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Impact of school infrastructure and pedagogical materials on its academic performance: Evidence from Khyber Pakhtunkhwa

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School enrollments at both primary and secondary levels have increased in Pakistan; however, there are serious concerns about quality of education. We study the determinants of school performance using a large data set from 23 districts of Khyber Pakhtunkhwa consisting of 1642 schools. Our findings show that electricity, gas, library and teaching quality have a positive effect on school performance in Khyber Pakhtunkhwa. However, our results show that science labs and playground have no impact on school performance. Looking at the results of rural and urban schools, we find that electricity and gas has a positive effect in rural schools. We suggest that these basic facilities are precious for better academic achievement of schools in rural areas. Furthermore, our results show that pupils in rural areas perform better in well-constructed schools. Therefore, while allocating the public expenditures, electricity, gas, infrastructure and teaching quality should be the priority to enhance the quality of education in Khyber Pakhtunkhwa.

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JEL Codes: C18, H40, H52, I20

According to endogenous growth theory, human capital has been documented as one of the fundamental source of long run economic growth. In the micro economic literature, the survey documents an average return of about 10 percent for each additional year of schooling (Card, 1999). Therefore, the policy lesson from this literature is quite clear: increase the spending on education to get the rewards of human capital formation in the form of higher productivity, higher wages, and economic growth. As a result, since 1980, in Latin America public expenditures on education has doubled, increased by more than three times in Middle East countries, and have risen by more than five and eightfold in East Asian countries and South Asian countries, respectively(Glewwe et al., 2011). Contrary to economic theory, the empirical investigation on the association between educational inputs and educational outcomes provides mixed results (Case & Deaton, 1999). In a survey of literature, Hanushek (1986, 1996) suggests that at the best, the positive effect of schooling facilities on educational outcomes measured by test scores is tenuous for both developing and developed countries.

The existing literature on the factors that affect a school's performance provides varied factors and mixed results (Case & Deaton, 1999). On the one hand, some studies find that educational outcomes are significantly affected by the class size. (Akerhielm, 1995; Angrist et al., 1998; Case & Deaton, 1999). However, on the other hand, some papers provide evidence that there is no impact of class size on educational outcomes (Hanushek, 1996; Hoxby, 2000). Similarly, research has found positive impact of teaching characteristics such as teacher's experience and teacher's education on academic performance of schools

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(Michaelowa & Wittmann, 2007; Santibanez, 2006). On the other hand, some research finds no relationship between teaching characteristics and educational outcomes (Buddin, 2011; Dash et al., 2012). Similarly, some papers find significant impact of basic facilities i.e., drinking water, and electricity on education outcomes (Bacolod & Tobias, 2006; Greenwald et al., 1996), while others find no such effect (Bowers & Urick, 2011). Furthermore, Long (2006) shows school performance is more sensitive to the availability of school inputs in developing countries with low income per capita.

Given the mixed findings in the literature, policy makers are faced with a challenge of efficient allocation of resources. Tan et al., (1997) suggest that the policy makers of developing countries with significant budget constraints cannot afford errors in allocating public expenditures. Specifically, this scenario presents a more difficult situation for a country like Pakistan with large budget deficit and a limited expenditure on education. According to World Bank, public expenditures on education in Pakistan are only 2.6 percent of GDP in 2015. In this context, this study examines the determinants of the school performance in Khyber Pakhtunkhwa, Pakistan. We aim to provide policy insights to educational outcomes in Khyber Pakhtunkhwa.

A limited number of academic writings have focused on the impact of educational inputs and educational outcomes in Pakistan (see, for example, Farooq et al., 2011; Aslam, 2003). Farooq et al., (2011) examined the educational performance of students in 10^{th} grade in Lahore, Pakistan, based on a sample of 600 students. The results show that parental education and socio economic status has a positive effect on educational performance of the students. Similarly, Aslam (2003) examined the student's academic success in secondary schools in Lahore, Pakistan. The study shows that family background, individual and academic factors within school are important factors of students' academic achievement, in Lahore. We observe that above mentioned studies along with other limited available literature is limited in scope, mostly focused on one city.

The present study contributes to the sparse literature on the association between school inputs and school's academic performance in Khyber Pakhtunkhwa. We employ a unique official survey data of public high schools for 23 districts of province Khyber Pakhtunkhwa, Pakistan. To our limited knowledge, our study is the first to explore the dynamics of educational outcomes based on this data for Khyber Pakhtunkhwa. In addition to the official survey data of Khyber Pakhtunkhwa, we use data on students' results of SSC (Secondary School Certificate) examination in 2014. Furthermore, in the existing literature school performance is based on the percentage of passing students (Aslam, 2003; Farooq et al., 2011). However, we use three measures of school performance i.e., Percentage of Passing Students (PPS), School Performance Index (SPI), and Percentage of First Division Students (PFS). Our first set of econometric estimates are based on OLS. Furthermore, the next set of results are based upon Logit modelling strategy. These models are appropriate in our case as the performance of school is converted into discrete variable. Our empirical results account for heteroscedasticity as we are using the cross sectional data. In the presence of heteroscedasticity, our estimates can suffer from biased statistical inferences. Furthermore, we provide separate analysis for schools in rural and urban areas. Similarly, we carry out our analysis according to gender, level of schooling and type of school.

Our main results show that teaching quality, electricity, gas, and school building improve school performance in Khyber Pakhtunkhwa. However, our results do not find a role for science lab and playground in school performance. Our findings show that the impact of electricity, gas and building construction is more pronounced in rural schools.

Following the section of introduction, overview of the literature is discussed in Section 2. Section 3 highlights the analytical framework and econometric model used for the empirical analysis. Section 4 discusses the data, sources and variables under study. Section 5 provides discussion of empirical results of the study and conclusion of the study is provided in Section 6.

Literature Review

A vast literature provides the empirical evidence on school inputs and educational outcomes since the Coleman report (Coleman et al., 1966). However, the existing studies offer a variety of factors affecting the school performance with mixed results. A large number of these papers report a positive impact of basic facilities such as drinking water, electricity on educational outcomes (Bacolod &Tobias, 2006; Greenwald et al., 1996), and teacher's education and experience (Michaelowa & Wittmann, 2007). On the other hand, Bowers and Urick (2011) shows no impact of school resources and facilities, Dash et al., (2012) find no significant impact of teacher's education on educational achievements of the school. In this section, we provide a brief overview of the relevant studies.

Research has shown that a school's academic performance is strongly associated with teaching characteristic i.e., qualification, experience and training of a teacher. The literature on the association between teaching characteristics and schools' performance relies on the hypothesis that a well-trained teacher with teaching qualification and experience will be more productive in increasing the pupils' skills. Many papers find a strong relationship positive between teaching characteristics and school performance (e.g., Bernal et al., 2016; Buddin, 2011; Lai et al., 2011; Rivikin et al., 2005). For example, Lai et al., (2011) analyzed the effects of teacher qualification and quality of school on the educational achievements of students in Beijing, China. The results show that teacher education and experience are most important determinants of student performance. Similarly, Buddin (2011) revealed that teacher's experience is a key factor of student performance in urban elementary schools in California, USA. Likewise, Rivikin et al., (2005) show that policy to rise the teacher quality by one standard deviation will be more fruitful than the reduction of ten students in class size in USA. Therefore, the study highlights the importance of teaching characteristics in achieving better academic performance of students. Bernal et al., (2016) show teaching quality and school resources are key determinants of student achievement in USA.

Another common factor associated with school performance is school building. Studies have shown that building characteristics play a significant role in facilitating the productive environment and improving the educational outcomes (Ammermuler et al., 2004; Cash, 1993; Huisman et al., 2010). Cash (1993) shows that academic resources and building conditions have an encouraging effect on academic improvement of a school. Similarly, Ammermuler et al., (2004) and Huisman et al. (2010) show that school building is a key cause in shaping the school performance of seven European countries. Likewise, Owoeye and Yara (2011) show that school building is a key factor of school performance in Nigeria.

Academic facilities of the school are also considered as a key determinant of school performance (Bowers & Urick, 2011; Gibson, 2012; Owoeye & Yara, 2011). Owoeye and Yara (2011) show that facilities at school such as laboratory, textbooks and library are significant determinants of the performance of secondary schools in Nigeria. Similarly, Bowers and Urick (2011) find that quality of available academic facilities exert a positive impact on educational outcomes in USA. Likewise, Afana et al., (2013) report a progressive effect of school resources on educational achievement in Palestinian Authority schools. Moreover, Gibson (2012) shows the strong positive impact of new school facilities on academic performance of pupils in USA.

The relationship between school facilities such as electricity, gas, playground and toilet has received much attention in the literature. Suryadarma et al., (2004) show that school facilities, pupil-teacher ratio and parent`s education are the significant determinants of school performance.

A few studies have been carried out that have examined the determinants of school performance in case of Pakistan (See, for example, Aslam, 2003; Farooq et al., 2011). Farooq et al. (2011) show that parental education play a significant role in students' academic performance in the secondary schools of Lahore, Pakistan. Aslam (2003) find that family background and facilities at school has a positive effect on school' educational performance in Lahore. The main objective of our study is to add to the thin literature on the determinants of school's academic performance in Khyber Pakhtunkhwa by employing official survey data of public high schools.

Analytical Framework

Our analysis of school inputs and educational outcomes is based upon a commonly used education production function (Hanushek, 1979). This approach of using the education production function is also recognized as the input-output method (Aslam, 2003; Kingdon & Teal, 2003). The model adopted in the present study is very simple and proposes that educational outcomes are related to school inputs.

$$SP_i = f(B_i, T_i, A_i, F_i) \quad (1)$$

Where SP_i is the school performance calculated by the grades of the schoolchildren, B_i denotes the school building characteristics, T_i stands for the teaching characteristics of schools, A_i measures the academic facilities of the school, F_i presents the other facilities of the school such as availability of playground, toilet etc. for school i. We measure the academic performance of the school with three different indicators i.e., School Performance Index (SPI), Percentage of Passing Students (PPS), and Percentage of First Grades Student in the class (PFS).

The education production function in Equation (1) is not based on a strong economic theory such as production function for firm analysis. Overall, the production function defined in Equation (1) is unknown as we do not have its standard specifications, and therefore, we estimate the education production function using available data. Despite these theoretical issues, the 'technological' relationship in Equation (1) is quite usual in the writings on economics of education and thus, we also use this approach to estimate the factors that affect school's performance of Khyber Pakhtunkhwa, Pakistan (Aslam, 2003). We can re-write equation (1) as following

$$SP_i = \beta_0 + \beta_1 ELEC_i + \beta_2 NGAS_i + \beta_3 LIBR_i + \beta_4 SLAB_i + \beta_5 PGRD_i + \beta_6 TOIL_i + \beta_7 TECH_i + \beta_8 TCLS_i + \varepsilon_i \quad (2)$$

Where, $ELEC_i$, $NGAS_i$, $LIBR_i$, $SLAB_i$, $PGRD_i$, and $TOIL_i$ are dummy variables for availability of electricity, natural gas, library, science lab, playground and toilet facility, respectively. All dummy variables in the study are coded as "1" for the existence of the facility at school and "0" for absence of the facility, $TCLS_i$ is the number of classrooms in school i, $TECH_i$ represents the number of teachers in the school i.

Moreover, if we use the proportion of science teachers to total number of teachers ($POST_i$) and $TECH_i$ in the same regression equation then it will cause multicollinearity problem. Likewise, we cannot use total number of classrooms ($TCLS_i$) and the proportion of Pakka to total classrooms ($PPTC_i$) in the same equation.[1] Therefore, we make a separate model and incorporate these two variables in the model instead of number of classrooms and number of teachers in the school. Equation (1) can be written as:

$$SP_i = \beta_0 + \beta_1 ELEC_i + \beta_2 NGAS_i + \beta_3 LIBR_i + \beta_4 SLAB_i + \beta_5 PGRD_i + \beta_6 TOIL_i + \beta_7 POST_i + \beta_8 PPTC_i + \varepsilon_i \quad (3)$$

We will also undertake separate regression analysis for all the schools which differ by region (rural/urban), school type (secondary/higher secondary) and by gender (boy/girls). The estimation of Equation (2) and (3) for all the groups separately will provide the estimates.

Method

Our empirical analysis is based upon data from 1642 schools including both secondary and higher secondary schools covering 23 districts of Khyber Pakhtunkhwa, Pakistan. In Pakistan, students are awarded Secondary School Certificate (SSC) after completion of ten years of schooling. Similarly, Higher Secondary School Certificate (HSSC) is awarded after completion of twelve years of schooling. Our paper makes use of official survey data of Education Management Information System (EMIS), Khyber Pakhtunkhwa. This unique official survey in Khyber Pakhtunkhwa provides information on a range of school characteristics including

[1] Pakka school is used in local language for the schools build with concrete materials. The term Kacha school is used in local language for the schools build with mud rather than concrete materials.

information on teaching characteristics, school building characteristics and the availability of different academic and other facilities of the school. We combine this data set with official results of SSC examination of Khyber Pakhtunkhwa for year 2014.

Table 1 shows that 70 percent schools in our study are boys' schools. However, only 30 percent schools are girl's schools. This gender gap in schooling is evident in Khyber Pakhtunkhwa as well as in Pakistan. Our sample contains 83 percent secondary schools and the remaining 17 percent schools are higher secondary. Similarly, a major proportion of schools (84 percent) is based upon schools in rural areas. However, only 16 percent schools in our sample are in urban areas.

Table 1

Number of schools classified by gender, region and schooling level

Type of school	Boys' schools		Girls' schools		Total
	Rural	Urban	Rural	Urban	
Secondary	826	139	324	73	1362
Higher secondary	161	27	75	17	280
Total	987	166	399	90	1642

Source: Authors own calculations

To check the academic performance of students and schools, developed countries have established national and international test systems such as National Assessment of Educational Progress (NAEP) and Program for International Student Assessment (PISA). These tests are intentionally designed to be useful for policy purpose. However, in most developing countries including Pakistan, there are no such national or international tests to evaluate the performance of schools. As a result, we do not have any official measure for the school's performance in Pakistan. Consequently, due to data limitations, the existing literature on developing economies has employed different indicators of school performance. For example, Asadullah (2002) used the percentage of students promoted to their next class as a measure of school performance. Bradley and Jim (1998) used the percentage of students getting A to C grades in their General Certificate of Secondary Education Examination (GCSE) as the indicator of the its academic performance.

Similarly, Carnoy et al., (2008) used the grade repetition rate of the school as an indicator for measuring the school performance. We understand that most of the measures employed in the literature are unable to capture the small improvement in the school's performance. These measures do no account for better academic achievement such as obtaining a grade A or first division. We use three measures of school's performance i.e., Percentage of Passing Students (PPS), School Performance Index (SPI) and Percentage of First Division Students (PFDS). SPI is calculated from the SSC annual examination results conducted by the particular boards of intermediate and secondary educations for the students of 9^{th} and 10^{th} classes. The grades of the students are divided into seven ranked categories. Prior researchers used the proportion of passed students as an indicator of the performance of school, but the main flaw in the measure was that all the ranked grades has given the same weights. Therefore, we are giving weights to proportion of number of students in each ranked category. SPI is the sum of these weighted proportions.

$$SPI_i = \sum_{j=1}^{7} \frac{N_{ji}}{N_i} \times \frac{j}{7} \quad (4)$$

Where N_{ji} represent the number of students in category j of school of i, N_i represent the total number students of 9^{th} and 10^{th} class appeared in exam from school i, and j represent the rank of the student grades ($j = 1,2,3, \dots ,7$) and then add all the weights, so that students got A1 grade should seem better than A grades students and so on.

Our PPS measure is similar to Asadullah (2002) as discussed above. Our third measure, PFDS is similar to Bradley & Jim (1998). In SSC examination in Khyber Pakhtunkhwa, first division means students getting 60 percent or above. Furthermore, PFDS is a better indicator of the school performance as it reflects

the academic achievement of the school. Details about the variables along with notations used in the present study is provided in Table 2.

Table 2

Description of variables used in the study

Variable	Description	Type
SPI	School performance index, calculated from the results of 9^{th} and 10^{th} class students of a particular school.	Continuous
PPS	Proportion of passed students, calculated through the ratio of passed to total number of students.	Continuous
PFDS	Proportion of first division students, calculated through the ratio of number of students gotten first division to total number of students.	Continuous
GEN	Gender, coded as "1" for the boys school and "0" for girls school	Dummy
ELEC	Availability of electricity facility in the school, coded as "1" for existence of the facility and "0" for the absence of electricity facility.	Dummy
NGAS	Availability of natural gas facility in the school, coded as "1" for existence of the facility and "0" for the absence of gas facility.	Dummy
LIBR	Availability of library facility in the school, coded as "1" for existence of the facility and "0" for the absence of library facility in the school.	Dummy
SLAB	Availability of science laboratory in the school, coded as "1" for existence of the facility and "0" for the absence of science laboratory facility.	Dummy
PGRD	Availability of playground facility in the school, coded as "1" for existence of the facility and "0" for the absence of playground facility.	Dummy
TOIL	Availability of toilet facility in the school, coded as "1" for existence of the facility and "0" for the absence of toilet facility.	Dummy
TECH	Number of teachers.	Continuous
POST	The proportion of science to all teachers, obtained by dividing number of science teacher on total number of teachers and multiplying by 100.	Continuous
POAT	The proportion of Arts to all teachers, obtained by dividing number of Arts teacher on total number of teachers and multiplying by 100.	Continuous
TCLS	Number of working classrooms.	Continuous
PPTC	The proportion of Pakka classrooms to all classrooms, obtained by dividing number of Pakka classes on total number of classes and multiplying by 100.	Continuous

Source: Authors own work.

Results

The empirical analysis of this study starts with pooled OLS estimates of Equation (2). In the base specification, we do not control for region, schooling level and gender. However, our econometric strategy allows us to use robust standard errors to account for presence of hetroskedasticity in the cross sectional data. Furthermore, we present three sets of results in Table 3 based upon three measures of school's performance. The results of the present study indicate that ELEC (electricity) has an affirmative effect on schools' academic performance in Khyber Pakhtunkhwa. Similarly, our results show that NGAS (availability of natural gas facility) and LIBR (library) has a significant and positive effect on the schools' performance.

However, SLAB (science lab), and PGRD (playground) are not important determinants of schools' academic performance in Khyber Pakhtunkhwa. The existing literature also offers diverse signal regarding impact of school resources on the school performance. Carnoy et al., (2008) indicate that availability of academic facilities positively affect the academic performance. On the other hand, Dahar, (2011) shows negative impact of the science lab on the school performance. Dahar suggests that lack of related lab equipment and apparatuses makes the science lab ineffective. Our findings are consistent with Heyneman & Loxley (1983). The authors showed that school resources such as science labs, playground have no effect on the performance of the school due to inefficient use of school resources.

Table 3

Pooled OLS estimates of the determinants of school`s academic performance

Independent Variable	Dependent Variable					
	SPI		PPS		PFS	
ELEC	0.043**	0.042**	7.696**	5.864*	4.468	5.934*
	(2.61)	(2.70)	(2.81)	(2.43)	(1.84)	(2.33)
NGAS	0.053***	0.035**	5.864***	3.555*	9.653***	7.221**
	(3.86)	(2.63)	(3.72)	(2.41)	(3.74)	(2.88)
LIBR	0.035***	0.037***	4.452***	4.378***	4.709***	5.264***
	(5.42)	(5.67)	(4.57)	(4.55)	(4.15)	(4.55)
SLAB	-0.008	-0.011	-1.455	-1.934	-0.627	-0.991
	(-0.99)	(-1.41)	(-1.30)	(-1.76)	(-0.46)	(-0.73)
PGRD	0.004	0.001	1.064	0.756	-0.069	-0.325
	(0.530)	(0.22)	(1.10)	(0.79)	(-0.06)	(-0.27)
TOIL	-0.055**	-0.074***	-6.816*	-10.12***	-6.686*	-8.312*
	(-2.77)	(-3.36)	(-2.32)	(-3.18)	(-2.00)	(-2.33)
TECH	-0.004***	---	-0.431***	---	-0.692***	---
	(-9.37)	---	(-6.84)	---	(-7.66)	---
POST	---	0.001***	---	0.084*	---	0.210***
	---	(4.22)	---	(2.29)	---	(4.47)
TCLS	0.006***	---	0.481***	---	0.933***	---
	(7.86)	---	(5.67)	---	(6.43)	---
PPTC	---	0.001***	---	0.160***	---	0.046
	---	(3.37)	---	(3.94)	---	(1.42)
Constant	0.509**	0.385***	80.940***	65.050***	30.630***	14.170**
	(27.81)	(13.03)	(28.05)	(13.71)	(9.73)	(3.23)
N	1642	1642	1642	1642	1642	1642
F-Statistic	16.92	9.22	11.14	6.88	12.17	7.86
P-Value	0.000	0.000	0.000	0.000	0.0000	0.000

Note: Hetroskedasticity consistent t-values are reported in parenthesis. Where *, **, and *** indicate weakly significant, moderately significant and highly significant, respectively.

Our findings show that TOIL (toilet facility at campus) has a significant and negative effect on schools' performance. This might be an indication that the toilet facility is not accompanied by water, electricity and proper sanitation. The results in Table 3 show that TECH (number of teachers) has a significant and adverse effect on the schools' performance. These results are somehow contrary to our expectation. However, TECH does not reflect a specific rise in teachers of either 9^{th} or 10^{th} class. As a result, we do no find association between TECH and indicators of school performance which are based on grades of the students of 9^{th} and 10^{th} class. In addition, due to high teacher – pupil ratio, teachers are taking more classes which affects their productivity.

Our results in Table 3 show that POST (proportion of sciences to all teachers) has a positive effect on the school' performance in Khyber Pakhtunkhwa. Our findings indicate that that POST is an important determinant of schools' academic performance. We also conclude that POST (proportion of sciences to all teachers) is a better measure than TECH (the number of teachers). Therefore, teaching plays a significant role in improving a school's performance.

Table 4 provides separate estimates of Equation (2) for rural and urban schools in Khyber Pakhtunkhwa. The objective here is to identify the determinants of schools' performance in both type of regions. Our empirical findings in Table 4 are quite interesting. The results of the study also indicate that ELEC has a significant and constructive effect on schools' performance in rural schools. However, the ELEC variable is not significant in urban schools although it is still positive. Our results also show that ELEC is a

pronounced factor of schools' performance in rural areas. Similarly, while NGAS has a significant and affirmative effect on schools' performance in rural areas, there is no effect of NGAS in urban areas. Both results result indicate that basic facilities of electricity and gas are precious for better academic achievement of schools' in rural areas of Khyber Pakhtunkhwa. Consistent with Table 3, we find that SLAB, PGRD, TOIL have no effect of schools' performance in Khyber Pakhtunkhwa. Similarly, TECH has a significant and negative effect on schools' performance but at the same time POST has positive effect, as in Table 3. Our results show that teaching characteristics (POST, LIBR) have a constructive effect on school performance.

Our findings in Table 4 show that PPTC (proportion of Pakka to Kacha schools) has an encouraging effect on the school performance in rural and urban regions. However, the estimated coefficient of PPTC is significant only in rural schools. Therefore, we show that pupils in countryside areas execute better in well-constructed schools. However, in urban schools PPTC is not important as most schools are Pakka. On the other hand, PPTC is no significant when we use PFDS measure of school performance. This happens as the availability of an additional PAKKA classroom is not sufficient to achieve 1st division in exams.

Now, we classify the performance of school into two categories i.e., satisfactory and non-satisfactory. (Carnoy, et al., 2008; Gibson, 2012; Niaz, et al., 2013). We categorize the school according to SPI value. A school obtaining greater than or equal to 0.50 in SPI index is categorized as "satisfactory" and others are placed into "unsatisfactory" category. In this case, we cannot use OLS as the dependent variable is a categorical variable. However, if we use Linear Probability Model (LPM) based upon OLS, we encounter econometric issues i.e., violation of normality assumption, heteroskedasticity and boundedness. Therefore, we use logistic regression analysis to estimate Equation (2). In Table 5, results based on logistic regression are presented.

In Table 5, the results of the logistic regression are presented. Overall, the results in Table 5 using logistic regression are similar to our results in Table 4. To check he robustness of our estimates, we report results according to gender in Appendix A, according to secondary schools and higher secondary schools in Appendix B and according to science and arts schools in Appendix C. We conclude that our results are robust to econometric methods, model specification according to gender and level of schooling.

Overall, our results show that teaching quality (number of science teachers), teaching facilities (availability of library), infrastructure (Pakka or Kacha) of class rooms and number of class rooms, and availability of utilities (electricity and natural gas) have positive effect on the school's academic performance in Khyber Pakhtunkhwa. We also show that science lab and playground have no effect on the school's academic performance. We find that library and number of science teachers are important determinants of school performance in urban schools. However, for rural schools, building construction (Pakka schools) is a key factor in school performance.

Table 4

Pooled OLS estimates of determinants of school's academic performance based upon rural and urban regions

Independent Variables	SPI				PPS				PFDS			
	Rural		Urban		Rural		Urban		Rural		Urban	
ELEC	0.050**	0.046*	0.021	0.030	9.037**	6.599*	2.959	3.534	4.213	5.524*	5.588	7.498
	(2.58)	(2.56)	(0.69)	(1.03)	(2.74)	(2.29)	(0.75)	(0.96)	(1.58)	(1.96)	(0.99)	(1.30)
NGAS	0.059***	0.034*	0.020	0.029	6.177***	3.451*	4.653	4.855	10.37***	6.983**	5.437	8.69
	(3.98)	(2.53)	(0.53)	(0.82)	(3.62)	(2.19)	(1.02)	(1.12)	(3.74)	(2.61)	(0.80)	(1.22)
LIBR	0.031***	0.032***	0.060***	0.067***	3.708***	3.662***	8.461**	8.977***	4.543***	4.864***	5.789*	7.515**
	(4.24)	(4.41)	(4.10)	(4.37)	(3.39)	(3.42)	(4.08)	(4.18)	(3.62)	(3.80)	(2.19)	(2.73)
SLAB	-0.004	-0.007	-0.021	-0.026	-1.197	-1.729	-2.250	-3.122	0.293	-0.062	-4.574	-4.831
	(-0.48)	(-0.86)	(-1.20)	(-1.52)	(-0.95)	(-1.40)	(-0.91)	(-1.29)	(0.19)	(-0.04)	(-1.46)	(-1.60)
PGRD	0.003	0.002	0.010	0.002	1.045	0.844	1.542	0.524	-0.410	-0.630	2.069	1.327
	(0.43)	(0.25)	(0.59)	(0.11)	(0.97)	(0.80)	(0.68)	(0.23)	(-0.31)	(-0.48)	(0.69)	(0.47)
TOIL	-0.050*	-0.070**	-0.066	-0.066	-6.890*	-10.03**	-5.561	-5.150	-4.672	-6.496	-14.71*	-14.39
	(-2.26)	(-2.92)	(-1.65)	(-1.23)	(-2.00)	(-2.77)	(-1.19)	(-0.91)	(-1.24)	(-1.65)	(-2.28)	(-1.81)
TECH	-0.004***	---	-0.004**	---	-0.438***	---	-0.372*	---	-0.74***	---	-0.451	---
	(-9.10)	---	(-2.67)	---	(-6.36)	---	(-2.37)	---	(-7.66)	---	(-1.77)	---
POST	---	0.001***	---	0.001*	---	0.083*	---	0.125	---	0.206***	---	0.242*
	---	(3.85)	---	(2.19)	---	(2.04)	---	(1.71)	---	(3.97)	---	(2.08)
TCLS	0.006***	---	0.005*	---	0.501***	---	0.343	---	0.940***	---	0.911*	---
	(7.47)	---	(2.42)	---	(5.48)	---	(1.47)	---	(6.03)	---	(2.23)	---
PPTC	---	0.001***	---	0.000	---	0.188***	---	0.009	---	0.052	---	0.022
	---	(3.46)	---	(0.26)	---	(4.02)	---	(0.03)	---	(1.48)	---	(0.29)
Constant	0.498***	0.363***	0.541***	0.450***	79.59***	61.52***	84.46**	74.89***	28.73***	11.82*	36.82***	21.07*
	(23.77)	(11.00)	(14.53)	(7.72)	(22.93)	(11.02)	(18.73)	(10.31	(7.91)	(2.45)	(6.59)	(2.08)
N	1386	1386	256	256	1386	1386	256	256	1386	1386	256	256
F-statistic	14.40	7.22	4.05	3.44	8.79	5.39	3.60	2.98	11.14	6.31	3.05	2.86
P-Value	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.003	0.000	0.000	0.003	0.005

Note: Hetroskedasticity consistent t-values are reported in parenthesis. Where *, **, and *** indicate weakly significant, moderately significant and highly significant, respectively.

Table 5 *Determinants of School's Performance based on Logit regressions*

Dependent Variable: School Performance (having value 1 if $SPI \geq 0.5$ and 0 otherwise)						
	Rural Region		**Urban Region**		**Overall all Schools**	
ELEC	0.079	0.064	0.003	0.0004	0.058	0.048
	(1.57)	(1.31)	(0.05)	(0.01)	(1.36)	(1.17)
NGAS	0.136***	0.106**	0.028	0.045	0.120***	0.097**
	(4.69)	(2.89)	(0.30)	(0.58)	(4.30)	(2.83)
LIBR	0.077***	0.077***	0.198***	0.220***	0.096***	0.098***
	(3.36)	(3.41)	(4.38)	(4.69)	(4.70)	(4.78)
SLAB	-0.029	0-.036	-0.034	-0.043	-0.033	-0.039
	(-1.16)	(-1.41)	(-0.85)	(-1.06)	(-1.46)	(-1.75)
PGRD	-0.001	-0.007	0.022	0.010	0.001	-0.006
	(-0.06)	(-0.29)	(0.55)	(0.24)	(0.04)	(-0.28)
TOIL	-0.046	-0.075	-0.038	-0.001	-0.047	-0.071
	(-0.88)	(-1.54)	(-0.68)	(-0.01)	(-1.04)	(-1.68)
TECH	-0.009***	---	-0.008*	---	-0.009***	---
	(-6.02)	---	(-2.79)	---	(-6.42)	---
POST	---	0.002*	---	0.002	---	0.002**
	---	(2.74)	---	(1.41)	---	(2.89)
TCLS	0.012***	---	0.011	---	0.012***	---
	(4.81)	---	(1.88)	---	(5.13)	---
PPTC	---	0.002	---	0.0002	---	0.002***
	---	(3.45)	---	(0.29)	---	(3.46)
N	1386	1386	256	256	1642	1642
χ^2 – Statistic	52.97	42.54	22.61	21.08	66.68	53.43
P-Value	0.000	0.000	0.000	0.000	0.000	0.000
Dependent Variable: School Performance (having value 1 if $SPI \geq 0.5$ and 0 otherwise)						
	Boys School		**Girls School**		**Overall all Schools**	
ELEC	0.055	0.050	0.014	-0.014	0.058	0.048
	(1.06)	(0.97)	(-0.58)	(-0.55)	(1.36)	(1.17)
NGAS	0.104	0.083	0.018	0.014	0.120***	0.097**
	(1.85)	(1.35)	(1.24)	(0.68)	(4.30)	(2.83)
LIBR	0.129***	0.135***	0.065***	0.068***	0.096***	0.098***
	(4.60)	(4.87)	(3.43)	(3.49)	(4.70)	(4.78)
SLAB	-0.040	-0.043	-0.001	-0.002	-0.033	-0.039
	(-1.31)	(-1.41)	(-0.07)	(-0.15)	(-1.46)	(-1.75)
PGRD	-0.014	-0.015	-0.030	-0.034	0.001	-0.006
	(-0.46)	(-0.50)	(-1.90)	(-1.88)	(0.04)	(-0.28)
TOIL	-0.104*	-0.122*	0.066	0.061	-0.047	-0.071
	(-2.08)	(-2.53)	(0.51)	(0.47)	(-1.04)	(-1.68)
TECH	-0.009***	---	-0.002*	---	-0.009***	---
	(-4.43)	---	(-1.97)	---	(-6.42)	---
POST	---	0.001	---	0.001	---	0.002**
	---	(1.44)	---	(1.26)	---	(2.89)
TCLS	0.014***	---	0.003*	---	0.012***	---
	(4.60)	---	(1.97)	---	(5.13)	---
PPTC	---	0.002*	---	0.0003	---	0.002***
	---	(2.56)	---	(0.46)	---	(3.46)
N	1153	1153	489	489	1642	1642
χ^2 – Statistic	54.87	40.81	23.06	22.47	66.68	53.43
P-Value	0.000	0.000	0.003	0.004	0.000	0.000

Note: Hetroskedasticity consistent t-values are reported in parenthesis. Where *, **, and *** indicate weakly significant, moderately significant and highly significant, respectively.

Conclusion

National Education Policy 2017, has focused on schooling to increase economic development of Pakistan. The main objective of national policy is to increase enrollment at both primary as well as secondary schools. Furthermore, this policy aims to increase quality of education. In this context, this study provides a new analysis of the factors of the school`s performance in Khyber Pakhtunkhwa, Pakistan. Our econometric estimates are based upon OLS and logistic regression analysis. Our OLS results show that electricity, gas, library and teaching quality have played an important in raising academic performance of the schools in Khyber Pakhtunkhwa. However, our results show that science labs and playground are not correlated with school performance. We explain this result as a reflection of underutilization of these resources. We show that type of school's construction play a key role in academic success of rural schools. Our logistic model results are consistent with OLS based analysis. Finally, our results are robust to econometric methods, model specification according to gender and level of schooling.

This work suggests that the policy should focus on quality of teaching and provision of basic facilities to enhance school performance. Furthermore, the school governance should be improved for efficient utilization of the resources. Moreover, academically advanced teachers should be hired. However, our research findings cannot be generalized to other provinces due to differences in institutions, and academic environment.

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Appendix A: Results for the determinants of school's performance for boy's and girl's schools using SPI, PPS and PFS

Variables	School Performance Index (SPI)				Percentage of Passing Students (PPS)				Percentage of First division			
	Boys` schools		Girls` schools		Boys` schools		Girls` schools		Boys` schools		Girls'	
ELEC	0.041*	0.039*	0.007	0.015	8.265**	6.208*	0.299	0.607	2.931	4.195	3.313	5.591
	(2.14)	(2.17)	(0.29)	(0.65)	(2.58)	(2.18)	(0.09)	(0.18)	(1.09)	(1.47)	(0.65)	(1.11)
NGAS	0.054**	0.045*	0.004	-0.009	6.986**	5.777*	0.279	-1.600	6.551	5.764	3.401	2.246
	(2.63)	(2.17)	(0.22)	(-0.59)	(2.93)	(2.46)	(0.13)	(-0.91)	(1.76)	(1.50)	(0.94)	(0.76)
LIBR	0.044***	0.047***	0.037**	0.039***	5.594***	5.656***	3.807**	3.778**	5.290***	6.081***	7.153***	7.806**
	(5.36)	(5.80)	(3.99)	(4.10)	(4.43)	(4.57)	(2.82)	(2.81)	(4.03)	(4.54)	(3.70)	(3.98)
SLAB	0.0435	-0.014	0.005	0.005	-1.582	-1.961	-0.814	-0.952	-1.889	-1.890	2.231	2.328
	(-1.32)	(-1.48)	(0.48)	(0.46)	(-1.58)	(-1.41)	(-0.51)	(-0.61)	(-1.18)	(-1.16)	(1.01)	(1.06)
PGRD	-0.006	-0.005	-0.008	-0.010	0.410	0.443	-0.528	-0.784	-2.193	-1.858	-1.431	-1.645
	(-0.69)	(-0.53)	(-0.80)	(-0.98)	(0.32)	(0.36)	(-0.38)	(-0.55)	(-1.53)	(-1.35)	(-0.72)	(-0.82)
TOIL	-	-	-0.018	-0.027	-9.051**	-12.4***	-6.172	-6.943*	-9.530**	-10.97**	-2.190	-4.118
	(-3.51)	(-3.94)	(-0.39)	(-0.55)	(-2.68)	(-3.41)	(-1.87)	(-2.00)	(-2.66)	(-2.87)	(-0.23)	(-0.40)
TECH	-	---	-	---	-0.350***	---	-0.273**	---	-0.47***	---	-0.55***	---
	(-6.27)	---	(-3.62)	---	(-4.54)	---	(-2.76)	---	(-4.50)	---	(-3.33)	---
POST	---	0.001*	---	0.001	---	0.047	---	0.054	---	0.110*	---	0.154
	---	(2.09)	---	(1.80)	---	(1.01)	---	(1.06)	---	(2.02)	---	(1.85)
TCLS	0.006***	---	0.004**	---	0.496***	---	0.281*	---	0.825***	---	0.937***	---
	(6.51)	---	(3.56)	---	(4.73)	---	(2.28)	---	(4.83)	---	(3.59)	---
PPTC	---	0.001**	---	-0.001	---	0.156***	---	-0.067	---	0.046	---	-0.341*
	---	(3.19)	---	(-1.51)	---	(3.66)	---	(-0.81)	---	(1.49)	---	(-2.54)
Consta	0.496***	0.409***	0.554**	0.630***	78.55***	66.32***	93.16***	96.56***	29.39***	20.05***	32.99***	59.03**
	(25.22)	(12.84)	(12.76)	(7.13)	(24.34)	(12.68)	(25.73)	(10.79)	(8.81)	(4.29)	3.75	(3.62)
N	1153	1153	489	489	1153	1153	489	489	1153	1153	489	489
F-	12.64	7.63	3.85	3.07	8.54	6.29	2.76	1.72	7.32	5.03	4.02	4.08
P-	0.0000	0.0000	0.0002	0.002	0.0000	0.0000	0.0055	0.0913	0.0000	0.0000	0.0001	0.0001

Note: Hetroskedasticity consistent t-values are reported in parenthesis. Where *, **, and *** indicate weakly significant, moderately significant and highly significant, respectively.

Appendix B: Results for the determinants of school`s performance for Secondary and Higher Secondary Schools using logit model.

Dependent Variable: School Performance (having value 1 if $SPI \geq 0.5$ and 0 otherwise)				
Variable	**Secondary Schools**		**Higher**	
ELEC	0.040	0.027	0.373	0.282
	(0.89)	(0.64)	(1.79)	(1.54)
NGAS	0.101*	0.096*	0.158**	0.125
	(2.43)	(2.42)	(4.07)	(1.99)
LIBR	0.091**	0.096**	0.114*	0.117
	(4.07)	(4.35)	(2.04)	(2.03)
SLAB	-0.047*	-0.049*	0.095	0.117
	(-2.00)	(-2.10)	(0.98)	(1.33)
PGRD	-0.004	-0.049	0.006	0.002
	(-0.18)	(0.01)	(0.13)	(0.05)
TOIL	0.001	-0.040	---	---
	(0.02)	(-0.78)	---	---
TECH	-	---	-	---
	(-3.57)	---	(-5.61)	---
POST	---	0.003**	---	0.003
	---	(3.21)	---	(1.16)
POAT	---	---	---	---
	---	---	---	---
TCLS	-0.007*	---	0.025**	---
	(2.73)	---	(5.63)	---
PPTC	---	0.002**	---	0.001
	---	(3.18)	---	(0.77)
N	1362	1362	275	275
χ^2	37.21	45.42	35.26	22.44
P-Value	0.000	0.000	0.000	0.000

Appendix C: Results for the determinants of school`s performance for Science and Arts schools using logit model.

Dependent Variable: School Performance (having value 1 if $SPI \geq 0.5$ and 0 otherwise)				
Variables	**Science Schools**		**Arts Schools**	
ELEC	0.119*	0.073	0.002	-0.019
	(2.60)	(1.87)	(0.03)	(-0.35)
NGAS	0.097**	0.084**	0.169**	0.127**
	(4.34)	(3.07)	(4.31)	(2.96)
LIBR	0.073**	0.072**	0.052*	0.040
	(3.84)	(3.81)	(2.02)	(1.55)
SLAB	-0.033	-0.035	-0.015	-0.023
	(-1.67)	(-1.78)	(-0.50)	(-0.78)
PGRD	0.016	0.014	0.002	-0.013
	(0.86)	(0.78)	(0.07)	(-0.51)
TOIL	-0.041	-0.068*	-0.037	-0.071
	(-1.07)	(-2.03)	(-0.50)	(-0.96)
TECH	-	---	-	---
	(-3.96)	---	(-5.11)	---
POST	---	0.001	---	0.004**
	---	(0.78)	---	(3.69)
POAT	---	-0.0003	---	0.002**
	---	-0.62	---	(3.23)
TCLS	0.007**	---	0.009**	---
	(3.16)	---	(2.99)	---
PPTC	---	0.002**	---	0.002**
	---	(4.66)	---	(2.74)
N	1498	1498	1394	1394
χ^2**Statistic**	50.42	61.89	32.07	24.71
P-Value	0.000	0.0000	0.0001	0.0071

Note: Hetroskedasticity consistent t-values are reported in parenthesis. Where *, **, and *** indicate weakly significant, moderately significant and highly significant, respectively.