

School Resources and Learning Outcomes: An Empirical Study of Rural Public Schools

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Abstract

This paper explores the association between school-level factors and learning outcomes of children in 361 rural public primary schools of Khyber Pakhtunkhwa (KP) Province, Pakistan. Two datasets have been used for the purpose: Education Management Information System (EMIS) for school-level factors and Annual Status of Education Reports (ASER) for student learning outcomes. The analysis reveals that school size, multigrade schools, teachers' qualification and teachers' attendance are significant predictors of children's numeracy and English reading skills whereas teachers' qualification and teachers' attendance, were found significant across all the three proficiency levels- reading Urdu, reading English and two-digit subtraction.

Keywords: rural primary schools, school resources, learning outcomes, developing countries.

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The number of out-of-school children is on a decline since the turn of the millennium. The latest Education for All Global Monitoring Report (UNESCO, 2017a) shows that the number of primary school-age children who are out-of-school has decreased significantly from 100 million in 2000 to 61 million in 2015. However, despite improved access to primary education, evidence is increasing that primary education is failing children, especially in developing countries. With overcrowded classrooms, and with insufficient classroom resources and teachers, large numbers of children drop out from schools without learning to read a single word. Recent UIS data (2017) show that 68% of the children enrolled in schools (262 million out of 387 million) will not be able to achieve minimum proficiency levels in reading at the end of the last grade of primary. To tackle the global learning crisis, it is of fundamental importance to gain a better understanding of the factors that influence the learning outcomes of children, especially in the developing world.

Review of literature reveals that four major factors affect learning outcomes. These factors have been categorized into individual, household, school, and system-level factors. Provision of quality education to all children is the prime responsibility of the state as has been pledged by many countries around the world at the World Education Forum, held in the Republic of Korea in May 2015, through the Incheon Declaration for Education 2030 (UNESCO, 2015). By taking up this responsibility, the state must cater to the educational needs of all the children and ensure quality learning outcomes for all throughout their lives. Hence, this study situates the low learning outcomes in the context of systematic factors that fail to maximize the educational outcomes of children.

The 1973 Constitution of Pakistan declared education a fundamental human right. Article 25-A of the Constitution ordains that the state shall provide free and compulsory primary

and secondary education to all children, from age 5 to 16 years. Pakistan's recent national commitments towards education include the National Plan of Action (2013-16), National Education Policy (1998-2010, 2009, 2017-25), and Vision 2030. Similarly, international agreements signed and ratified by Pakistan include the United Nations Universal Declaration of Human Rights (1948), Beijing Declaration and Platform for Action (1945), World Declaration on Education for All (2000), Dakar Framework for Action (2000), the Millennium Declaration (2000) and Global Education 2030 Agenda (UNESCO, 2010; UNESCO, 2017b). All of these national and international commitments clearly lay out the responsibility of the state to ensure inclusive and quality education for all and promote lifelong learning. In line with Pakistan's commitment to education, the four provincial governments – Khyber Pakhtunkhwa (KP), Punjab, Sindh and, Baluchistan - have also promulgated similar legislations for free and compulsory quality education known as The Right to Education (RTE) Act as well as prepared Education Sector Plans that stress the need for provision of free and compulsory quality education to all children.

However, despite local, national and international commitments, the absence of basic physical facilities such as boundary walls, clean drinking water, and toilets still exists. There is also a shortage of school staff and high pupil-teacher ratios severely affect the quality of education delivered in schools.

According to Pakistan Education Statistics 2015-2016, in Khyber Pakhtunkhwa (KP) province, one of the most war inflicted provinces, 42% of primary schools have no electricity, 28% of primary schools are without drinking water, 14% of primary schools are without a latrine and boundary walls and, 19% of primary school buildings need repair (Academy of Educational Planning and Management [AEPAM], 2017). Given the unsatisfactory school conditions despite

the government's local, national and international commitments, it is imperative to discern the systematic factors that predict learning outcomes in the context of the KP province. The results thus obtained may be helpful in formulating policy interventions aimed at improving learning outcomes of the children especially in the developing countries.

Theoretical Framework

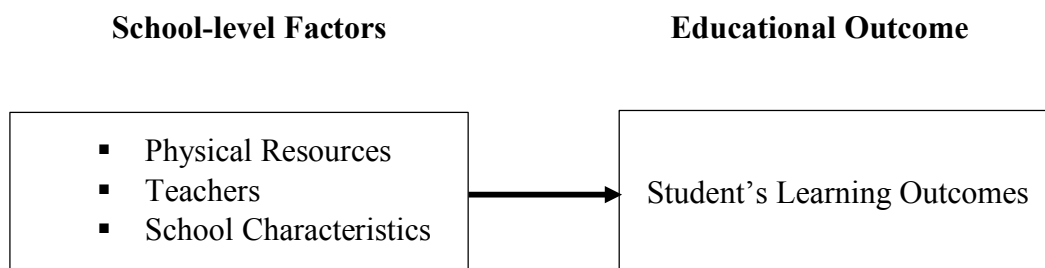
This paper employs the education production-function model to estimate students' learning outcomes in public primary schools in the KP province. Education production within the schools takes place through a complex process. In particular, student inputs (socio-economic status, age, and gender), household inputs (parents' education, income, and number of children), school inputs (infrastructure, teachers, and school location) and system-level inputs (school location, number of schools, and examination structure) are systematically related to each other and to student learning outcomes. However, this paper assesses the impact of school level factors on students' learning outcomes since, as mentioned above, it is the state's responsibility to provide a quality education and decent classroom conditions in which children can learn.

The initial years of primary schooling are very crucial for children as has been shown by a growing body of literature (EFA-GMR, 2013; Global Campaign for Education [GCE] and Results Education Fund, 2007; Rose, 2013). In Pakistan, and particularly the KP province, public schools are attended mostly by the children from low socio-economic status. These children have no resources at home to supplement the skills learned in schools. Their parents are mostly illiterate or semi-literate and are incapable of asking their children what they learned at school so as to correct them or improve their cognitive skills. In such a scenario, when these children get enrolled in a far-off school which is overcrowded with fewer teachers and fewer classroom resources, how can it be expected that they will develop strong foundations in basic literacy and

numeracy? Resultantly, if children are unable to learn the basics early on, they are unlikely to acquire other skills in later grades and are more likely to drop out (EFA-GMR, 2013; GCE & Results Education Fund, 2007; Hanushek, 1995; Rose, 2013).

Using the Education Production model, this paper assesses the impact of school-level factors (input) on students’ learning outcomes (output). For a detailed analysis of production-function model see Rahim (2017) and Hanushek (2007). Following Lee and Zuze’s (2011) typology, school- level factors have been categorized into physical resources, teachers, and school organization, as illustrated in Figure 1.

Figure 1: The Influence of School Factors on Children’s Learning Outcomes



Analytical Model of Learning Outcomes

Source: A Modified version of framework used in Lee and Zuze (2011)

Literature Review

Research indicates that student learning outcomes are influenced by resources available to the students in schools (Glewwe, Hanushek, Humpage & Ravina, 2011; Glewwe & Jacoby, 1994; Heyneman & Loxley, 1983; Lee & Zuze, 2011; Wilms & Somers, 2001). These resources have been grouped into three categories based on the typology used by Lee and Zuze (2011): physical resources, teachers, and school characteristics.

Physical Resources

Review of the literature indicates that physical resources can be grouped into three categories: infrastructure (classroom, sports facility, science lab and library); instructional materials (desk and chair, blackboard, charts, maps, teaching kits and textbooks); and amenities (toilet, electricity, drinking water, and boundary wall). In line with this categorization, the following sections analyze the relationship between physical resources and learning outcomes.

School infrastructure.

The relationship between school infrastructure and students' learning outcomes in developing countries is mostly positive. Glewwe, Hanushek, Humpage, and Ravina (2011) examined studies published between 1990 and 2010 to investigate the effects of school characteristics on student learning outcomes in developing countries (from South West and East Asia, Africa and Latin America). Seventy-nine studies including 43 high-quality studies found a positive impact of school walls, roofs, and ceilings on learning outcomes. Out of the 43 high-quality studies, four studies looked at the impact of the library on learning outcomes. Three studies were positive out of which two were significantly positive and none was significantly negative.

Using the Ghana Living Standards Survey (GLSS), Glewwe and Jacoby (1994) examined the relative effectiveness of repairing school buildings over investments in instructional materials, such as books, desks, and blackboards. The research found that improvement in material resources, such as repairing leaky classrooms, directly affect mathematics and reading test scores (as leaking classrooms cause interference in normal classroom activities) and indirectly affect retention. Similarly, research by Lee and Zuze (2011) found strong positive links between school

resources (an index created from all three categories of physical resources: infrastructure, instructional material, and amenities) and learning outcomes of grade six students in four sub-Saharan African countries: Namibia, Botswana, Malawi, and Uganda. The research concludes that the effects of resources on reading and mathematics test scores were larger in some countries than others.

In contrast, in a cross-national study of 13 Latin American countries, Willms and Somers (2001) found little evidence of positive effects of school infrastructure (library, laboratory, gym, art classroom, computer room) on language and mathematics test scores of third and fourth-grade students. Both of these studies used similar statistical methods (hierarchical linear model), created an index of various school resources, and observed data from more than one country. However, their results are contradictory. One potential explanation is that in Latin American countries schools have high levels of resources (Glewwe, Grosh, Jacoby, & Lockheed, 1995) which may have reduced the impact of resources on achievement. In contrast, in Sub-Saharan African countries, even the most basic resources are missing (Lee & Zuze, 2011) and hence the availability of bare- minimum resources may have a positive impact on learning outcomes.

Instructional materials.

The second category of physical resources is the availability of instructional materials (desks, chairs, blackboards, and textbooks). The relationship between school instructional materials and learning outcomes in developing countries is mostly positive. In a meta-analysis of 37 developing countries, Glewwe, Hanushek, Humpage, and Ravina (2011) shortlisted five high-quality studies that looked at the impact of desks, tables, and chairs on students' achievement. The findings of all five studies are positive and two of them are significantly positive. Similarly, findings for blackboards are positive in three studies and significantly positive in one study. This

finding is consistent with that of Glewwe and Jacoby's (1994) research in Ghana that found out that blackboards have a statistically significant impact on both math and reading test scores of students in secondary schools.

Similarly, in a cross-national study of 13 Latin American countries, Wilms and Somers (2001) found significant positive effects of instructional materials (blackboards, calculators, and maps etc.) on language scores of third and fourth-grade students. Their research indicates that an increase of five items in instructional materials is associated with an increase in language scores by about ten points. The findings of this study are consistent with that of Aslam (2003) who found that in Lahore, Pakistan school facilities have a consistent and significantly positive impact on the reading skills of 8th grade students. Similarly, using the 1990 Jamaican Survey of Living Conditions, Glewwe, Grosh, Jacoby and, Lockheed (1995) found that school facilities and instructional materials influence student achievement in primary schools. However, the study found that other variables measuring teaching practices are more often significantly related to student achievement than are physical and pedagogical variables. Nevertheless, the authors contend that it may be due to the fact that Jamaican schools have high levels of school inputs that reduced the impact of physical resources on achievement.

In contrast, a household survey carried out by Lloyd (2000) to explore the relationship between school quality and educational outcomes in Kenya, found a low correlation between the facilities index and the average percentage of students scoring a passing grade on the Kenyan Certificate of Primary Education (KCPE) examination. In short, the evidence is mostly positive with regard to the association between instruction materials and learning outcomes.

Amenities.

This is the third categorization of physical resources. Availability of basic amenities such as

toilets, electricity, and drinking water is important to attract students to schools, retain them and improve their performance. Lee, Zuze and Ross's (2005) research in 14 Sub-Saharan African countries found a strong positive relationship between an index of amenities and infrastructure and reading test scores of grade six students, a finding consistent with that of Lee and Zuze (2011) in four sub-Saharan African countries.

Electricity is one of the major amenities in schools especially in countries where the weather is hot and humid for the most part of the year. Children sitting in overcrowded classrooms without electricity fail to focus on what is being taught in the classroom. However, the evidence on the impact of electricity on learning outcomes is mixed. Although the studies conducted by Lee et al. (2005) and Lee and, Zuze (2011) found a positive impact of electricity on test scores, the meta-analysis of 37 developing countries by Glewwe et al. (2011) found no evidence that electricity has a significant positive impact on students' achievement.

The toilet is another such crucial resource that has been frequently analyzed. Suryadarma et al. (2006) investigated the correlation between the performance of public primary schools in Indonesia. Using OLS regression on a nationally representative sample of fourth graders, the study found that students in schools with at least one functioning toilet had higher levels of performance in mathematics than those in schools with no toilet. The effect was significant for girls but not for boys. The finding is consistent with that of Asadullah (2005), who argued that availability of toilets is particularly important in increasing enrollment and attainment in Bangladesh.

To sum up, the studies indicate that the existence of basic school infrastructure such as school boundary walls, roofs, and classrooms as well as regular repair and maintenance of the infrastructure has a statistically significant impact on students' learning outcomes. With regard to

the impact of instructional material such as desks, chairs, blackboards, and textbooks, most of the researchers agree that availability of instructional materials has an impact on students' learning outcomes. Similarly, researchers found a positive relationship between an index of amenities and learning outcomes.

Teachers

Evidence on the impact of teachers' quality (educational level, experience, and training) on student achievement is inconclusive. Regarding teachers' experience, studies from fourteen Sub-Saharan African countries and India, Iran, and Malaysia found that teachers' experience is strongly and positively associated with students' learning outcomes (Heyneman & Loxley, 2005; Lee & Zuze 2011; Lee, Zuze & Ross 2005). In contrast, studies from Ghana, Latin America, and Mexico indicate that teachers experience is not associated with students' learning outcomes (Glewwe & Jacoby 1994; Luschei 2012; Willms & Somers 2001). Regarding teacher's training, the findings are mostly positive in countries like Israel and Latin America and negative in India. Angrist, Joshua, and Lavy (2001) examined the effect of in-service teacher training on achievement in Jerusalem. Using differences-in-differences regression and matching estimates, the research found that teacher training provided a cost-effective means of increasing reading and math test scores. The authors suggest that teacher training may provide a less expensive strategy for raising test scores than reducing class size or adding school hours. Similarly, in a cross-national study of 13 Latin American countries, Willms and Somers (2001) found significant and positive effects of teacher training on grade three and four students' language and math test scores. In contrast, Suryadarma et al.'s (2006) research in Indonesia found that the proportion of teachers with pre-service training does not have a significant impact on students' achievement.

Regarding teachers' education, the findings are inconclusive. Santibanez (2002) found that students of teachers with advanced degrees had greater achievement gains in both primary and secondary schools in Mexico City. This finding is consistent with that of Heyneman and Loxley (1983) in India and Lee and Zuze (2011) in Sub-Saharan African countries. However, in their study of rural northeast Brazil, Ralph Harbison and Eric Hanushek (1992) found that teachers' education levels were not systematically related to student performance on standardized tests.

In short, the findings on the effects of teachers' quality are contradictory, which can be attributed to various statistical approaches, e.g., differences in research methods, differences in level of aggregation, relevant control and omitted variables, functional form of equation, type of data (longitudinal versus cross-sectional), difference in political climate of the country, quality of training, or availability of school resources.

School Characteristics

School characteristics focus on how schools are organized such as school size, school location, pupil-teacher ratio, single or multi-grade teaching, school fee and school shifts (same school resources are utilized by various students at different times of a day) (Glewwe et al. 2011; Lee & Zuze, 2011). This paper review two variables due to the nature of research question and availability of data. These variables are school location and pupil-teacher ratio.

Urban/Rural locations.

Evidence suggests that the urban/rural location influences learning outcomes. This finding may be in part due to the inferior physical resources of school (buildings, instructional resources, facilities) and teachers' quality (level of schooling, experience, and training). For example, Zhang (2006) investigated factors underlying the learning disadvantage of rural primary school students in fourteen Sub-Saharan African countries. Using data from the 2000-

2002 Southern and Western Africa Consortiums for Monitoring Educational Quality (SACMEQ II) reading assessments, the research found that students in rural areas score far below in reading than the children in urban areas. Among the reasons put forward for the variation in performance is fewer and inferior quality physical resources in rural schools as compared to urban schools.

Another reason why students from rural areas lag behind in their learning outcomes compared with their urban counterparts is teacher quality differences across rural and urban schools. Studies both in developed and developing countries indicate that the difference in teachers' quality is due to the difficulties in recruiting qualified teachers to work in remote rural schools. Teachers avoid working in rural areas for many reasons including isolation, poor living facilities, limited school resources, and even safety concerns. Luschei, (2012) in his analysis of two Mexican states, found that student achievement is significantly lower in rural areas as compared to those living in urban areas. He found that more experienced teachers and higher ability teachers are concentrated in urban schools whereas less qualified and less experienced teachers are employed in rural areas. Rural teachers are also highly mobile and "pay their dues" to get transferred to schools located in better areas.

Pupil-Teacher ratio (PTR).

The effect of class size on student achievement has conflicting results in developing countries. In a study of school choice in Pakistan, Alderman, Orazem, and Paterno (2001) found that large pupil-teacher ratios in public schools have a negative impact on student achievement especially language skills. Similarly, research in Indonesia by Suryadarma et al. (2006) shows that a class size below or above an average fourth-grade class size (25 children) has a negative impact on student performance in math and dictation. The authors conclude that very

small or very large class sizes are detrimental to students' performance and that the optimal size shall be in between the two class sizes. Case and Deaton (1999) analyzed five data sources to examine the relationship between pupil-teacher ratios and school outcomes amongst blacks and whites in South Africa. The study found that a higher pupil-teacher ratio had a negative effect on the mathematics score but a positive and insignificant effect on literacy. They also found that among whites the pupil-teacher ratio had a positive, but insignificant, effect on both tests. Similarly, in a cross-national study of 13 Latin American countries, Willms and Somers (2001) found significant positive effects of PTR on grade three and four students' language and math test scores. However, the effect was very small. The study shows that a decrease in the class size of 10 students is associated with an increase in achievement of about five points on mathematics and language test.

In contrast, Lee and Zuze (2011), in their analysis of students' achievement and school resources in four sub-Saharan countries, found that class size had no impact on grade six students' achievement in reading and mathematics. In a randomized trial in Western Kenya, Duflo, Dupas, and Michael Kremer (2009) found that a reduction in class size (from 82 to 43 students on average) without any other changes in school organization (such as training of school council) had a small and insignificant impact on the increase in test scores. Similarly, a review of studies on developing countries reported mixed results on the effects of class size (Glewwe et al. 2011). In their analysis, five studies found a significantly negative impact of class size on student achievement while three studies found a significantly positive impact of class size on student achievement. The differences in the results of these studies may be due to differences in the distribution of class size, as had been suggested by Suryadarma et al. (2006), that both very small and very large class sizes can have a negative relationship with schooling outcomes.

In sum, the studies indicate that the location of school influences learning outcomes either because of lack of physical resources and lower teachers' quality in rural schools as compared to urban schools. However, with regards to PTR, the findings are inconclusive.

Research Question, Data, and Variables

Two data sources were used to address the research question: What school factors are associated with learning outcomes? These sources were: a) Education Management Information System (EMIS) obtained from the Ministry of Elementary and Secondary Education, Government of KP; and b) the Annual Status of Education Reports (ASER), which is available online, and is an NGO-sponsored, large-scale national household survey about the quality of education in rural and some urban areas of Pakistan.

The three dependent variables are the rate of proficiency in reading Urdu, reading English, and basic mathematics. The independent variables included in the analyses of learning are school location (urban/rural), amenities, medium of instruction, teachers' attendance, academic and professional qualification, school size, PTR (Kindergarten/kachi-grade 2), PTR (grades 3-5), multigrade schools and, school gender. The school facilities measured in 2012 were used to predict learning outcomes in the same year.

The ASER assessment measured children's literacy and numeracy skills at five proficiency levels. These levels are a) reading beginner/ cannot read; b) reading letters; c) reading words; d) reading a sentence; and e) reading a story. Similarly, numeracy skills have been measured at five proficiency levels: a) math beginner /cannot recognize digits; b) recognizes digits from 1-9; c) recognizes digits from 11-99; d) two-digits subtraction; and e) three-digit division. However, for this study, two lower-levels of proficiencies have been grouped into one. In particular, in the case of reading Urdu, two levels (reading a letter or word) have been grouped into a category

‘reading words or less.’ Similarly, for mathematics, recognizing digits from 1-9 and 1-99 have been combined into one category, i.e., recognizes digits from 1-99.

Analyses of the rates of proficiency at each of the four proficiency levels in each subject area (Urdu, English, and Mathematics) have been conducted. However, the results of only the third proficiency levels (reading sentence in Urdu, reading words in English, and performing two-digit subtraction) are discussed in this paper to maintain uniformity across various analyses, and because the results were meaningful and statistically significant. Consequently, the research question has been divided into three parts: What school factors are associated with a) reading sentences in Urdu b) reading words in English, and c) performing two-digit subtraction? Accordingly, three dependent variables (reading Urdu sentences, reading English words, and mathematics) are constructed. The variable Read-Urdu-Sentence ‘RDURDSNT’ is constructed to determine the percentage of children who can read a sentence in Urdu. It is an interval level variable having values: 0 to 100. The second variable, Read-English-Word ‘RDENGWRD’, is constructed to determine the percentage of children able to read a word in English. Finally, the third variable, MATH, is constructed to determine the percentage of children able to do two-digit subtraction.

Guided by the literature, the independent variables were classified into physical resources, teachers, and school characteristics. The category ‘physical resources’ was comprised of independent variables such as the number of classrooms, number of desks and chairs, and amenities. However, due to insufficient and incorrect EMIS data in the first two categories, these variables were dropped, and the variable ‘amenities’ was selected for the analysis.

The second category, ‘teachers’, consisted of variables such as number of teachers, teachers’ attendance, and academic and professional qualifications. The first variable, number of

teachers, was transformed into a variable ‘multigrade’ to assess whether a teacher teaches two or more grades at the same time in a classroom. With regards to the second variable, teachers’ attendance, a dummy variable was constructed based on the hypothesis that educational outcomes are better in schools where teachers’ attendance is greater than 90 percent in comparison to those schools where attendance is less than 90 percent. The third variable, teachers’ academic qualifications, indicate whether the teacher has a Matriculation degree (completion of grade 10) and a high school degree. The fourth variable, teachers’ professional qualifications, indicates whether the teacher has a Primary Teaching Certificate (PTC) and Certificate in Teaching (CT)¹. The final category, ‘school characteristics’, is comprised of variables such as school location, medium of instruction, school size, student-teacher ratio and school gender.

Resultantly, the set of independent variables comprised of amenities, multigrade schools, school location (urban/rural), medium of instruction, school size, PTR (Kindergarten/kachi-grade 2), PTR (grades 3-5), teachers’ attendance, teachers’ academic and professional qualification and, school gender. The first variable, amenities, was constructed by adding five basic items in a school: electricity, drinking water, boundary wall, toilets, and usable toilets. An ordinal variable was constructed, which had values from 0–5 where 0 presents no amenities and 5 presents availability of all five amenities. The second variable, multigrade, determines whether a teacher teaches two or more grades at the same time in the same classroom or space. Multigrade is a dummy variable where 1 represents a multigrade school if a school has less than six teachers and 0 represents monograde schools if a school has more than six teachers.

¹PTC is awarded after a one-year program on the basis of Secondary School Certificate, i.e., 10 years of school attendance. The award qualifies the holder to teach in a primary school. CT is awarded after a one-year program on the basis of Intermediate/Higher School Certificate examination. The award qualifies the holder to teach in middle schools (6th to 8th grades). (Qualifications Recognition, 2011)

The third variable, school location, has been coded into a dummy variable (0, 1) where 1 indicates urban schools and 0 indicates rural schools. The fourth variable, medium, indicates the medium of instruction in schools. A dummy variable (0, 1) was constructed where 1 represents the medium of instruction as Urdu or English, and 0 represents Pashto medium schools. The fifth variable, school size, is an interval level variable that has been constructed from the students' enrollment data 2012. The school enrollment variable was created by summing enrollments from Kindergarten/kachi to grade 5. School size had a moderate positive skew hence it was transformed into Log school size. Using quartile approach, the sample schools were grouped into small (less than 104 students), small-to-medium (104-194 students), medium (195-397 students) and large sized schools (greater than 398 students).

The sixth and seventh variables in this category, PTR, estimate class size. Two interval level variables have been constructed; one for early grades (Kindergarten/kachi–grade 2) and another for higher grades (grades 3–5). These variables are created in two steps. First, the school enrollment (Kindergarten/kachi– grade 2) variable was created by summing enrollments from Kindergarten/kachi to grade 2. Second, PTR (Kindergarten/kachi– grade 2) was computed as school enrollment (Kindergarten/kachi–grade 2)/number of teachers multiplied by 100. A similar method has been adopted for the interval level variable PTR (grades 3–5).

The variables under teachers' category consist of teachers' academic and professional qualification and attendance. The eighth variable, teachers' attendance, is a dummy variable that indicates percentage of teachers' (90% or more) present during the day of school visited by the surveyors of the ASER team. Hence, 1 represents teacher attendance greater than or equal to 90 percent, and 0 represents otherwise. The ninth variable, teachers' academic qualifications, represents officially mandated qualifications for teachers to teach in a primary

(Kindergarten/kachi to grade 5) or middle (grades 6-8) school whereas a higher qualification is officially required for teachers to teach in high schools (grades 9-10) and college (grades 11-12). The tenth variable, teachers' professional qualification, is an interval level variable that determines percentage of teachers having professional qualifications as PTC and CT.

The last variable, school gender, has been constructed because officially in KP province the schools are strictly segregated and labeled as boys' and girls' schools only, which is accordingly reflected in the EMIS. However, during school visits, it was observed that in some boys' schools a significant number of girls were enrolled. The head masters explained that girls attend boys' schools when there are no girls' schools nearby or when the parents perceive that the quality or security of boys' schools is better than that of girls' schools. Given this reality, the researcher decided to create a third category of 'mixed schools' to observe the difference in educational outcomes across the three types of schools. Hence, a variable school gender was created having values from 1 to 3 where 1 indicates boys' schools, 2 represents girls' schools, and 3 refers to mixed schools (boys 'schools with girls enrolled in them).

To summarize, 13 independent variables were initially proposed for this study: school gender, school location, amenities, medium of instruction, school size, pupil-teacher ratio (Kindergarten/kachi– 2), pupil-teacher ratio (3–5), number of teachers, number of classrooms, number of desks and chairs, teachers' attendance, teachers' academic qualifications and professional qualifications. Out of these 13 variables, eleven variables were selected for analysis as explained in the following section.

Methodology

To answer the research question, "What school factors are related to learning outcomes?" the data from 361 schools were analyzed. Two data sources were used to examine

this question: EMIS 2012 and ASER 2012. The two databases were integrated through a unique school code, which resulted in the specified number of schools. The school quality variables were retrieved from EMIS database while learning outcomes variables were used from the ASER 2012 database. A multiple linear regression analysis was conducted to assess the relative influence of school resources on students' learning outcomes.

The hypothesized relationship between school quality and learning outcomes has been examined using the education production-function model, which argues that students' learning outcomes as the educational output are affected by various school-level factors, perceived as inputs. To better understand the impacts of various inputs on learning outcomes, it is helpful to model these complex relationships explicitly. Production functions for school-level factors and learning outcomes is presented in the following equation:

$$LO = f(PHYRES, TEACHER, SCHORG, \eta) \quad (1)$$

LO stands for learning outcomes measured as the percentage of students achieved a given proficiency level in reading and mathematics. Consequently, separate models of three learning outcomes were constructed. The specific learning outcomes refer to the following abilities: Reading a story in Urdu, reading a sentence in English, and the ability to do two-digit subtraction. Production functions are derived as follows:

$$RDURDUSTORY_i = PHYRES_i + TEACHER_i + SCHORG_i + u_i \quad (2)$$

$$RDENGSENT_i = PHYRES_i + TEACHER_i + SCHORG_i + v_i \quad (3)$$

$$MATH_i = PHYRES_i + TEACHER_i + SCHORG_i + w_i \quad (4)$$

where RDURDSTRY, RDENGST, and MATH refer to the percentage of children who can read a story in Urdu, read a sentence in English and do a two-digit subtraction. Subscripts “i” represent schools whereas u, v and w, are error terms. The estimation of equations 1, 2, 3 and 4 are for public primary schools only. Thus, learning outcomes for children enrolled in private or other types of schools are not considered in this study.

The variables PHYRES, TEACHER and, SCHCORG represent school physical resources, teachers and, school characteristics. School infrastructure, instructional materials, and amenities are physical resources (PHYRES) included in the production functions. However, the first two variables were eliminated during the analysis due to faulty data. Amongst the variables included in the category TEACHER are teachers’ attendance and teachers’ academic and professional qualifications. Variables included in the school organization (SCHORG) are school location, medium, school size, PTR (Kindergarten/kachi–grade 2), PTR (grades 3–5), school gender, and multigrade.

A multiple linear regression was used to address the research question. However, before running regressions, tests for linearity and normality were conducted to meet the regression assumptions. The scatter plots and histograms indicated that several of the independent variables required transformations. For example, the variable, school size, had a moderately positive skew. Hence, a log transformation was performed to make the distribution normal and a new variable “*Log School size*” was created (de Vaus, 2002). Similarly, the variable PTR was split into PTR at two levels (Kindergarten/kachi to grade 2 and grade 3 to grade 5) as the data analysis revealed that many children drop out of schools after grade 2. The second regression assumption, the absence of collinearity between the independent variables, was also tested. It was observed that all independent variables had relatively low tolerance and the resulting Variance Inflation Factor

(VIF) values did not exceed the cutoff value 5. As the coefficients of all the three proficiency levels were the same, the results of only one proficiency level, doing two-digit subtraction, has been presented in Table 1.

Table 1

Collinearity Diagnostics (School Resources and Numeracy Skills)

Variables	Coefficients ^a	
	Tolerance	VIF
Rural School	.947	1.057
Medium of Instruction-Urdu	.869	1.151
Amenities	.746	1.341
School Size (Log)	.296	3.377
Pupil-Teacher Ratio (grades kachi-2)	.687	1.457
Pupil-Teacher Ratio (grades 3-5)	.558	1.791
Multi-Grade School	.447	2.237
Teachers' Qualification (Matriculate & Intermediate)	.847	1.180
Teachers' Qualification (PTC & CT)	.947	1.056
Teachers' Attendance (≥ 90)	.812	1.231
Girls School	.866	1.155
Mixed School	.871	1.148

a. Dependent Variable: Learning Proficiency - Mathematics

After these initial tests, the following variables were selected for the final analysis: school location (urban/rural), amenities, medium of instruction, school size, pupil-teacher ratio (Kindergarten/kachi– grade 2), pupil-teacher ratio (grades 3–5), multigrade schools, teachers' attendance, academic and professional qualifications and school gender (girls' only, boys' only, and mixed schools). The summary statistics of these eight school-quality variables are presented in Table 2.

Table 2

Summary Statistics of Independent Variables

Descriptive Statistics					
Variables	N	Minimum	Maximum	Mean	Std. Deviation
Rural School	361	0	1	0.98	0.14
Medium of Instruction-Urdu	361	0	1	0.60	0.49
Amenities	361	0	5	3.30	1.78
School Size (Log)	361	1.15	2.97	2.18	0.33
Pupil-Teacher Ratio (grades kachi-2)	361	5	106	25.62	12.72
Pupil-Teacher Ratio (grades 3-5)	361	0	57	19.02	8.414
Multi-Grade School	361	0	1	0.72	0.448
Teachers' Qualification (Matriculate & Intermediate)	361	0	100	41.61	37.96
Teachers' Qualification (PTC & CT)	361	0	100	78.48	25.62
Teachers' Attendance (≥ 90)	361	0	100	84.59	28.56
Girls School	361	0	1	.12	.321
Mixed School	361	0	1	.38	.487
Valid N (listwise)	361				

To measure the strength of an association between dependent and independent variables, a bivariate correlation analysis was conducted. Table 3 makes clear that the bivariate effects of the school characteristics are largely in line with the expectations. Higher PTR in grades Kindergarten/kachi-2, grades 3-5, and large school size were found to have a significantly negative impact on children's ability to read a sentence in Urdu. Teachers' officially mandated academic qualifications were found to have a negative impact on children's English reading skills.

Children's ability to do subtraction was affected by higher PTR in early grades and teachers' academic qualifications. Other indicators (amenities, school gender, medium of instruction, teachers' professional qualification, teachers' attendance and multigrade schools) were found to not have a significant impact on children's proficiency levels.

Table 3

Bivariate Pearson's Correlation Analyses

	Learning Proficiency – Two-Digit Subtraction	Learning Proficiency-Read A Word In English	Learning Proficiency-Read A Sentence In Urdu
Amenities	.085	.040	-.045
Medium of Instruction-Urdu	.049	.071	.096
School Size (Log)	-.034	-.064	-.146**
Pupil-Teacher Ratio (grades kachi-2)	-.129*	-.047	-.152**
Pupil-Teacher Ratio (grades 3-5)	.005	.000	-.121*
Multi-Grade School	-.056	-.033	.026
Teachers' Qualification (Matriculate & Intermediate)	-.117*	-.133*	-.094
Teachers' Qualification (PTC & CT)	-.102	-.034	-.041
Teachers' Attendance (≥ 90)	.088	.100	.096
Girls School	.020	.002	-.014
Mixed School	.006	-.038	.060
Rural School	.027	.066	.052

** $p < 0.01$; * $p < 0.05$.

Results

The coefficients of the bivariate analyses are important because they show how learning outcomes vary with various levels of school resources. They thus represent the observable reality in the rural schools in the KP province. However, because these characteristics may be related to each other (e.g., large schools tend to have higher PTR, or teachers with officially mandated qualification are deployed in schools that tend to have more children), the bivariate data gave

no insight into the relative importance of the various characteristics in explaining proficiency levels. Thus we may know little about the underlying causes of low learning outcomes. To gain more insight into these underlying causes, a multivariate analysis was conducted.

The coefficients for the regression model of the 11 independent variables related to school resources predicting literacy and numeracy skills are depicted in Table 4. A total of 361 schools were examined in relation to learning outcomes (read a sentence in Urdu, read a word in English, and do two-digit subtraction). Concerning a child's ability to read a sentence in Urdu, two variables, teachers' attendance and teachers' qualifications, showed a statistically significant relationship (columns 2 and 3). The analysis indicates that in schools in which teacher attendance was greater than 90 percent, the percentage of children who can read a sentence in Urdu was nearly four percentage points higher than those schools in which teachers' attendance was less than 90%. Teachers' officially mandated qualifications were also found to have a negative association with children's ability to read Urdu. Interestingly, most of the variables that showed significant effects in the bivariate analysis are not significant any more in the multivariate analysis. For example, school size, PTR in early and later grades and multigrade schools lose their significance after controlling for other variables. The regression model explains the nearly seven percent of variance in the rates at which students were proficient in reading, which was statistically significant ($R^2 = 0.068$, $F=2.088$, $p \leq .05$).

In relation to mathematics (columns 4 and 5) four of the school facility variables, school size, teachers' attendance, teachers' academic qualification and multigrade schools, show a statistically significant relationship with the children's ability to perform two-digit subtraction. The overall model explained six percent of variance in students' numeracy skills ($R^2 = 0.064$, $F=1.95$, $p \leq .05$). The analysis indicates that a one-unit increase in school size is related to

a nearly ten percentage point decrease in percentage of children who can perform subtraction. The analysis also reveals that schools in which teachers' attendance was greater than 90 percent, the percentage of children who can do subtraction was nearly four percentage points higher than those schools in which teachers' attendance was less than 90%. Furthermore, teachers' official academic qualifications, Matriculation, and Intermediate, decrease children's ability to do subtraction by five percent. The analysis also indicates that in a multigrade school, the percentage of children who can perform two-digit subtraction decreases by nearly six percentage points. Finally, an analysis by school gender indicates that there is no difference in numeracy skills amongst the children in boys only, girls only, or mixed schools. Interestingly, out of the two variables that showed significant effects in the bivariate analysis, one of them, teachers' qualifications, holds significance in the multivariate analysis whereas the other variable, PTR, loses its significance. Thus, after control for the other factors, it becomes clear that only children taught by teachers with relatively advanced qualifications are able to do mathematics as compare to children taught by teachers with lower qualifications.

Columns 6 and 7 in the Table 3 report the predictive value of the school resource variables on English reading skills. All four variables, school size, teachers' attendance, teachers' academic qualification and multigrade schools, that were found significant in assessing children's mathematical skills, show a significant relationship with the children's ability to read a word in English. Again teachers' qualifications that showed significant effect in the bivariate analysis held its significance in the multivariate analysis. The overall model explained seven percent of variance in schools' rates of students' ability to read a word in English ($R^2 = 0.068$, $F=2.07$, $p \leq .05$).

Table 4

*Multivariate Analysis of School Facilities on Learning Outcomes
(Reading Urdu, Reading English, and Mathematics)*

Variables	Dependent Variables#					
	Percentage Children Who Can Read a Sentence In Urdu		Percentage Children Who Can Do Two-Digit Subtraction		Percentage Children Who Can Read a Word In English	
	B	β	B	β	B	β
Number of Amenities	-.056	-.006	0.837	.082	.978	.086
Medium of Instruction-Urdu	1.970	.055	1.365	.037	2.31	.056
School Size (Log)	-7.854	-.150	-9.975	-.183*	-15.36	-.25**
Pupil-Teacher Ratio (grades kachi-2)	-.123	-.090	-0.137	-.096	.040	.025
Pupil-Teacher Ratio (grades 3-5)	-.037	-.018	0.227	.105	.200	.083
Teachers' Qualification (Matriculate & Intermediate)	-.052	-.114**	-0.050	-.105*	-.087	-.164**
Teachers' Qualification (PTC & CT)	-.006	-.008	-0.034	-.048	.019	.423
Teachers' Attendance (≥ 90)	3.743	100*	3.963	102*	4.874	2.104**
Rural School	6.929	.059	3.963	.102	11.70	.086
Multi-Grade	-3.511	-.090	-5.577	-.137*	-8.31	-2.36**
Girls School	1.808	.033	2.427	.043	.307	.087
Mixed School	2.269	.063	.677	.018	-1.29	-.559
(Constant)	30.905**		37.094**		44.23**	
<i>n</i>	361					
R^2	.068		.064		.068	
<i>F</i>	2.08**		1.95**		2.07**	

*** $p \leq .001$; ** $p \leq .05$; * $p \leq .10$.

For measurement of these variables refer to Annex-I.

A lower R-square at the three proficiency levels in Table 4 reflect a higher variability around the regression line. The regression assumptions behind low R-square were checked to validate the robustness of the model. One of the regression assumptions is the presence of multicollinearity. However, Table 1 indicates the independent variables are not correlated. Other assumptions are inaccurate measurement of dependent or independent variables and a small sample size. With regards to the measurement of variables, this study measured the variables as guided by the literature. The last assumption, small sample size, does not hold significance as the sample size of 361 rural schools is by no means a small sample. (Jin & Myers, 2006; Reisinger, 1997).

Researchers argue that the low R-square does not make the model spurious if the F ratio and the intercept in multiple regression model is significant (Moksony, 1990). The regression analysis passes both of the tests. As is evident from Table 4, the F ratio is significant, across all the three proficiency levels. Also, the intercepts in this model are also significant, which means that the R value in this model is not due to chance. Furthermore, this paper aimed to assess the relationships between school resources and learning outcomes at three levels hence the low R- Squared values do not negate the importance of the significant variables. The statistically significant p-values continue to identify relationships, and the coefficients have the same interpretation despite low R-square (Frost, 2017).

In short, the small but significant R-square means that there is a significant albeit small impact of independent variables, teachers' qualification, teachers' attendance, school size and, multigrade schools, on dependent variables, children's numeracy, and English reading skills.

However, it is possible that the majority of the impact would be better explained by other variables

²The Multiple Linear Regression analysis was re-run without the variable log (school size) having VIF greater than 3, which means there is a probability of multicollinearity, however, the regression results at all three proficiency levels were almost the same as presented in Table 4.

not included in this study, e.g., children's socio-economic status, school syllabus, teaching methodology, classroom management and, degree of autonomy delegated to schools. The same holds true for the effect of teachers' qualification and teachers' attendance on children's ability to read Urdu.

Discussion

This study provides some useful insights into the complex relationship between school resources and students outcomes. One of the major findings emerging from these analyses is that children attending schools that are staffed with sufficient teachers (at least one teacher per grade) have better numeracy and literacy skills as compared to those children who attend schools where there are fewer teachers. Empirical research on the impact of teacher shortage on learning outcomes is scarce despite the fact that the shortage of teachers is a huge challenge in developing countries. Analysis by UNESCO Institute of Statistics indicates that 24.4 million primary school teachers are needed to be recruited by 2030 (UIS, 2016). Nearly half of the vacancies (42.6%) arise in sub-Saharan Africa and South Asia where 10.4 million primary school teachers are needed to achieve universal primary education by 2030 (6.3 and 4.1 million teachers respectively). As per Pakistan Education Atlas 2015, nearly 30 percent of primary schools are run by only one teacher in Pakistan (AEPAM, 2017; Khattak 2016). The finding, hence, has an important policy implication and stresses the need to sufficiently resource the schools to improve educational outcomes of the students.

Not only teachers' availability but ensuring their attendance is crucial. The study reveals that teacher's attendance has a positive effect on students' literacy and numeracy skills, which is in consonance with earlier studies (Duflo, Hanna, & Ryan, 2012; Kremer et al., 2005; Miller, Murnane & Willet, 2007; Rogers & Vegas, 2009; Suryadarma, Suryahadi, Sumarto & Rogers,

2006). Teachers' absenteeism results in loss of instructional time and affects other education indicators such as access and school completion rates (Abadzi, 2009; Benavot & Limor, 2004; Chaudhury, Hammer, Kremer, Muralidharan, & Rogers, 2006).

The third finding is about teachers' qualifications. The study reveals that teachers' official academic qualifications have a negative impact on children's ability to read a sentence in Urdu, read a word in English, and do two-digit subtraction. The studies that examined the relationship between teachers' academic qualifications and learning outcomes yielded mixed results. Studies conducted by Heyneman and Loxley (1983) in India and Lee and Zuze (2011) in Sub-Saharan African countries found a positive impact of teachers' academic qualification on learning outcomes. However, studies conducted by Aslam and Kingdon (2008) in Pakistan and Harbison and Hanushek (1992) in Brazil found no explicit linkages between teachers' qualifications and learning outcomes. The finding is relevant to most low-income countries including Pakistan for two reasons. First, education quality is not up to the mark in most developing countries and, even when the teachers get matriculation and intermediate degrees, they do not possess sufficient knowledge and skills to teach effectively. Second, the teaching profession is not a choice but compulsion for many of those people applying for government teaching jobs who are either rejected by other recruiters or lack motivation to excel in life. Hence, the finding has an important policy implication and stresses the need to review teachers' qualifications criteria to improve educational outcomes of the students.

Finally, it was observed that an increase in school size has a negative effect on students' numeracy and English reading skills. A review of literature on school size indicates that much of the school size research has been conducted on high schools especially in developed countries (Chavez, 2002; Leithwood & Jantzi, 2009; Slate and Jones, 2007; Steifel,

Berne, Iatarola and Frucher, 2000; Werblow & Duesbery, 2009) and the evidence on school size effect is mixed. The theoretical framework that serves as the rationale for small size schools, that is, school connectedness, argues that teachers provide individual attention to children in small schools hence students feel supported and cared for by teachers, which may overcome other barriers such as poverty and may lead to improved students' performance (McMillen, 2000; Ready & Lee, 2006; Zoda, Combs, & Slate, 2011). In KP province, a vast majority of students enrolled in public schools are from economically disadvantaged backgrounds having mostly illiterate parents. Added to this, there is a shortage of teachers as primary schools are mostly run by one teacher. In such a scenario, the school connectedness model fits well with the findings as struggling students need more attention to individual needs and a more caring environment.

Unlike the vast majority of previous studies on school location and students' achievement (Luschei 2012; Zhang, 2006), this study does not show a positive association between urban schools and learning outcomes. The lack of systematic positive association between the two may be due to fewer urban schools (2%) than rural schools (98%) in the data set. The relationship between amenities and learning outcomes is also found to be statistically insignificant unlike some of the earlier studies (Lee & Zuze, 2011; Lee, Zuze & Ross, 2005). The insignificant relationship between PTR and learning outcomes was observed after the regression model was modified by adding the teachers' characteristics variable. The initial regression model that did not contain the teachers' characteristics variable showed statistically significant association between PTR and learning outcomes, which means that teachers' characteristics overshadowed the importance of PTR.

Conclusion

This paper analyzed the effects of school-level factors on children's learning outcomes in 361 rural public primary schools in 23 districts of the KP province, Pakistan. The school-level factors were categorized into physical resources, teachers, and school characteristics. The physical resources were further grouped into school infrastructure, instructional materials, and amenities. Teachers' category consisted of teachers' academic and professional qualifications, attendance and number of teachers in schools. The last category, school characteristics, comprise of PTR (Kindergarten/kachi-grade 2), PTR (grade 3-5), school location, size, medium of instruction and, school gender (boys' only, girls' only, and mixed schools).

Following policy recommendations can be deduced from this study. First, the strong positive effect of teachers' attendance indicates that in schools where teachers' absenteeism is low children's ability to read a word in English, read a sentence in Urdu and do two-digit subtraction are better than schools where teachers remain absent. Second, the results make clear that the requisite number of teachers are very important too. If there are too few teachers in schools, learning outcomes are substantially decreased. The findings suggest that, in schools with low learning levels, increasing the number of teachers might be a good policy to improve children's ability to read and do mathematics. Third, if teachers who hold a bare minimum qualification (high school or intermediate degree) teach primary school children, the learning outcomes will not get any better. This finding suggests that policy measures aimed at increasing the level of teachers' qualifications for induction might help improve learning outcomes of children in rural schools. Finally, the study shows that a continuous increase in school size may result in lowering learning outcomes.

Learning outcomes are influenced by many school-level factors especially teachers and

school characteristics. Mapping the role played by these factors is the first step to solve the learning crisis in low-income countries. This study points to the need to sufficiently resource the schools to improve the educational outcomes of students in rural public primary schools

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Annex-I: Operationalization of Variables

The Dependent Variables have been computed as:

- a) The variable ‘percentage children who can read a sentence in Urdu’ was calculated by dividing the number of children who can read a sentence in Urdu by total number of children sampled minus number of children who were not tested in Reading Urdu. The output was multiplied by 100.
- b) The variable ‘percentage children who can do two-digit subtraction’ was calculated by dividing the number of children who can do subtraction by total number of children sampled minus number of children who were not tested in Mathematics. The output was multiplied by 100.
- c) The variable ‘percentage children who can read a word in English’ was calculated by dividing the number of children who can read a word in English by total number of children sampled minus number of children who were not tested in reading English. The output was multiplied by 100.

The Independent Variables were computed as:

- a) Amenities: a five-point scale summing five nominal variables indicating the existence of five amenities: electricity, drinking water, toilets, boundary wall and useable toilets. 5 = all five amenities, 0 = no amenities.
- b) Medium of instruction: 1 refers to a school in which the medium of instruction is Urdu; 0 = Pashto.
- c) School size (Log): Log of number of children enrolled in schools in 2012.
- d) Pupil-Teacher Ratio (grades Kachi-2): sum of children enrolled from kachi to grade 2 divided by number of teachers and multiplied by 100.
- e) Pupil-Teacher Ratio (grades 3-5): sum of children enrolled in Grades 3 to 5 divided by number of teachers and multiplied by 100.

- f) Teachers' Academic Qualification: Sum of teachers having a Matriculation Degree and a High School Degree, divided by total number of teachers in the school, multiplied by 100.
- g) Teachers' Professional Qualification: Sum of teachers having a Primary Teaching Certificate (PTC) and Certificate in Teaching (CT), divided by total number of teachers in the school, multiplied by 100.
- h) Teachers' Attendance: A dummy variable indicating percentage of teachers' (90% or more) present during the day of school visit by the surveyors of ASER team.
- i) Multigrade: 1 refers to a school where the number of teachers is less than six indicating at least one multigrade class; all other schools (with 6 or more teachers) are defined as 0.
- j) Rural: 1 refers to a rural school; 0=Urban school.
- k) Girls school = 1 refers to a girls' school; 0=others