compare to normal and lower standard schools. Category good standard school is considered base for the reaming two normal and low standard categories. The coefficients of both normal and low standard categories is found statistically significant with $t = -5.08$ and $p = 0.000$ and $t = -5.08$ and $p = 0.000$ comparatively to good standard schools. Finally by using multilevel regression the total remaining error is divided into two types error related to level one factors and related to level two factors i.e. there are other factors also which effect the academic performance of students.

6. Conclusion and Recommendations

In this study, the effect of different factors were investigated at two level simultaneously i.e. factors related to student's level age, gender, mother education, family type, family monthly income and factors related to school level class size, school type and school standard. It is found at level one age, gender, mother education, family type and family

income significantly enhanced the academic performance of student's. However at level two class size, school type and school standard also play significant role in student's academic performance. Finally we found that the performance of male students were significantly better than female students and on the average students from public schools secured maximum marks as compare to private schools students. Moreover, often the response varies due to individual effect but the environmental effect also plays a major role. In this study, while evaluating students score, it came to the knowledge that along with the student's level factors the schools level factors also play the significant path. We advocate that the outcomes of this study can be indiscriminate or replicated in other parts of nation for smooth integration. Keeping in view the study findings, achieved by analysing student's academic performance through multilevel regression, the following recommendations are made.

1. There is strong evidence that student's academic performance is related with, age, gender, mother education, family type, family monthly income, class size, school type and school standard. For the significant improvement of the students' academic performance, the concerned government authorities has to work amicably to solve these issues.
2. To work out the economic problems of the families, it is recommended that government should provide maximum number of scholarships at SSC level.
3. It is recorded that, class size has negative and significantly affect the performance of students, so it is recommended that government should make arrangements to minimize the number of students per teacher at SSC level.

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