Determinants of Students Learning Outcomes in Sikkim:

A Production Function Approach

A Thesis Submitted

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Sikkim University

In Partial Fulfillment of the Requirement for the

Degree of Doctor of Philosophy

By

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This is to certify that Thesis titled "**Determinants of Students Learning Outcomes in Sikkim: A Production Function Approach**" submitted to the Sikkim University for partial fulfillment of the degree of Doctor of Philosophy in the **Department of Economics**, embodies the result of bonafide research work carried out by **Amit Singh** under my guidance and supervision. No part of the dissertation has been submitted for any other Degree, Diploma, Association and fellowship.

All the assistance and help received during the course of investigation have been duly acknowledge by him.

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DECLARATION

I, **Amit Singh,** hereby declare that the research work embodied in the thesis titled **"Determinants of Students Learning Outcomes in Sikkim: A Production Function Approach"** submitted to Sikkim University for the award degree of Doctor of Philosophy is my original work. The thesis has not been submitted for any other degree of this University or any other University.

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Abbreviations

ANOVA	Analysis of Variance
ASER	Annual Status of Education Report
BRC	Block Resource Coordinators
CBSE	Central Board of Secondary Education
CISCE	Council of Indian School Certificate Examinations
CRS	Constant Returns to Scale
DEA	Data Envelopment Analysis
DISE	District Information System for Education
DMUs	Decision Making Units
EDI	Educational Development Index
EGRA	Early Grade Reading Assessment
EPF	Education Production Function
Figs	Figures
GDP	Gross Domestic Product
GEN	General
GJHS	Government Junior High School
IQ	Intelligence Quotient
JHS	Junior High School
Km	Kilometers
MHRD	Ministry of Human Resource Development
Min	Minutes
NCERT	National Council of Educational Research and Training
OBC	Other Backward Classes
OECD	Organization for Economic Cooperation and Development
OLS	Ordinary Least Square
PISA	Program for International Student Assessment
PTR	Pupil Teacher Ratio
QR	Quantile Regression
RBI	Reserve Bank of India
Rs	Rupees
SC	Scheduled Castes
SCR	Student Classroom Ratio
SDR	Student Desk-Bench Ratio
SFA	Stochastic Frontier Approach
SSA	Sarva Siksha Abhiyan
ST	Scheduled Tribes
TFP	Total Factor Productivity
U-DISE	Unified District Information System for Education
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nation Children's Fund

Executive Summary

The tangible accomplishments in quantitative indicators of school education across India have been less evident for quality aspects. Parallel setback in terms of less satisfactory quality outcomes at elementary level public education has been pervasive in the state of Sikkim. The cognitive fabrication of future human capitals through quantitative educational inputs has not delivered adequate standard consequences at national as well as in state levels. Present study was initiated with the primary motivation of understanding the factors explaining cognitive outcome of pupils enrolled in Government Junior High schools of Sikkim under education production function framework. Cognitive outcome of the student was captured by conducting standardized test based on standard format for elementary level pupils. The sampled students (total of 408) were exclusively from the highest grade (VIII) within the academic structure of elementary level school education.

Initially, an inter-district comparison on overall development, productivity and efficiency of elementary education in the state was analyzed using secondary level data for the reference period of 2003-04 to 2014-15. The analytical framework of the objective was based on Educational Development Index, Malmquist Productivity Index, and Data Envelopment Analysis. Findings from the secondary data analysis indicated overall educational development with respect to accessibility of school, infrastructural availability, teacher components and educational outcomes along with productivity growth in transforming educational input resources into outcomes was better in North and South Sikkim. However, the relative parameter on educational efficiency was greater in the elementary schools of East district.

Similarly, the district-wise analogues understanding on standardized test performance of sampled students were fulfilled using Kruskal Wallis test. The statistical evidence from the analysis suggested variation in the performances of the sampled pupils within districts. Comparatively, sampled cohorts from East and South Sikkim were identified as the better performers on an average. Whereas, the test scores of selected pupils from West district were relatively deficient to the scores of students from other three districts.

Further, the study examined the effect of predictors inclusive of components from school institutional, teacher, parent and household, student individual and peer levels given the scholastic levels of sampled 8^{th} grade students. Ordinary Least Square and Quantile regression models were estimated for the objective. The results of regression analysis indicated relationship and impact of input factors to vary across the spectrum of students test scores. For example, the positive effect of head masters' years of administrative experience was confined within the low and average performers. The covariate was inversely related at the upper end of the test score distribution.

Lastly, the determinants of technical inefficiency for overall test score of the students were examined with Stochastic Frontier Production Function and Censored Tobit regression models. The predictive nature of attributes such as student birth order, duration of tutorial classes, years of teachers' teaching experience and parental literacy were robust in explaining technical inefficiency for overall test score of pupils amongst the variables considered in the analysis.

Overall, the coherent implications from the findings of present study implied that the production mechanism for student cognizance is inclusive of deterministic factors from non-academic perimeters. Components related to parents, friends, neighborhood and student individual are instrumental in the scholastic developmental process of pupils especially at the foundational stages of a formal educational system. This further could be crucial in defining the status of human capital in long run.

Chapter 1

Introduction

1.1 Introduction

Being a merit good the importance of Education in Human Resource Development is indispensable. Sen (2003) expressed education helps in gaining access to social, political, economic, and health benefits of life which one might be deprived of erstwhile without it. As pedestal in nature the elementary education is needed to be braced in any economy for better human capital formation. Becker (1964) suggested investments in education improve human capital which ultimately results in economic benefits. The United Nation convention on Universal Declaration of Human Rights emphasized education as a basic right of every individual and provision of such should be free (United Nation, 1948). Promotion of elementary level education for children in every deprived country under educational strategy of UNICEF (United Nation Children's Fund) was motivated by similar right-based approach (UNICEF Strategic Plan, 2014–17). The fundamental focus of the strategy was to enhance learning outcomes and promote equity in educational accessibilities especially for the upliftment of human capital formation within disasters and conflicts prone regions of the world. Investment and initiatives for education complements the growth process through improved knowledge and skill of citizens thereby helping them to engage in better employment and wage opportunities (Muralidharan, 2013).

There has been significant surge in educational investment across the countries of the world over the past two decades as an agenda of Millennium Development Goal. Globally, public expenditure on education as a percentage of Gross Domestic Product (GDP) has rolled up from 4.2% (1999) to 4.8% (2015) (UNESCO, 2019). Similar pattern of increase in educational expenditure was evident during this period in South Asia. Total government expenditure on education rolled up from 2.8% (1999) to 3.4% (2017) in the region. Countries like Bhutan, Nepal, Maldives, and Afghanistan were the significant contributors to regional average of public expenditure in education during 2017. The respective figures were 7.1%, 5.1%, 4.3%, and 3.7% (UNESCO, 2019). Surprisingly, the share of public investments on education declined from 4.5% (1999) to 2.7% (2017) in India (UNESCO, 2019; Economic Survey Report, 2017–18). Moreover, countries such as Pakistan and Sri Lanka executed greater public investments on education than India in 2017. The proportions were 2.8% of GDP for each of these two economies.

Within North-Eastern states of India, expenditure on education as a percentage of total public expenditure was relatively greater in Assam and lower in Arunachal Pradesh during 2017–18 (RBI, 2018). However, the share of educational expenditure has declined from 20.1% (2007–08) to 18.3% (2017–8) in Assam. Similar decline in public expenditure was evident in the state of Manipur (RBI, 2018).

The genesis of modern Indian education system could be traced back to 1813 (Aggarwal, 2009). During the colonial rule, Charter Act of 1813 by British government recommended the encouragement of academic activities amongst the native Indians. However, provision and extension of elementary education was prioritized during 1882 under the reference of Indian Education Commission (1882–83). Later, the British government resolution on Educational Policy (1904) emphasized further expansion of primary and secondary education. During 1910–1913 Gopal Krishna Gokhale initiated a demand for compulsory elementary education in the country to Imperial Legislative Council. It was also known by Gokhale’s Bill for Compulsory Primary Education (1910–12). The chronology of policy recommendations, planning, and initiatives with reference to elementary level education during pre-independence period have been evident from Charter Act (1813) to the revival of Central Advisory Board of Education (1938)[1] till Sargent Report (1944). The concept on provision of free and compulsory education for children within the ages of 6–14 was one amongst major suggestions of Sargent report (Aggarwal, 2009). The post-independence period witnessed numerous commission, committee, and policy initiatives on education in India. Some amongst the major inceptions towards the development and improvement of school education in the country were Secondary Education Commission (1952), Concept of Basic Education (1956), Kothari Commission (1964–66), National Policy on Education (1968 and 1986), Ramamurtti Review Committee (1990), Janardhana Reddy Committee (1992), Revised National Policy on Education (1992), Mid-Day meal Programme (1995), Sarva Siksha Abhiyan (2000–01), Kasturba Gandhi Balika Vidyalaya (2004), National Scheme for Incentive to Girl for Secondary Education (2008), Rashtriya Madhyamik Siksha Abhiyan (2009), Right to Education Act (2009), and Padhe Bharat Badhe Bharat (2014) (Aggarwal, 2009; British Council Report, 2014; Government of India, Ministry of Information and Broadcasting, 2017). Both public and private sector intervention plays important role in formal and non formal educational program in India. The administrative setup of school education in India is characterized with multiple governing bodies. At the apex, Ministry of Human Resource Development (MHRD) leads the accountability on development of human resources and monitoring of policy initiatives in the country which is further alienated into two departments, Department of School Education and Literacy and Department of Higher Education. Beside this, National Council of Educational Research and Training (NCERT)

[1] Central Advisory Board of Education in India was initially setup in 1920 but was dissolved in 1923 as a measure of economy.

founded in 1961 is an advisory organization on school education to both central and state governments. It provides technical and academic assistance to schools across country. With respect to the aspect of academic curriculum, the school education system is governed by various national and state-level educational boards. Central Board of Secondary Education (CBSE), Council of Indian School Certificate Examinations (CISCE), Uttar Pradesh Board of High School, and West Bengal Board of Secondary Education are few examples of school educational boards in India (British Council Report, 2014).

Provision of free and compulsory education for all children up to the age fourteen is a constitutional commitment in India which has been evident from the public intervention of Sarva Siksha Abhiyan (SSA). Besides providing free and compulsory education for the age group of 6–14, SSA also had taken initiative for opening up the new schools; upgrading and extending the old ones; addressing inadequacy in teacher numbers and providing skill development training for existing teachers; and ensuring that there is significant enhancement in the learning achievement levels of children up to elementary stage. Reports of DISE (District Information System for Education) on the trends of Elementary education in India during 2005–06 to 2016–17 reveals that there has been considerable amount of improvements in the quality of government schools as measured in terms of availability of various kinds of inputs such as school infrastructure, teachers quantity, students grants etc. Total numbers of schools inclusive of both government and private have mounted from 1,124,023 (2005–06) to 1,467,680 (2016–17) in the country. The percentage of government schools with single classroom and single teacher has fallen from 9.54% (2005–06) to 3.87% (2016–17) and 12.17% (2005–06) to 8.38% (2016–17) respectively. Similarly, schools with the facilities of drinking water and girls toilet increased from 61.26%

(2005–06) to 97.12% (2016–17) and 37.42% to 93.99% during 2005–06 till 2016–17. In addition, the statistical facts of ASER (Annual Status of Education Report, 2018) disclose that India is close to universal enrollment for the age group of 6–14 years with the percentage of children enrolled in school at above 95% since 2007 and the percentage of children out of school being 2.8% nationally in 2018.

1.2 Study area

Present study is based on Eastern Himalayan state of Sikkim. Sikkim is the 22nd state of India, geographically second smallest and least populous with a population size of 6,10,577 (Census, 2011) state of the nation formed May 16th, 1975. The Nepali, Bhutia, Lepcha, Bihari, Marwari, and Bengali are the primary inhabiting communities of the state. The overall literacy rate of the state stands at the figure of 82.20% (Census, 2011). Whereas, a total of 1,317 schools inclusive of both government and private ownerships are operational (U-DISE Flash Statistics, 2016–17).

During the pre-merger periods, Sikkim was fundamentally the land of peasantry where every section of the population depended on primary means of production and where the feudal and traditional classes used to control and decide the nature and degree of likelihood in educational and occupational opportunities (Dewan, 2012). Datta (1991) alleged educational opportunities in the pre-merger Sikkim were restricted to the Feudal upper-class people so as the better occupational opportunities were available within this class. Nonetheless, the first of government schools in the state started functioning at Namchi, Rhenock, and Pathing during 1921 (Dewan, 2012). Successively, in the year 1924, an initiative of Christian Missionary under the leadership of Mary Scott was able to establish a girl's school in Gangtok (Dewan, 2012). It was first of its kind in the Sikkim. Later in the year 1925, High School in the name of monarch as Sir Tashi Namgyal High School was started. Soon after the merger, education sector was given a greater priority and the schools begun to mushroom rapidly (Dewan, 2012). With the beginning of 21st century, Sikkim paved the way towards achieving the targets such as complete literacy, universal enrolment, complete school accessibility etc. as the literacy rate of the state has been in an inclining trend. Sikkim ranked 13th position amongst Indian states and union territories in terms of literacy rate (Census, 2011). In the course of attaining such targeted goals, SSA in Sikkim was launched in a phased manner. In the first phase in 2000–01, SSA was implemented in the West District. Subsequently, SSA was extended to the remaining three districts of the state in 2002. At present, the flagship programme of SSA covers all the districts of Sikkim focusing especially up to elementary level students. Many educational indicators have been observed so far on its positive trend, for example, total number of school institution in the state of Sikkim has flourished from 1097 to 1317 schools during 2005–06 till 2016–17. Whereas, the recent figure on percentage of single teacher school was mere 0.23%. Proportion of government schools with toilet facility for girls was 99.49%, whereas 93.59% of private schools in the state were functional with the facility during 2017 (U-DISE Flash Statistics, 2016–17).

Given such accomplishments on quantitative aspects of school education at national and state level over the years, it is needful to understand the consequences of such initiatives on overall scholastic development of future human capitals. Status of student achievement or learning outcomes at global, regional, and state-level have been discussed in the next section.

1.3 Status of Learning Outcomes or Students Achievement

There are numerous agencies or organizational bodies worldwide dedicated to gauge the statistical evidences on status of student learning outcomes or scholastic achievements. Present section presents the statistical status of student achievements or learning outcomes during last 10 years at Global, South Asian, and Inter-state levels. Program for International Student Assessment or popularly known by PISA is an international initiative to study the cognitive abilities of students those within the age of 15 years. It is a survey based study conducted by Organization for Economic Cooperation and Development (OECD). The sampled nations under PISA are basically the OECD members; however the assessment of 2015 was inclusive of some partner economies. Amongst all the sampled cohorts of students from 70 countries, the performance of pupils from Singapore was superior in all three components of PISA. The average achievement scores of Singapore in Science, Mathematics, and Reading were above the OECD nations. The performance of China was an exception as well. China was placed in 10th position amongst top 70 nations in PISA 2015. Countries such as Chile, Brazil, Turkey, Romania, Indonesia, and Dominican Republic failed to touch the baseline of average or top performers.

In the context of South Asia, the regional or country specific assessment bodies conduct nationwide achievement tests. The findings of Early Grade Reading Assessment (EGRA) during 2016 claimed 14% of 2nd graders and 35% of 4th graders out of 11,771 sampled pupils were able to comprehend the cognitive abilities based on their learning in Afghanistan. In addition, 45% of 6th graders were recognized with low writing abilities. The National Student Assessment report (2013) obtained about 92% of 3rd graders and 75% of 5th graders within total sample of 40,699 students were short of appropriate reading capabilities in Bangladesh. Similarly, the student ability with respect to word recognition, vocabulary, grammar, reading etc. in Dzongkha language was limited to 60% of total sampled 4th graders in Bhutan (The Bhutan Learning Quality Survey, 2007–08). Likewise, there was a substantial variation of learning outcomes at regional level in Maldives. Majority of the top performing pupils were from the sampled schools of Male. Overall, National Assessment of Learning Outcomes (2008) reported mean achievement score of 7th graders from the country failed to cross even 30%. On the other side, the learning outcomes of pupils with respect to Nepali vocabulary was better amongst 5th graders in Nepal (National Achievement of Students Assessment, 2012). However, their performances were less satisfactory in readings. The cognitive competencies of pupils in Pakistan and Sri Lanka were found below global standards as well. ASER (2016) claimed 48 of 5th graders in Pakistan were unable to read class II level Urdu/Sindhi/Pashto literatures. Moreover, 7% of them failed to recognize even letters. In a national level assessment in Sri Lanka, majority of the students enrolled in 4th grade failed to obtain proper scores in writings. They were found deficient on writing skills (National Assessment of Achievement, 2015).

The findings of ASER reports over one decade in India reveal the declining trend in overall cognitive achievements of 8th graders. The percentage of class 8 students from government schools who can read IInd standard level text has fallen from 83.6% in 2008 to 69% in 2018 (ASER, 2018). Similar pattern of decline was evident in terms of arithmetic ability. In 2008, 65.2% of 8th grade pupils were able to do division which eventually fell to 40% during 2018. However, overall scholastic levels within the students of Sikkim enrolled at grade 8 have been observed to be above the national average. Around 79% of total sampled, 8th graders were able to read class II level text, while 44.6% of pupils from grade 8 were able to do division. On an average, the percentage of students in the states like Manipur, Mizoram, Nagaland, and Arunachal Pradesh with better arithmetic abilities were greater in share amongst all the North-Eastern states. Mizoram was a top performing state in terms of reading with 89.4% of pupils able to read appropriately, while 72.5% of students in Manipur comprehended the arithmetic task. Sikkim was found lagging with 5 North-Eastern states in terms of reading and arithmetic achievements during 2018. Assam was observed to be a state having lower arithmetic and reading levels on an average within all other North-Eastern states including national average considered in the comparison. Around 61% and 31.2% of sampled 8th graders were recognized with reading and arithmetic abilities in Assam (ASER, 2018).

1.4 Statement of the Problem

Despite some tangible accomplishments in quantitative indicators, the quality aspect of education in India yet needs a potential upliftment (Economic Survey, 2018). Mehta (2002) concluded even the states that have almost attained universal access, enrolment, and retention, the quality of education is very poor. There lies a huge setback in the form of low academic outcomes amongst the school students especially in rural areas despite the government efforts in providing educational inputs (ASER, 2014). India was ranked in 113th position out of 157 countries in Human Capital Index (HCI) rankings of 2018 (World Bank, 2018). The overall index value of South Asian neighbors such as Sri Lanka, Nepal, Bangladesh, and Mauritius were better than India. Moreover, India was found lagging in most of the components under HCI. For example, the harmonized test score of India was 355 out of 625 total points which was again lower than the scores of these neighboring countries (World Bank, 2018). The extent of apprehension is similar for Sikkim as well. The 8th graders of government schools from Sikkim were amongst the low performing students within

North-Eastern states in terms of both reading and arithmetic tasks (ASER, 2018). The report found only 18.1% of 8th grade pupils able to read standard I level text, while 41.2% and 44.6% comprehended respective subtraction and division tasks. The worrying fact is that those were basic floor level tests (2-digit carry-forward subtraction and division skills) without which one cannot progress in the school system. Further, the inclining trend of student enrolment at private schools across years provides ambiguity over educational production mechanism within government schools. Percentage of children (6–14 years) enrolled in private schools of Sikkim increased from 28.3% (2009) to 30.7% (2018), whereas the declining trend was evident for government schools during that period (ASER, 2009, 2018). The major implications from these statistical evidences suggest that the cognitive developmental process of students through quantitative educational inputs has not delivered the satisfactory outcomes in national level as well as in Sikkim. Students even at the highest grade of elementary level education (VIII) are not been able to comprehend the knowledge provided in the previous grades. This indicates the pervasiveness of problems and issues in the course of realizing quality outcomes those motivated through various public initiatives for elementary level education at national and state levels. Appropriate evaluations and monitoring of deterministic factors those curtailing student scholastic abilities are needful at utmost extent.

1.5 Significance of the Study

Human resource or Human capital is an important component for overall economic prosperity and development. Proper investments and quality monitoring on educational sector provide greater utility on human capital formation of any economy. Becker (1993) emphasized, the economic paradigm of modern era is based on greater investments in educational sector for better accumulation of human capital, apparently to attain higher economic achievements in the long run. Similarly, World Development Report (2018) advocated, benefits of education are long lasting which encourages economic growth. However, realization of superior economic benefits will be deficient until mechanism of human capital formation is monitored appropriately. The standard perimeter of human capital in any economy depends on the comprehensive examination of performances in educational sector. Students with higher level of scholastic capabilities and technical skills could make a robust contribute on economic progress. Thus, need of understanding the components explaining cognitive development of pupils is vital. Present study attempted to examine the aspects related with scholastic developmental process of 8th grade students in Sikkim. Inputs considered in the study were inclusive of academic and non-academic factors those predicting pupils learning outcomes. Research initiative on the same might provide conceptual and empirical wisdom with respect to production mechanism and the standards of future human capital on their formative stage.

1.6 Objectives

The study was undertaken to investigate the following objectives:

1. To understand the inter district status and performance of elementary education in government schools of Sikkim.
2. To examine the inter-district variation in learning outcomes amongst eighth graders of government junior high schools in Sikkim.
3. To identify the factors determining students learning outcomes in the study area.

4. To analyze the determinants of technical inefficiency in cognitive outcome of eighth graders.

1.7 Research questions

The research questions of the present study were as follows:

1. What is the status of productivity growth, educational development, and efficiency of elementary education in the state?
2. What are the factors determining learning outcome of eighth graders in the study area?
3. Does the effect of educational inputs vary given the cognitive abilities of students?
4. What are the potential predictors explaining inefficiency component in education production mechanism of eighth graders?

1.8 Data Source

Present study is based on secondary as well as primary data. The dataset of published Report Cards on Elementary Education in India for the period 2003–04 to 2014–15 was collected from District Information System for Education (DISE). Data was collected on number of students qualified in examination, number of schools, percentage of school beneficiary of development grants, number of teachers, student-classroom ratio, and pupil-teacher ratio of all four districts of Sikkim. Since the actual data does not reflect the accessibility of different variables of present study, so randomization was done for obtaining the per-capita availability or accessibility. Thus, the district-wise age group population data has been used in order to calculate the availability of schools per thousand population bearing age group of 6–14 years.

The source on district wise population figure by age group was Census of India (2011). Data on availability of elementary level government schools per thousand populations between age group of 6–14 was acquired multiplying the ratio of total number of government elementary schools and total number of population bearing age group 6–14 years with thousand. Analysis of secondary data will give a broad picture on status of elementary education in the state along with trend and pattern of educational productivity. However, secondary data analysis was insufficient for understanding the inter-district variation in learning outcome and the factors determining them. Therefore, for this purpose primary data was collected by conducting field survey. Sampling technique and sample design is summarized in the subsequent section.

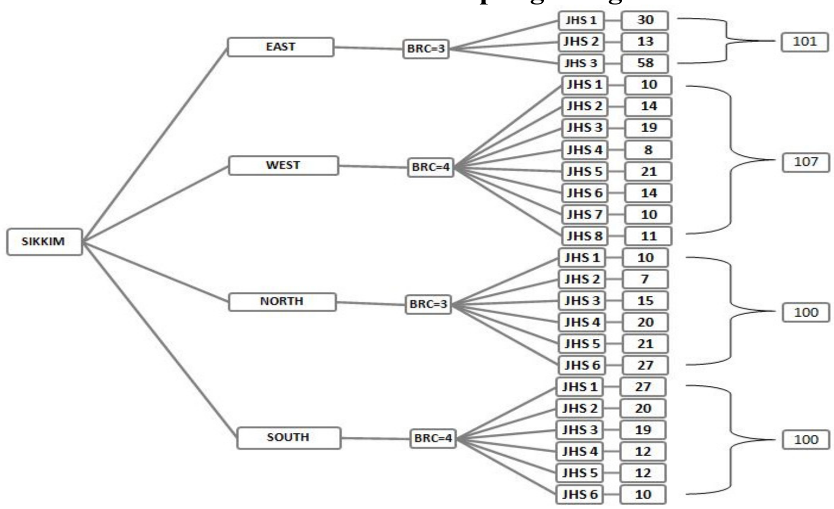
1.9 Sampling Technique and Sample Design

Present study applied multistage random sampling technique inherent of five stages in data collection. In the initial stage all four districts of the state has been selected, then from each district the school blocks were selected randomly from total of 32 BRCs[2] across state (Government of Sikkim, 2016). In the third stage, from each of the selected school blocks Government Junior High Schools were selected.[3] In the final stage, from each of the sampled school, students attending grade VIII were selected.[4] Given the vastness of the universe with time and resource constraint for an individual researcher a minimum of 100 students were surveyed from each district of the study

[2] Block Resource Coordinators which is a block level administrative coordinating body for quality education aspects of government schools, the study selected various JHSs from different BRCs; JHS represents Sampled Government Junior High School.
[3] Given the enrolment ratio, school selection were not uniform across the districts of the study area.
[4] Present study specifically selected the sampled students of Grade VIII under the rationale of class VIII being the highest grade within the collective segmentation of primary and upper primary level of education.

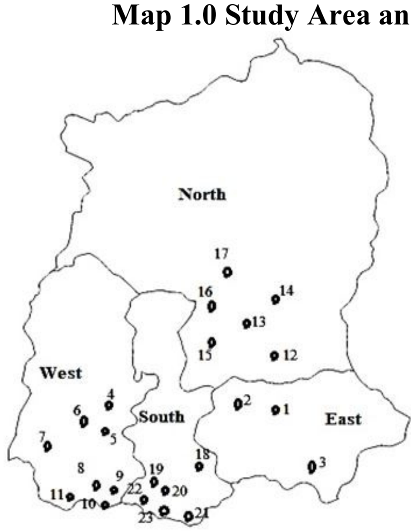
area resulting in a total sample size of 408 students for the present study. The sample design is shown in Flow Chart 1.0.

Flow Chart 1.0 Sampling Design



Given the Flow Chart I, standardized test along with field survey was conducted in 23 Government Junior High Schools and localities/villages across four districts of Sikkim. In this course total of 23 headmasters, 46 teachers, and 408 parents were interviewed to capture the requisite information on determinants of students learning outcomes. The location of sampled schools and households has been presented in Map 1.0.

Map 1.0 Study Area and Location of Sampled Schools



Sl. No.	School Name (Location)
1	Government Junior High School, Lumsey (Gangtok)
2	Government Junior High School, Tumin-Dhanbari (Tumin)
3	Government Junior High School, Rongli (Rongli Bazar)
4	Government Junior High School, Lower Chongrang (Tashiding)
5	Government Junior High School, Ongchum (Gyalshing)
6	Government Junior High School, Chumbong (Pelling-Chumbong)
7	Government Junior High School, Dentam Tar (Dentam Bazar)
8	Government Junior High School, Malbasey (Soreng)
9	Government Junior High School, Mendogoan (Chyakhung)
10	Government Junior High School, Mangsari (Tharpu)
11	Government Junior High School, Rumbuk (Sombaria)
12	Government Junior High School, Tumlong (Phodong)
13	Government Junior High School, Rang-Rang (Mangan)
14	Government Junior High School, Naga (Chungthang)
15	Government Junior High School, Gnon Sandong (Lower Dzongu)
16	Government Junior High School, Lingthem (Dzongu)
17	Government Junior High School, Lingzya (Upper Dzongu)
18	Government Junior High School, Chalamthang (Bermoik)
19	Government Junior High School, Mamley (Lower Mamley)
20	Government Junior High School, Gumpa Ghurpisey (Namchi)
21	Government Junior High School, Kameray (Sumbuk)
22	Government Junior High School, Tinik Chisopani (Chisopani)
23	Government Junior High School, Mick Khola (Kitam)

1.10 Phases of Field Survey and Nature of Data

Present study covers various phases of field survey to collect data on multiple dimensions for fulfillment of the objectives. Initially a standardized test was conducted for the students of grade VIII based on the assessment framework of ASER and Raven (2008) in the sampled schools of all four districts. In the next phase student individual level information on demographic, social and educational factors were captured. In the third phase of survey teachers, headmaster and school level information were collected. In the final stage primary data on socio-economic and demographic factors from the households of sampled students were collected.

Data for each phases of the survey was different by its nature. Both qualitative and quantitative information were captured to attain the objectives of the study. Initially data on standardized test score were collected by setting multiple choice questions on Arithmetic, English, and Intelligent Quotient with a comprehensive score of 30 marks inclusive of 10 marks from each of the subject segment. Uniform question pattern of standardized test were followed for all the sampled schools.

In the second phase, the study instrumented interview schedule (close ended) while conducting a personal interview with sampled students. Student individual level informations were inclusive of demographic, social, educational, and enabling aspects such as age, gender, ethnicity, number of siblings, duration of self study at home, duration of travelling to school etc.

In the third phase data was collected using scheduled questionnaire with a provision of separate set for teachers and headmaster. Other than data on school infrastructure and administration, information on enabling factors of school, teacher socio-economic and educational details were collected at this phase. In final phase of the survey, the study used interview schedule for gathering socio-economic details with respect to parents and families of sampled students in the study area. The primary data was collected via four phases during March 2017 till March 2018.

1.11 Analytical Framework

Present study used inferential statistics, regression analysis, non parametric and parametric techniques for analysis of data. Non parametric approaches such as Educational Development Index (EDI), Malmquist Productivity Index (M Index), and Data Envelopment Analysis (DEA) have been implemented in the analysis of secondary data. The study instrumented Kruskal Wallis test (H test) to capture inter-district disparities of students learning outcomes. Similarly, the determinants of students learning outcomes have been examined using parametric methods such as Ordinary Least Square (OLS), Qualtile Regression (QR), and Stochastic Frontier Analysis (SFA). SFA Present study used SFA for understanding the determinants of students learning outcome together with factors determining the technical inefficiency for students learning outcome. Censored Tobit model was estimated in order to study the marginal effects of predictors explaining technical inefficiency for students overall test scores.

1.11.1 Educational Development Index

The district level status of elementary education in Sikkim was examined through Educational Development Index (EDI). The Educational Development Index under the framework provided by Planning Commission (Government of India, 2001) was used in this study. The EDI index equation has been defined as,

$$\mathbf{I} = \frac{\sum_{i=1}^{n} \mathbf{X_i} \, [\sum_{j=1}^{n} \mid \mathbf{L_{ij}} \mid \mathbf{E_j}]}{\sum_{i=1}^{n} \, [\sum_{j=1}^{n} \mid \mathbf{L_{ij}} \mid \mathbf{E_j}]} \qquad (1)$$

Where, I is the index, X_i is the i^{th} indicator,

L_{ij} is the factor loading value of the i^{th} variable on the j^{th} factor,

E_j is the Eigen value of the j^{th}. EDI value ranges between 0–1, values closer to 1 indicate better performance.

The value of EDI is determined by four different components such as accessibility; infrastructure; teacher; and outcome. The different sub indicators related to respective components such as number of schools available per thousand population of age 6–14 years, student-classroom ratio, percentage of schools with drinking water facilities, percentage of schools with girls toilet, percentage of female teachers, pupil-teacher ratio, gross enrolment ratio, repetition rate, percentage of students passed in an annual examination etc. considered in the present study have been listed in Appendix A. Earlier studies of Motkuri (2005), Naik and Sharada (2013) and Samanta and Bajpai (2015) popularized EDI for measuring overall educational disparities at district or block levels in India.

1.11.2 Malmquist Productivity Index

For examining educational productivity growth across the different districts of Sikkim the Malmquist Index proposed by Caves, Christensen, and Diewert (1982) was used. The output-oriented Malmquist Index has been used for calculating the productivity change in the present study. Implementation of such technique has been popularized in the works of Caves, Christensen, and Diewert (1982) and Coelli, Rao, and Battese (1998). The output-oriented Malmquist Productivity Index focuses on winching output level with control in input use over two-time periods. The output-based Malmquist Productivity Index between time periods *t* and *t+1* can be defined as;

$$M_{t,\ t+1}\left(y^{t}, y^{t+1}, x^{t}, x^{t+1}\right) = \left[\frac{D^{t}\left(y^{t+1}, x^{t+1}\right)}{D^{t}\left(y^{t}, x^{t}\right)} \times \frac{D^{t+1}\left(y^{t+1}, x^{t+1}\right)}{D^{t+1}\left(y^{t}, x^{t}\right)}\right]^{\frac{1}{2}} \quad (2)$$

Or,

$$M_{2003-04,\ 2014-15}\left(y^{2003-04}, y^{2014-15}, x^{2003-04}, x^{2014-15}\right) = \left[\frac{D^{2003-04}\left(y^{2014-15}, x^{2014-15}\right)}{D^{2003-04}\left(y^{2003-04}, x^{2003-04}\right)} \times \frac{D^{2014-15}\left(y^{2014-15}, x^{2014-15}\right)}{D^{2014-15}\left(y^{2003-04}, x^{2003-04}\right)}\right]^{\frac{1}{2}} \quad (3)$$

Where, M is the Malmquist Productivity Index,

y^t is the output vector produced using the input vector x^t in time period t (2003–04),

y^{t+1} is the output vector produced using the input vector x^{t+1} in time period t+1 (2014–15),

D represents the distance function.

The first ratio is the Malmquist Index for the period 2003–04 which evaluates productivity change during two time periods with the initial year technology. The second ratio is the Malmquist Index for the year 2014–15 which evaluates the productivity alteration during two time periods using recent period technology as a benchmark. Growth, decline or stagnation of productivity depends on the value of M being greater than; less than; or equals to one respectively (i.e. $M > 1$; $M < 1$; $M = 1$). The technique was instrumental in prior investigations of Maragos and Despotis (2004), Castona and Cabanda (2007), Essid, Oullette, and Vigeant (2013) and Cebada, Pedraja, and Santin (2014).

1.11.3 Data Envelopment Analysis

Data Envelopment Analysis (DEA) is a non-parametric approach of measuring technical efficiencies of production units i.e. elementary schools in present study. DEA originally developed by Charnes, Cooper, and Rhodes in (1978) was instrumental in assessing relative efficiency of units assuming that the units operate under constant returns to scale (CRS). Later, Charnes, Cooper, and Rhodes (1981) extended the method of DEA to address the problem of efficiency measurement for decision making units (DMUs) with multiple inputs and multiple outputs in the absence of market prices. They coined the phrase decision making units in order to include non-market agencies like schools, hospitals, and courts, which produce identifiable and measurable outputs from measurable inputs but generally lack market prices of outputs (and often of some inputs as well). In this study, DMUs is synonymous with elementary schools across four districts of Sikkim.

The output-oriented approach is best suitable approach with regard to education given the differences in resource combination utilization (Tibenszkyne, 2007). Following Fare, Grosskopf, and Kokkelenberg (1989) and Fare, Grosskopf, and Lowell (1994) the output-oriented DEA linear programming model for technical efficient measure of output is given as;

Maximize,

$$\Phi$$

Subject to,

$$\Phi\, y_{i,m} \leq \sum_{i=1}^{m} z_i\, y_{i,m} \quad \forall\ m$$

$$\sum_{i=1}^{m} z_i\ x_{i,n} \leq x_{i,n} \quad \forall\ n$$

$$\sum_{i-1}^{m} z_i = 1$$

Where,

Φ is a scalar showing how much the output (students academic achievements) can be increased using inputs in a technically efficient configuration; $y_{i,m}$ is the amount of output m produced by ith school, number of 8th grade students passed in an annual examination in the schools of four different districts in the present analysis; $x_{i,n}$ is the amount of input n (or n × 1 inputs) used by ith school, inputs such as number of schools, number of teachers, school development grants, student-classroom ratio and pupil-teacher ratio in the present analysis; z_i is the weighting factors which is used in the transformation of the vectors of inputs and outputs into two single virtual scalars, the DEA model allows each DMU (Elementary Schools from each district) to choose the set of multipliers (weights, say z_0 and z_1) that permits it to appear in the best light.

The restriction $\sum_{i=1}^{m} z_i = 1$ is imposed to allow for variable returns to scale.

The technical efficiency of a DMU is computed using the engineering like efficiency measure of efficiency as ratio of virtual output produced to virtual input consumed such as:

$$Technical\ Efficiency = \frac{\sum weighted\ outputs}{\sum weighted\ inputs}$$

Such that the technical efficiency estimates becomes,

$$TE = \frac{1}{\Phi}$$

The measure of Φ ranges from 1 to infinity. Value of the ratio less than 1 resembles inefficiency in production. Numerous investigations have implemented the technique to measure technical efficiencies in education. Some of the studies which applied DEA for evaluating performance of schools offering elementary education are Barbetta and Turati (2003), Dutta (2012), Mahmudi, Ismail, Ananda, and Khusaini (2014) and Purohit (2016).

1.11.4 Kruskal-Wallis H test

It is a non-parametric statistical test based on the rank of data to identify distinctions between two or more sample groups within statistical inferences. Kruskal-Wallis or H test in this regard is an extension of Mann-Witney *U* test which is subject to comparison of two groups only. It is also considered as an alternative non-parametric approach to one-way ANOVA and is often termed as one-way ANOVA with ranks. Kruskal and Wallis (1952) provided the statistical specification of the test statistic as,

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{c} \frac{R_i^2}{n_i} - 3\ (N = 1) \qquad (4)$$

Where, *C* is a number of samples,

n_i is the number of observations in the ith sample,

N is $\sum n_i$, total number of observations of all the sample groups,

R_i represents the sum of ranks in the ith sample.

The hypothetical statement is a pre requisite condition prior to the calculation of H. higher the value of H greater will be the probability of rejecting null hypothesis. The test statistic follows χ^2 distribution and is independent of normality assumption. The application of H test is evident in the studies of Hassan et al. (2012), Poyraz, Gulten, and Bozkurt (2013) and Ozden and Yenice (2016).

1.11.5 Quantile Regression Analysis

Quantile regression (QR) analysis as pioneered by Koenker and Basset (1978) is a natural extension of Ordinary Least Square (OLS) regression model. The main difference between OLS and QR is that the OLS estimator aims to estimate the average effect of independent variable on the dependent, while QR estimation is about the effects at conditional median or quantiles. The latter provides more useful understanding about predictive nature of explanatory variables at different point of distribution of response variable. Additionally, QR technique is characterized with robust standard error estimates under non-normality of the random error term.

Give such advantages, present study implemented QR technique to understand the association and effect of inputs on sampled students test score in the study area. Such empirical strategy for analyzing the determinants of students learning outcomes will allow one to explore how the impact of predictors varies given the performer type. Numerous authors implemented the technique under education production function framework to evaluate the effects of determinants at different ends of the students performance distribution (See Eide & Showalter, 1998; Levin, 2001; Tian, 2006; Konstantopoulas & Chung, 2009; Giambona & Porcu, 2015).

The basic equation formation of quantile regression model (Buchinsky, 1998) can be written as,

$$y_i = x_i^{'} \beta_\tau + u_{\tau i} \qquad (5)$$

Where, y_i is the dependent variable, students test scores in the present analysis,

$x_i^{'}$ repesents K× 1 vector of predictors,

β_τ is slope coefficient given the point of quantile τ, 0.10; 0.50; 0.90 for present analysis,

$u_{\tau i}$ is the random error component at different percentiles of the quantile distribution,
τ is the conditional quantile,

Provided the predictors of an outcome variable, τ^{th} quantile regression model follows the expression as,

$$Quantile_\tau (y_i / x_i) = x_i^{'} \beta_\tau \qquad (6)$$

However, Koenker and Basset (1978) explained minimization of total absolute deviation of residuals from *y*, a requisite to acquire the quantile regression estimator. Thus, the QR equation of dependent variable with minimization of problem may be expressed with following expression.

$$\min_{\beta^\tau} \sum_{i:y_i > x_i\beta^\tau} \tau |y_i - x_i\beta^\tau| + \sum_{i:y_i < x_i\beta^\tau} (1-\tau)|y_i - x_i\beta^\tau| \qquad (7)$$

1.11.6 Stochastic Frontier Analysis

As an extension or improvement over conventional production function approach which inherit the assumption of producer to operate efficiently on production frontier, and any evidence of deviation from the frontier are explained by the random shocks. The stochastic frontier analysis (SFA) as developed by Aigner, Lowell, and Shmidst (1977) and Meeusen and Van Den Broeck (1977) introduced a fragmented form of traditional random error term which included a technical inefficiency component. This provided a theoretical and empirical basement on definitive relevance of inefficiencies over production inconsistencies. Thus, an empirical formation of basic stochastic frontier model can be expressed as,

$$y_i = f(x_i \beta)^{e^{u_i}} \qquad (8)$$

$$\forall, i = 1,2,\ldots\ldots,n \text{ and } u_i = \xi_i - \zeta_i$$

Where, y_i is an outcome or dependent variable,

x_i is a vector of inputs or explanatory variables,

β is a vector of parameters,

u_i comprises ξ_i which accounts for unobservable; and ζ_i accounts for technical inefficiency.

However, the logarithmic form of Eq. (1) will follow the following expression,

$$ln\ y_i = x^{'}\beta + \epsilon_i \qquad (9)$$

$$\epsilon_i = \vartheta_i - u_i \qquad (10)$$

Which assumes $\vartheta_i \sim iid\ N\ (0,\ \sigma_v^2)$, which is homoskedastic. ϵ_i is regarded as the composed error term. u_i is production inefficiency which is non-negative. Present study assumes $u_i \sim iid\ N^+\ (\mu,\ \sigma_u^2)$ following Stevenson (1980). Both the mentioned error components are independent of association with each other and with regressors.

The final specification of stochastic frontier model in the present study is under the assumption suggested by Battese and Coelli (1988). The study also specified the functional form of technical inefficiency model to identify the determinants those associated within the periphery of student learning outcome. Frontier model is as follows,

$$lny_i = \beta_0 + \sum_{j=1}^{29} \beta_j lnx_{ij} + \vartheta_i - u_i \qquad (11)$$

$\forall$ *i= 1,2,……, 408*

j=1,2,…,29

Where, lny_i is log of standardized test scores of the sampled 8th graders enrolled in sampled government junior high schools; β_0 is an intercept; β_j is a vector of input parameters; lnx_{ij} is the vector of inputs in logarithmic inclusive of aspects from student level, school level, teacher level, family and parental level; ϑ_i is the random error term for frontier model; u_i constitutes a non-negative technical inefficiency in the production.

Present study formulated $u_i \sim iid\ N^+ (\mu, \sigma_u^2)$, thus the functional regression form of the technical inefficiency is,

$$\mu_i = \delta z_i + w_i \qquad (12)$$

Where, μ_i is technical inefficiency scores for overall test score of sampled students, z_i is the vector of attributes; δ represents vector of estimated parameters, w_i represents unobserved random error term, assumed to be independently distributed with a positive half normal distribution such that, $w_i \sim iid\ N (0 , \sigma_w^2)$.

An empirical strategy using Stochastic frontier Analysis have been evident in numerous earlier investigations (See Dolton, Marcenaro, and Navarro, 2003; Conroy and Arguea, 2008; Misra, Grimes, and Rogers, 2012; Scippacercolaa and Ambra, 2013; Diaz, Castillo, and Cabral, 2016).

1.11.7 Tobit Regression Analysis

Tobit model as propounded by James Tobin (1958) also know by censored regression model is used to estimate the relationship between a dependent variable (Those are different from negative values) and independent variables. The regression model is subject to restrict the values of regressand given upper or lower limits. The basic empirical form can be expressed as:

$$y_i = X_i\beta + u_i \quad if\ RHS > 0, \qquad (13)$$

$$y_i = 0 \qquad if\ X_i\beta + u_i \leq 0 \qquad (14)$$

$$\forall\ i = 1,2,3, \dots \dots, n$$

Where, y_i is the dependent variable or technical inefficiency scores for overall test scores; X_i is the vector of independent variables inclusive of factors from student individual level, teacher level, school institutional level, and parental level; β is the vector of coefficients to estimate; u_i is an error term assumed to be independently distributed with mean as 0 and variance σ^2.

However, depending on the censoring of dependent variable Tobit model can be explained through different empirical expressions. It can be expressed with latent variable y^* (unobservable) which holds a linear conditioning with $X_i\beta + u_i$. Thus, censoring at upper or lower limits gives the following forms of Tobit model:

$$y_i = \begin{cases} y_i^* = X_i\beta + u_i & if\ y_i^* > y_L \\ y_L & if\ y_i^* \leq y_L \end{cases} \qquad (15)$$

Or,

$$y_i = \begin{cases} y_i^* = X_i\beta + u_i & if\ y_i^* < y_U \\ y_U & if\ y_i^* \geq y_U \end{cases} \qquad (16)$$

Where, y_L is censoring at lower limit; y_U is censoring at upper limit. Censored regression model of present study is based on Eq. (4). The latent variable y_i^* should not hold negative values and could be observed given the nature of censoring. Earlier studies by Conroy and Arguea (2008) and Santin and Sicilia (2015) estimated Tobit regression model to identify the potential predictors of educational inefficiency.

1.12 Organization of Chapters

Present study is organized with six chapters.

Chapter 1: Introduction

This chapter includes introduction of the study; specification of study area; status of learning outcomes at global, regional, and state levels; statement of the problem; significance of the study; objectives and research questions; secondary and primary data sources; sampling technique and design; and analytical framework of the study.

Chapter 2: Theoretical Foundation and Review of Literature

This Chapter covers the theoretical and conceptual framework of the study. In addition, it is inclusive of literature review with respect to multiple determinant aspects explaining students learning outcomes.

Chapter 3: Status of Elementary Education in Sikkim

This Chapter provides the insights about overall development, productivity, and efficiency of elementary education in Sikkim. Analytical exercises are based on secondary data for the period of 2003-04 to 2014-15.

Chapter 4: Inter-District disparity in students learning Outcomes at government junior high schools of Sikkim

This Chapter covers statistical analysis of inter-district variation in test scores of sampled 8^{th} graders. It also includes summary statistics results of primary data used in the regression analysis.

Chapter 5: Determinants of Students Learning Outcomes

This Chapter describes results of regression analysis motivated to identify the determinant factors of students learning outcomes and their educational inefficiencies in Sikkim. Interpretation of empirical findings is inclusive of comparative evaluation with prior investigations.

Chapter 6: Conclusions and Policy Implications

This Chapter makes a conclusive discussion and policy recommendations about overall findings given the research objectives. Research limitations and future research implications are presented in last section of the Chapter.

Chapter 2

Theoretical Foundation and Review of Literature

This chapter covers the theoretical framework and conceptual issues. A detailed survey of supporting literature has also been summarized in this chapter.

Present chapter comprises of six sections and two sub sections. Section 2.1 covers the theoretical background of learning outcomes, while the conceptual issues relating to educational production function, and its relevance, limitations being covered in Section 2.2. Section 2.3 discussed the conceptual understanding relating to efficiency estimation in economics, while Section 2.4 presents analytical framework for capturing learning outcome. The studies for identifying the determinants of learning outcome has been covered in Section 2.5. The research gap in the direction of present study is summarized in the final section of this chapter.

2.1 Learning Outcome

Jenkins and Unwin (1996) advocated learning outcomes as the statements of what is expected that a student will be able to do as a result of a learning activity. Again, as per Allan (1996), learning outcomes represent what is formally assessed and accredited to the student in the form of educational inputs such as curricula which shift the emphasis from input and process to the celebration of student learning outputs. Similarly, Morss and Murray (2005) also connoted learning outcomes as, specific statements of what students should know and be able to do as a result of learning. The theories defined learning outcomes as a result or product which is a function of a learning process.

The provenance of learning approaches has not been particularly edified historically. However, the origins can be loosely traced to be around 19th and 20th century with the approaches developed through the work of Russian psychologist Ivan Pavlov. Pavlov (1903) propounded the approach of classical conditioning. The key element in classical conditioning is an association. It means that if two stimuli repeatedly experienced together, they will become associated. For example, if a student frequently encounters unpleasant stimuli in Mathematics class such as unfriendly teachers, difficult questions, and a lot of homework, he/she may learn to dislike Mathematics. Following this, the psychologists Watson (1913) and Skinner (1938) pioneered the 'behaviorist approach' that explained human behavior is determined and shaped by the environment. Behavior, environment, and personal factors interact to influence learning. They influence and are influenced by each other. For example, a teacher's feedback (environment) can lead students to set higher goals and these goals will motivate students to put more efforts (behavior) in their studies.

Bloom, Engelhart, Furst, Hill and Krathwohl (1956) proposed six major levels arranged in a hierarchy that determine the cognitive outcomes of the students under the 'Cognitive approach'. Knowledge which is an ability to recall or remember facts; Comprehension which is an ability to understand and interpret learned information; Application, an ability to use learned material in new situations; Analysis as an ability to compare and contrast the information; Synthesis which resembles an ability to put parts together; and Evaluation which is an ability to judge value of material for a given purpose. The model was later revised by Anderson and Krathwohl (2001) where knowledge being lowest in the taxonomy. The cognitive domains were revised into remembering, understanding and applying at the lower level and analyzing, evaluating and creating at the higher level. Similarly, the Social learning theory focuses on how people learn by observing and imitating others (Bandura & Walters, 1963). To motivate learning using this approach, a teacher may use constructive measures to make sure students see the positive behaviors which will lead to positive outcomes.

In Summary, Learning Outcomes resembles the results of learning which are usually defined in terms of a mixture of knowledge, skills, abilities, and understandings that an individual will attain as a result of his or her successful engagement in a particular set of experiences stimulated by various factors. Hence, on such basis of understanding learning outcomes can be assumed as a result of linear and causal interaction between inputs - learning process - and exclusive outputs or outcomes as a direct consequence and evidence of the foregoing process.

2.2 Education Production Function Approach

Education production function (EPF) approach focuses on establishing causal relationships between school resource inputs and school outcomes, where the school acts as a primal producer of education services. More or less the concept is identical to the economic understanding of production as perceived in microeconomic theory, but producers are independent of profits under EPF. Given the scarce resources, educational institutions will try to process the best possible combination of inputs for better educational outcome. The conceptual background of EPF approach provides a coherent understanding about the standard mechanism of educational production process (Monk, 1989). However, such production process is not confined within schools or academic elements. The mechanism and outcome is attributed by non-academic factors as well. Factors such as student socio-economic backgrounds, parental literacy, teacher socio-economic characteristics, and peer influences are also related with student cognitive development. Coleman Report[5] (1966) was one amongst the pioneering attempts to analyze the functional relationship between inputs those related with school and non-school peripheries and output under educational production function approach. The report basically considered school level factors, teacher level factors, material facilities and curriculum, and student socioeconomic background and claimed the effect of family related factors relatively substantial than other aspects. Similarly, Bowles (1970) suggested environmental aspects of home, neighborhood, peers, and school to be crucial in cognitive developmental process.

Successively, many studies had implemented the approach of EPF while capturing the linear relationship between input and output. Some of the earlier studies based on education production function approach were Hanushek (1971), Polachek, Kniesner and Harwood (1978), Hanuhek (1986), Goldhaber and Brewer (1996); Tremblay, Ross and Berthelot (2001), Kingdon and Teal (2002), Suryadarma et al., (2006), Aturupane, Glewwe and Wisniewski (2006), Kasirye (2009), Hassan and Rasiah (2011), Muvawala (2012) and Raj Sen, Annigeri, Kulkarni and Revankar (2015) (2015). The basic functional framework of education production function model can be specified as follows.

$$TS = f\,(SF, FF, TF, SL)$$

Where,

TS stands for test scores of students
SF stands for vector of student level control variables
FF stands for vector of family level control variables
TF stands for vector of teacher level control variables
SL stands for vector of school level control variables

Despite its popularity, the approach is characterized with inconsistencies in conceptual and analytical basis (Hanushek, 1979). The effect of inputs varies given

[5]Coleman et al., (1966), Equality of Educational Opportunity, National Centre for Educational Statistics, Report number OE-38001.

the socio-economic background and cognitive capabilities of the student. In such context it creates arbitration while generalizing the impacts of predictors. Bowles (1970) argued the technical failure of EPF lies in the inappropriate considerations of less effective variables within input indexes.

However, given the limitations, EPF have been widely instrumental in empirical investigations while identifying the linear relationship and effectiveness of various input factors on student learning outcome.

2.3 Efficiency Analysis in Economics

Farrell (1957) developed analytical and conceptual idea for efficiency analysis. His concept of modern efficiency measurement inclusive of multiple inputs was based on the works of Koopmans (1951) and Debreu (1951). He proposed that the firm's efficiency has two components: technical efficiency and allocative efficiency, where the former reflects an ability of a firm to maximize its output given the set of inputs while the latter replicates firm's ability to optimize the proportion of inputs used provided the respective prices of inputs. Total economic efficiency is obtained by combining these two measures.

2.3.1 Input-orientated Measures

Farrell (1957) has used a simple example to demonstrate his ideas involving firms which use two inputs (x_1 and x_2) to produce a single output (y), by assuming constant returns to scale. Knowledge of the fully efficient firm's unit isoquant permits the measurement of technical efficiency which is represented by SS' in Fig. 1.0. If the point P reflects the quantities of inputs used by a given firm, which indicates that without reducing output this QP amount of input could be reduced proportionately.

This inefficiency can be expressed by the QP/0P, which represents the percentage by which all inputs could be reduced.

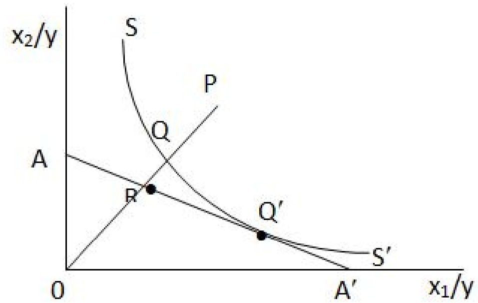


Fig. 1.0 Technical and Allocative Efficiencies.

The most common way to measure the input technical efficiency (TE_I) is to be the ratio

$$TE_I = 0Q/0P \qquad (17)$$

Eq. (17) can also be articulated as (1 - QP/0P). The value of these lies between zero and one, and consequently it provides an indicator of the degree of technical inefficiency of the firm. The fully technically efficient firm takes the value of one. For example, the point Q, the technically efficient point as it lies on the efficient isoquant SS′. If the line AA′ represents input price ratio in Fig. 1.0, the allocative efficiency may also be calculated. The allocative efficiency (AE) of the firm operating at P is defined to be the ratio

$$AE_I = 0R/0Q \qquad (18)$$

Since the production costs can be reduced by the distance RQ if the firm could produce at both the allocatively and technically efficient point Q′, instead of at allocatively inefficient but the technically efficient point Q.

The total economic efficiency (EE) is defined to be the ratio

$$EE_I = 0R/0P \qquad (19)$$

Where, further costs can be reduced by the distance RP. It can be noted that the overall economic efficiency is the result of the product of both allocative and technical efficiency. The overall economic efficiency is

$$(TE_I)(AE_I) = (0Q/0P)(0R/0Q) = (0R/0P) = EE_I \qquad (20)$$

Note that all three measures are bounded by zero and one.

2.3.2 Output-orientated Measures

The above measure of input-orientated technical efficiency addresses the question: "without changing the output quantities produced, by how much can input quantities be reduced proportionally"? The question could alternatively be asked "without varying the input quantities used, by how much can output quantities be proportionally expanded"? This output-orientated measure is an opposed measure to the input-oriented measure discussed above. A simple example can illustrate the difference between the input- and output-orientated measures involving one input and one output. This is depicted in Fig. 2.2(a) where an inefficient firm is operating at the point P and f(x) represented decreasing returns to scale technology. Here, the Farrell the output- orientated measure of TE would be equal to the ratio CP/CD while input-orientated measure of TE is AB/AP. In presence of constant returns to scale, the input- and output-orientated measures will only provide equivalent measures of technical efficiency, whereas it will be unequal in existence of decreasing or increasing returns to scale (Fare and Lovell, 1978). Fig. 1.1 is drawn by depicting the constant returns to scale case for any inefficient point P we care to choose. Where we observe that AB/AP=CP/CD.

Output-orientated measures further can be considered in the case where production involves two outputs (y_1 and y_2) and a single input (x_1). Again, it is assumed that constant returns to scale prevail, we can represent the technology in two dimensions by a unit production possibility curve. As an example of is Fig. 1.2 is drawn where the line ZZ′ is the unit production possibility curve and the point A is corresponding to an inefficient firm. Note that as ZZ′ represents the upper bound of production possibilities, the inefficient point A lies below the curve.

The output-orientated efficiency measures of would be defined as follows. In Fig. 1.2 the technical inefficiency is represented distance AB. That is, without requiring extra inputs, the amount by which outputs could be increased. Hence a measure of output-orientated technical efficiency (TE_O) is to be the ratio,

$$TE_O = 0A/0B \qquad (21)$$

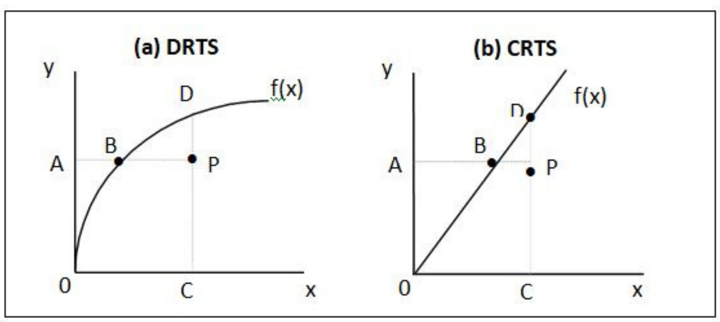


Fig. 1.1 Input & Output-Oriented Technical Efficiency Measures and Returns to Scale.

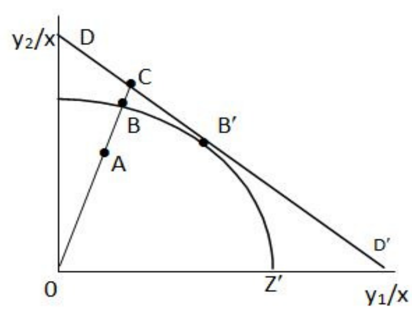


Fig. 1.2 Technical and Allocative Efficiencies from an Output-Orientation.

The iso-revenue curve DD′ can be drawn by assuming that we have the price information and the allocative efficiency is to be

$$AE_O = 0B/0C \qquad (22)$$

This has a revenue increasing interpretation (similar to the cost reducing interpretation of allocative inefficiency in the input-orientated case). Furthermore, the product of these two measures can define as the overall economic efficiency

$$EE_O = (0A/0C) = (0A/0B)(0B/0C) = (TE_O)(AE_O) \qquad (23)$$

Again, the values of all these three measures are bounded by zero and one.

All of the measures of efficiency are measured along a ray from the origin to the observed production point. Therefore, they embrace the relative proportions of outputs (or inputs) constant. Unit invariant is an advantage of these radial measures. That is, changing the units of measurement (e.g. measuring quantity of labour in person hours instead of person years) will not change the value of the efficiency measure. It may be argued for a non-radial measure, such as the shortest distance from the production point to the production surface, but this measure will not be invariant to the units of measurement chosen. Changing the units of measurement in this case could result in the identification of a different "nearest" point.

Input and output-orientated technical efficiency measures of Farrell can be shown to be equal to the distance functions of input-output discussed in Shepherd (1970). It becomes more when we discuss the use of DEA methods in calculating Malmquist indices of TFP change in this observation. Many different methods have been used to estimate the frontiers over the past 40 years. The two principal methods are: Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) which involve mathematical programming and econometric methods respectively. Graphical replication for measures of technical efficiency under input and output-orientation following Fare and Lovell (1978) and Fare, Grosskopf and Lovell (1985) are evident in Figs. 1.3 and 1.4.

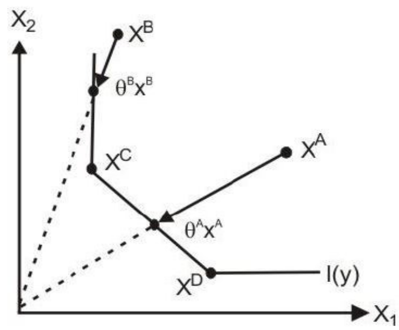


Fig. 1.3 Input-Oriented Technical Efficiency.

In Fig. 1.3, input vectors x^A and x^B posses a scope of contraction on radial without losing their potential of producing the output, whereas x^C and x^D producing output vector y lies in the input isoquant I(y) which cannot be arranged in a former sequence. Thus, a firm using input vectors x^C and x^D will attain greater technical efficiency relatively until x^A and x^B are scaled radially on isoquant I(y) as $\theta^A x^A$ and $\theta^B x^B$.

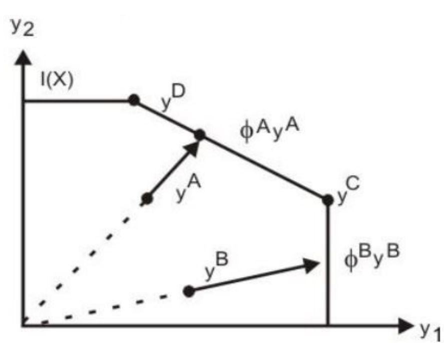


Fig. 1.4 Output-Oriented Technical Efficiency.

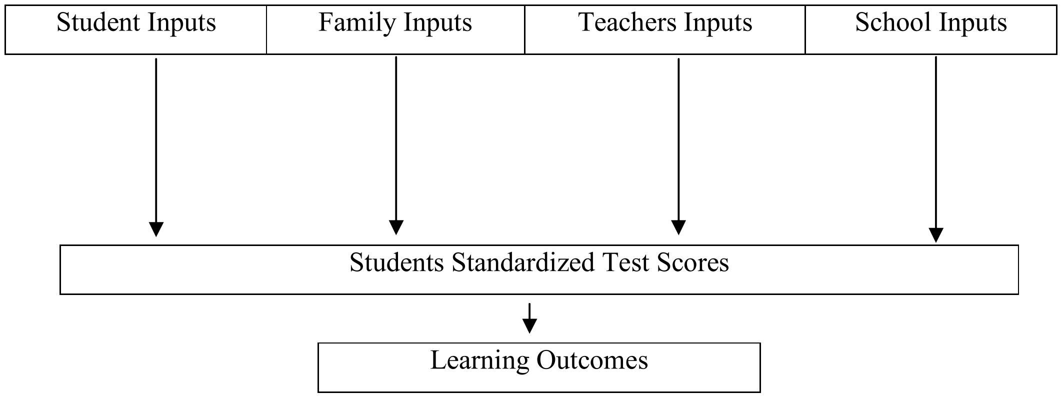
On the other side, Fig. 1.4 shows radial scaling of output vectors y^A and y^B to $\phi^A y^A$ and $\phi^B y^B$ on I(x) the best step to realize the maximum technical efficiency as like y^C and y^D in an output-orientation of production mechanism.

An initial attempt of measuring technical efficiency in education production was evident in the study of Levin (1974), wherein the author emphasized variation in educational outcomes are attributed by the differences in efficiency components of the educational institutions or schools. Education institutions (such as schools) are seen as multi-product organizations producing an array of outputs from various inputs. Frontier estimation methods can be used to estimate cost functions or production frontiers for these institutions from which efficiency estimates can be derived (Johnes, Portela, & Thanassoulis, 2017). Subsequent investigations in this direction were initiated by Colbert, Levary and Shaner (2000), Worthington (2001), Johnes (2004), Gimenez, Prior and Thieme (2007), Emrouznejad, Parker and Tavares (2008), Johnes (2008), Worthington and Lee (2008), Woessmann (2008), De and Kortelainen (2013) and Johnes (2014).

2.4 Measuring Learning Outcomes

Breslow (2007) identified two measures of assessing learning outcomes, the direct and indirect measures. The indirect measure includes the assessment of learning outcomes using the data of retention rates, graduation rates, curriculum, and a number of students progressing to advanced degrees. On the other hand, a direct measure of assessment is done by conducting standardized tests. Present study has applied the direct measure of assessment to identify the learning outcomes of the students represented by the standardized test scores. Hence, under the reference of theoretical understanding, present study considered learning outcomes as an output represented by standardized test scores. The explanatory variables or inputs determining learning outcomes are grouped into four sets of variables namely, student inputs, family inputs, teachers' input and school inputs.

Framework



2.5 Review of Literature

In general, learning outcomes resembles the abilities or capabilities of the students replicated in the form of test scores, examinations scores etc. determined by various constituents. A number of studies has been initiated over decades to understand the determinants of students learning outcomes using educational production function approach. Studies, as reviewed, reveal primarily four main dimension of input factors in educational production. Components from school, teacher, student individual level, and household or parental level were identified aspects of student learning outcome. Following section made an attempt to cover some existing studies discussing such determinants.

2.5.1 Socio-economic Factors

On understanding the impact of socio-economic factors on learning outcomes Coleman et al., (1966), White (1980), Hanushek (1986), Gross (1993), Hanushek and Luque (2003), Duncan and Magnuson (2005), Aturupane et al., (2006), Sun et al., (2009), Altschul (2012), Ogunshola and Adewal (2012), Ahmar and Anwar (2013), Giambona and Porcu (2015) and Li and Qui (2018) found the positive relationship between socio-economic factors and students learning outcomes. The household expenditure, mothers' age at child's birth, household incomes were identified to have a positive impact on academic performance of the students. Gender, students from the minority community, poor sanitation at home were observed as a negative predictor. Parental involvement also plays a significant role in explaining the effects of socio-economic components on academic achievements (Altschul, 2012). The significant direct association of family income on student academic achievement in China was documented in the study of Sun et al., (2009). Similarly, using probit model Garcia (2014) found family resources including socioeconomic status, cultural, and social capital to have a positive and significant effect on educational achievements amongst the students of Tatarstan. However, disparities in outcomes were observed amongst the boys and girls as well as amongst the Tatar and Russian speaking students.

2.5.2 Teachers Level Factors

Studies by Dildy (1982), Goldhaber et al., (1996), Kingdon and Teal (2002), Rockoff (2004), Kingdon and Teal (2007), Adeyemi (2008), Bloom (2008), Holmund and Sund (2008), Lam et al., (2009), Neugebaner, Helbig and Landmann (2011), Rawal and Kingdon (2010), Khalid et al., (2011), Escardibul and Mora (2013), Robert, Owiti and Ongati (2013), Winters et al., (2013) and Lodewijiks (2015) made an attempt to understand the impact of teacher level factors on learning outcomes of the students. Amongst various components of teacher, Dildy (1982) emphasized professionally trained teachers to provide a constructive influence on student academic performances. On contrary, the covariate related to teacher training was a negative predictor of student test score in the analysis of Rawal and Kingdon (2010).

Higher academic attainment of teachers was found to have a positive relation with the test score of students in Mathematics and Science (Goldhaber et al., 1996). The study emphasized specific training of teachers is more important than the teachers' ability. No significant relationship between teacher salary and student achievement in public schools of India while the magnitude of increment on students academic performance was observed to be highly supported by the increment in teachers' salaries at private schools (Kingdon et al., 2002).

Teaching experience of the teacher claimed to have a positive significant relationship with students' Mathematics computation test scores Rockoff (2004). However, the covariate of the same was observed insignificant with the test scores of conceptual Mathematics. The positive relationship between teaching experience and learning outcomes of the students has been found in the study of Adeyemi (2008). The importance of teacher gender on explaining learning outcomes under teacher level factors have been evident in many studies in this direction. Amongst different control variables the academic achievement in mathematics was observed to be positively influenced by gender (female teacher) who teaches mathematics in the year before (Escardibul et al., 2013). In line with the findings of Escardibul et al., (2013), studies by Lam et al., (2010), Khalid et al., (2011), Robert et al., (2013), and Winters et al., (2013) advocated the positive effect of female teachers on students learning in general. However, the investigations of Bloom (2008), Holmund and Sund (2008) and Neugebauer et al., (2011) suggested the relationship to be insignificant. Other than teacher gender and teaching experience Eberts and Stone (1988) claimed principal administrative experience as positive predictor of student cognitive outcome. The study found significant direct relationship between the covariate and student achievement. Nevertheless, the observation of Brewer (1993) and Masci et al., (2018) confuted with Eberts et al., (1988).

Yamarik (2007) found the positive impact of cooperative learning teaching practices on the test scores of the students. It is not only the teachers' teaching experience, salaries, gender, and academic achievement levels that have been identified as the determinants of teachers' side factors. Social and religious background of the teacher were also found to influence the learning outcome of the students (Rawal et al., 2013); Raj et al., 2015). Homogeneity in the caste and religious background of teacher and student claimed to positively influence the test scores or learning outcomes of students (Rawal et al., 2013). In addition, Lodewijiks (2015) argued younger teacher to positively determine student learning outcomes.

2.5.3 Parental and Household Level Factors

Some studies which have been initiated to understand the role of parental level factors in determining learning outcomes of the students found that parental educational qualification, occupational status, and parent age positively and significantly determines the learning outcomes (Hanushek, 1986; Dolton, Marcenaro, & Navarro, 2003; Hassan & Rasiah, 2011; Ogunshola & Adewale, 2012; Omolade et al., 2014; Raj et al., 2015). Contrary to this, parental educational background and magnitude of parental involvement were not the significant determinants of learning outcome in the findings of Rout and Sahoo (2014). Similarly, the investigations of Henderson and Mapp (2002) and Pong, Hao and Gardner (2005) observed parent-school communication to effectively supplement the academic performance of student. However, the findings of Chu and Williams (1996) suggested the effect to be minimal.

Scholars such as Blake (1989), Black, Devereux and Salvanes (2004), Kean (2005) and Karwath, Relikowski and Schmitt (2014) advocated family size as an important determinant of student academic performances. These studies further suggested over congestion or larger family size hampers learning environment of children at home which ultimately could result in lower academic outcomes.

2.5.4 School Level Factors

Determinants of school and class level factors also have been identified by a collection of studies. Students of privately affiliated schools with well-equipped infrastructure facilities were found to be a better performer in academics compared with students of public schools with poor infrastructural facilities in Pakistan (Javaid, Mussadiq, & Sultan, 2012). Similarly, Srivastava and Singh (2014) found school learning environment to positively influence the academic outcomes of the students under which type of school plays a significant role. Peer level influences have also been identified to determine academic performance along with school and home learning environments (Korir & Kipkemboi, 2014). After reviewing around 100 studies on developing countries, Fuller and Clark (1994) advocated strong relationship between school resources and student outcomes. Similarly, school type and school location also have been identified as a positive predictor of students learning by Tremblay et al., (2001). Suryadarma et al., (2004), Javier and Marcelo (2011), Sprietsma (2012), Raj et al., (2015), Banerjee et al., (2007) and Lee et al., (2017) emphasized school infrastructural facilities, proportion of trained teachers in schools, classroom qualities, pupil teacher ratio, sanitation facilities as the determinants which positively and significantly determines the learning outcomes of the students. In line with this finding, Oweeye et al., (2011) stated school facilities as a potent to high academic achievements; provision of proper functional and adequate material resources should prevail in order to enhance teaching and learning process. On the other side, Hanushek (2003) on the basis of an extensive review of empirical studies that focused on input and output relationships concluded that school inputs such as teacher salaries and classroom size did not matter in relation to student test score performance. He argued it is mainly family background in terms of parental income and education that are most important determinants of student performance.

Likewise, the importance of classroom and school enrolment has been highlighted in many earlier studies (Eide & Showalter, 1998; Levin, 2001; Rivkin et al., (2005); Jackson & Page, 2013; Welsch & Zimmer, 2016), wherein the investigations of Rivkin et al., (2005) and Jackson and Page (2013) emphasized lower class size to be a greater utility for better learning environment within classroom which further helps to improve overall cognitive outcomes of the students. On the other side, authors such as Eide and Showalter (1998), Levin (2001) and Welsch and Zimmer (2016) argued greater positive association of school size on scholastic achievement of students.

2.5.5 Student Individual Level Factors

In an attempt to identify the student level factors Kingdon et al., (2002) found that students' gender as male, abilities, books availability at home to have a positive correlation with learning outcomes. The findings of Kingdon et al., (2007) and Kuecken and Valfort (2013) also suggested textbook concentration at home to positive determine student scholastic outcome. Similarly, Aturupane et al., (2006) identified the age of the students, seniority in birth, hours of tutorial classes, pre-schooling status of the students, hours of studying at home, class attendance status to have a positive relationship with the students' test scores. Along with these factors the role of Parent-Teacher association for child's academic development has been emphasized by Singh, Gupta and Thakur (2014). The study found a positive correlation between Parent-teacher association status and students' academic development. Byamugisha and Ssenabulya (2004) found that the attendance patterns of pupils significantly impacted on the learning achievement as well as the quality outcomes. Likewise, a group of scholars (Refer Schmidt, 1983; Marburger, 2001; Dolton, Marcenaro, & Navarro, 2003; Carvin, 2006; Stance, 2006; Chen & Lu, 2009; Grave, 2011; Metcalfe, Burges, & Proud, 2011; Arulampalam et al., 2012; Ng et al., 2016; Lukkarinena, Koivukangasa, &Seppala, 2016; Viera, Viera, & Raposo, 2018) suggested student related components such as classroom attendance, self study time, and internet accessibility plays pivotal role in explaining learning outcome.

Additionally, the role of educational interventions on improving students' learning have been highlighted in the studies of Muralidharan et al., (2011) and Raj et al., (2015). These studies confirmed the positive effect of efficient public interventions on learning outcomes of the students. Effective and under-ambitious educational interventions help to solve the problem of low learning outcomes in developing countries (Pritchett et al., 2012).

2.6 Research Gap

The review of existing literature at global and national level identified several factors determining learning outcomes, but studies examining the influence of some other major components related to academic, peers, teacher, and school was minimal. Factors such as pupils' achievement in previous grade; no of classes daily or weekly; number of academic assignments given by a teacher; teacher mobility in terms of number of transfer; number of extracurricular activities were rarely evident in prior empirical investigations. Moreover, the literature is limited with the evidence of how the input from different aspects predicts the academic achievements of students given their cognitive abilities. Additionally, prior investigations were ambiguous over the findings on the effect of some important factors such as class size, teacher gender, teacher training, student age, student gender, and gender of head master. Present study shall try to bridge such research gap.

Chapter 3

Status of Elementary Education in Sikkim

Present chapter is consists of four sections. The status of EDI has been covered in Section 3.1; educational productivity growth in Section 3.2; educational efficiency estimates have been discussed in Section 3.3; and finally the conclusion of the chapter is covered in Section 3.4.

3.1 Status of Educational Development

As per the annual report EDI (2012–13) published by DISE, the state of Sikkim, Lakshadeep, Pondicherry and Tamil Nadu were placed amongst the top performing states in India in terms of educational development. The district level EDI of Sikkim for the period of 2004–05 to 2014–15 at district level is reported in Table 3.1.

The educational development in terms of EDI with regard to elementary level schooling has been observed to be less satisfactory in East district of Sikkim compared with rest of the districts of the state. Despite sparsely populated and less administrative importance the value of EDI was observed higher in North district of Sikkim.

Table 3.1 District-wise Educational Development Index in Sikkim (2004–05 to 2014–15).

Year	East	West	North	South
2004–2005	0.29	0.57	0.73	0.47
2005–2006	0.34	0.53	0.82	0.60
2006–2007	0.27	0.47	0.82	0.69
2007–2008	0.31	0.53	0.86	0.62
2008–2009	0.41	0.48	0.80	0.44
2009–2010	0.36	0.51	0.85	0.58
2010–2011	0.53	0.44	0.66	0.58
2011–2012	0.43	0.55	0.73	0.83
2012–2013	0.54	0.45	0.56	0.59
2013–2014	0.63	0.40	0.58	0.52
2014–2015	0.31	0.44	0.78	0.82
Average	0.40	0.49	0.74	0.61

Source: Self-estimates based on data compiled from DISE (2004–05 to 2014–15).

Overall, the district of North and South Sikkim could be considered as the top two developed districts in terms of accessibility, infrastructure, teacher status, and outcome at elementary level schooling, while the East and West districts of Sikkim have been observed to be lagging behind in all such respect during the study period (Refer to Table 3.1). However over the years the development index value of elementary education has been observed to be unstable amongst all four districts over the years which suggest inconsistencies in terms of number of schools, enrolment and teacher level factors. Similar observation with regard to declining rate of enrolment at government schools had been reflected in the studies of Singh and Sridhar (2002), Sharma and Tripathi (2016) and Subba and Bhutia (2016).

3.2 Educational Productivity Growth

The estimated value of Malmquist Index reported in Table 3.2 reflects that the East and West district of Sikkim registered a negative growth[6] in educational productivity change during the study period. The rate of positive change was found to be higher in South district of Sikkim with a growth of 20.8% during the study period, while the highest rate of productivity decline has been intense in East Sikkim amongst all the districts. The average educational growth was decelerating at the rate of 10.7% over the study period.

The educational productivity change of a Sikkim has been observed to be positive over the considered years. The productivity growth of South and North districts of Sikkim was found to be satisfactory when compared with East and West districts of Sikkim.

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[6] East Sikkim TFP growth rate = ((0.893-1)$\times$ 100)= -10.7 %.
West Sikkim TFP growth rate = ((0.962-1)$\times$ 100)= -3.8 %.
North Sikkim TFP growth rate = ((1.161-1)$\times$ 100)= 16.1 %.
South Sikkim TFP growth rate = ((1.204-1)$\times$ 100)= 20.4 %.
Sikkim TFP growth rate = ((1.047-1) $\times$ 100)= 4.7%.

Table 3.2 District-wise educational/total factor productivity index (2003–04 to 2014–15)

District	Educational Productivity	Rank
East	0.893	4
West	0.962	3
North	1.161	2
South	1.204	1
Sikkim	1.047	

Source: Self-estimates based on data compile from DISE (2003–04 to2014–15).
Note: Malmquist Index averages are geometric means.

Overall, the result (Table 3.2) suggests that the process of transforming given educational inputs represented through accessibility, infrastructural, and teacher factors into output in terms of student academic outcomes has been found to be more effective on South and North districts of the state under the study period. In contrast, Jaforullah (2010) studied the productive performance of Secondary Schools in New Zealand over a period of 1997–2001 using Malmquist Productivity Index. The study reported 113 out of 333 schools to be improved on productivity changes during the reference period. Similarly, Cadavid, Gomez, and Guijarro (2017) analyzed productivity change of Higher Educational Institutions of Colombia during 2011–12 using data from Ministry of National Education. The study found decrease in overall productivity as 23 out of 33 sampled Universities exhibited a negative TFP (Total Factor Productivity) growth rate.

3.3 Inter-district Educational Efficiency

Present study attempted to analyze the efficiency of the elementary schooling system while transforming given set of inputs such as number of schools, school development grants, number of teachers, student-classroom ratio, and pupil-teacher ratio on output (i.e. number of students passing in an annual examination of grade VIII) through non-parametric approach at four districts during the period of 2003–04 to 2014–15.

Table 3.3 District-wise technical efficiency scores for number of students passed (2003–04 to 2014–15)

YEAR	EAST	WEST	NORTH	SOUTH	SIKKIM
2003–2004	1.00	0.87	0.59	0.80	0.82
2004–2005	1.00	0.62	0.53	0.56	0.68
2005–2006	1.00	0.58	0.52	0.62	0.68
2006–2007	1.00	0.64	0.52	0.72	0.72
2007–2008	1.00	0.68	0.49	0.71	0.72
2008–2009	1.00	0.83	0.49	0.79	0.78
2009–2010	1.00	0.72	0.72	0.70	0.78
2010–2011	1.00	0.70	0.71	0.60	0.75
2011–2012	1.00	0.80	0.92	0.80	0.88
2012–2013	1.00	0.85	0.78	0.85	0.87
2013–2014	1.00	0.97	0.86	0.92	0.94
2014–2015	1.00	0.91	0.76	0.83	0.88
Average	1.00	0.76	0.66	0.74	0.79

Source: Self-estimates based on data compile from DISE (2003–04 to2014–15).
Note: Technical Efficiency Scores are calculated under output–oriented VRS assumption of DEA.

The study found East Sikkim to be the most efficient district amongst all. The efficiency score of 1.00 was consistent during the study period (Table 3.3). The efficiency scores of East district have been observed to be higher than the all state scores as well throughout the reference period. The average difference between the technical scores of East and all Sikkim was 0.21. Amongst all the districts North Sikkim has been identified to be less efficient while transforming the educational inputs into output.

Relatively the districts of West, North, and South have been less efficient that if they would employ their resources efficiently, they could increase the retention rate by 24%, 34%, and 26% respectively. On an average, each of these districts was short of 0.24, 0.34, and 0.26 points with East Sikkim on technical efficiency aspects.

Similar attempt has been made in order to examine the efficiency of same set of inputs on output in terms of number of students passing with 60% or above marks amongst four districts. Interestingly, East Sikkim again observed as the most efficient district with regard to efficient utilization of given inputs (Table 3.4). The worst performer in terms of efficiency was North and South Sikkim sharing identical average technical efficiency score of 0.49. However, indication of improvement has been observed in the scores of South Sikkim in later periods with relative to the initial periods.

Table 3.4 District-wise technical efficiency scores of students passing with 60% (2003–04 to 2009–10).

YEAR	EAST	WEST	NORTH	SOUTH	SIKKIM
2003–2004	1.00	1.00	0.56	0.78	0.83
2004–2005	1.00	0.44	0.27	0.45	0.54
2005–2006	1.00	0.38	0.51	0.50	0.60
2006-2007	1.00	0.43	0.58	0.24	0.56
2007–2008	1.00	0.47	0.47	0.26	0.55
2008–2009	1.00	1.00	0.68	0.32	0.75
2009–2010	1.00	0.29	0.36	0.90	0.64
Average	1.00	0.57	0.49	0.49	0.64

Source: Self-estimates based on data compile from DISE (2003–04 to2014–15).
Note: Technical Efficiency Scores are calculated under output–oriented VRS assumption of DEA.

While analyzing the inter-state efficiency in elementary education of Indian states Dutta (2012) found states like Delhi, Kerala, Tamil Nadu, and Nagaland as efficient performers within elementary education frontier during 2007–2008. Similarly, an investigation of Purohit (2016) obtained the elementary schools in urban areas of states like Andhra Pradesh, Maharashtra, and West Bengal maintaining higher efficiency while transforming educational resources into outcomes during 2012–13. The study argued higher budgetary allotments for elementary education responsible for better efficiency in the states like Maharashtra and West Bengal. Overall, the literature signifies variation in developmental aspects to attribute in educational efficiencies. Findings of present study concurs the literature in this respect.

3.4 Conclusion

There seems to be variations in terms of overall educational development and educational productivity. The trend in EDI for all four districts has been more or less inconsistent. However, positive tendencies in the recent years have been observed in case of North and South district, while the tendencies in EDI over these years from 2004–05 to 2014–15 were negative in East and West Sikkim. The district of North and South have been observed to be a better performer in terms of overall educational development on an average whereas West and East were found to be lagging behind for the overall study period. Educational productivity growth in terms of TFP was satisfactory for North and South districts during period of study. The educational productivity of East and West district was less satisfactory compared to other two districts. The districts of Sikkim which are educationally advance as per EDI values were found to be educationally productive as justified by their respective productivity growth rate during the reference period. The status on school availability, schools with drinking water facilities, gender specific toilet facilities, student-classroom ratio, pupil-teacher ratio, and concentration of professionally trained teachers were observed to be better in North and South districts of Sikkim as compared with the other two districts. Such pattern in development and productivity of elementary education amongst the districts was supplemented by accessibility, infrastructure and teacher level factors. Interestingly, despite having administrative importance and population density the East district was lagging behind both in terms of EDI and TFP growth which might be attributed by quantitative aspects such as the number of schools with higher concentration of students hindering overall infrastructural status to excel. However, the elementary schooling system of East Sikkim was better than all other districts with respect to efficient utilization of available educational resources. Surprisingly, the districts of North and South were lagging in this aspect. Major implication of the finding signifies that district with lower productivity growth holds higher efficiency in elementary level educational production frontier. On the other side, districts with greater productivity lack efficiency in such course. Overall, the findings further unfold the space of research to understand whether such variation is prevalent in the cognitive capabilities of students within the districts of the state or not. The inter-district comparison on standardized test scores of sampled 8th graders is evident in Chapter IV.

Chapter 4

Inter-District Disparity in Students Learning Outcomes at Government Junior High Schools of Sikkim

Present chapter made an attempt to examine the inter-district disparity in standardized test scores of sampled 8th graders from Government Junior High Schools in the study area. The chapter also provides the summary statistics of variables used in the parametric experiments of the study.

4.1 Inter-District Disparity in Standardized Test Scores

The summary statistics results for test scores and deviation scores of four hundred eight sampled students from twenty three sampled Government Junior High Schools (GJHS) across four districts of Sikkim has been covered in this section. In addition, findings from statistical test for analyzing disparity in students test scores at inter-district level has been discussed subsequently. Test scores in the study have been regarded as the learning outcomes of the students given all the input factors at different level during the course of elementary level education of the students. Similarly, deviation scores were calculated in order to identify the differences between the total and the acquired scores.

Present study has been made to evaluate the students learning outcome in the sampled schools of four districts by conducting a test based on three subjects Arithmetic, English and Intelligence Quotient (IQ) having 10 marks in each subject with aggregate marks being 30. The summary statistics of subject specific and aggregate marks being presented of sampled students in four districts of Sikkim is shown in Table 4.1.

With respect to mean value on aggregate scores of pupils from respective districts of Sikkim, it has been observed that the performance of the students in East district was better than rest of the districts of the study area scoring 61.43% followed by students performance of South and North district with a figure of 60.8 and 56.17%. The performance of students of West district was less satisfactory when compared with the rest of the districts of Sikkim. The students of West district of Sikkim scored 52.47%.

Table 4.1 Summary Statistics of Test Scores

District	Test Scores	Mean	S.D	Min	Max	Observation
West	Arithmetic (10)	4.89	2.24	0	9	107
	English (10)	6.05	2.80	0	10	
	I.Q (10)	4.80	2.63	0	10	
	Aggregate (30)	15.74	5.57	3	28	
South	Arithmetic (10)	6.14	2.01	0	10	100
	English (10)	7.15	2.20	1	10	
	I.Q (10)	4.97	2.72	0	10	
	Aggregate (30)	18.24	4.72	3	27	
North	Arithmetic (10)	5.42	2.09	0	9	100
	English (10)	6.28	2.71	1	9	
	I.Q (10)	5.15	2.86	0	10	
	Aggregate (30)	16.85	5.77	3	28	
East	Arithmetic (10)	5.93	1.89	2	9	101
	English (10)	6.90	2.26	2	9	
	I.Q (10)	5.59	2.89	0	10	
	Aggregate (30)	18.43	5.29	7	27	
Sikkim	Arithmetic (10)	5.58	2.11	0	10	408
	English (10)	6.59	2.54	0	10	
	I.Q (10)	5.13	2.78	0	10	
	Aggregate (30)	17.29	5.44	3	28	

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Aggregate Marks = 30; Arithmetic (10), English (10), IQ (10).

It seems that the aggregate score of sampled students in respective districts of the study area is more influenced by the scores of English than other subjects, which may be because of better cognitive abilities or understanding of the English language. The IQ test result was found to be less influential when compared with other two subjects in aggregate score of the students in the study area. The close correlation of the scores of Arithmetic and IQ amongst the students of West, North and East districts signifies the association of ability of the students in these subjects with each other in the form of academic cognizance and learning outcomes. Barring South district, the average scores of Arithmetic ad IQ seemed to be correlated for rest of the districts of the study area as the scores of Arithmetic seen to be slightly higher than IQ scores.

With reference to the subject wise mean score as in Table 4.1, it has been observed that the students of South Sikkim performed better in Arithmetic and English scoring 61.4 and 71.5% respectively followed by students of East Sikkim ranking second by scoring 59.3 and 69% respectively in those subjects. The students of North Sikkim scored 54.2 and 62.8% respectively in Arithmetic and English. However, the performance of students from West Sikkim was less satisfactory when compared with the sampled cohorts of other districts. The average score in Arithmetic and English attained by sampled 8th graders of West district was 48.9 and 60.5% respectively.

However, the performance trend was reversed while taking account of IQ score as the students of East district of the state performed relatively well scoring 55.9% followed by North and South district of the state with a score of 51.5 and 49.7% respectively. The sampled 8th graders of West Sikkim were consistently found to perform at the bottom as their IQ score was lowest when compared with rest of the districts of the study area.

As for the comparison with all Sikkim, Table 4.1 shows considerable differences between the test scores of all four districts and Sikkim as a whole. The average aggregate scores of the sampled students from East and South districts were slightly higher than the state average. The average scores of the pupils from East and South districts were 61.4 and 60.8% approximately, 3.8 and 3.2% higher than that of all Sikkim respectively. In contrast to this result, the performance of sampled cohorts from West and North districts were below state average. The study found an average difference of 5.1% (West) and 1.4% (North) on aggregate test score with all Sikkim average. Such disparities indicate students outcomes may vary according to developmental and locational advantages.

Having acquired the data on test scores of 408 individual students across four districts, the study constructed new dataset using same test scores. The individual acquired score of sampled pupils were subtracted from the total test score to identify the gap between attained and total scores. The study termed it as a 'deviation score[7]' of the students further hypothesizing the tradeoff as higher deviation score exhibiting lower learning outcome and lower deviation score revealing better learning outcome. Summary statistics for deviation scores is presented in Table 4.2.

Considering the average deviation scores of three subjects from respective districts of Sikkim the study observed considerable gap between acquired and total scores of test amongst the students of West district. Average deviation on aggregate score was 14.26 points, which was found to be 2.50, 1.11, and 2.69 points higher than South, North and East districts. The result supplements the findings from Table 4.1 of lower pupils' test scores within the sampled schools of West district. Comparatively, such deviations were lesser amongst the students' test scores from East district than all other sampled districts.

Analyzing subject wise mean deviation score as in Table 4.2, the study observed similar higher gaps between acquired scores and total test score with respect to subjects like Arithmetic, English, and IQ amongst the students of West district. Sampled pupils deviated with the average marks of 5.11, 3.95, and 5.20 from the respective total of 10 marks in Arithmetic, English and IQ respectively. Remarkably, sampled 8th graders across South district maintained lower differences between their

[7] Deviation Score= (Total Test Score – Secured Marks in Standardize Test).

acquired scores and total test score for Arithmetic and English, while similar observation was found for IQ amongst the students within sampled schools of East district (See Table 4.2).

Table 4.2 Summary Statistics of Deviation Scores

District	Deviation Scores	Mean	S.D	Min	Max	Observation
West	Arithmetic	5.11	2.24	1	10	107
	English	3.95	2.80	0	10	
	I.Q	5.20	2.63	0	10	
	Aggregate	14.26	5.57	2	27	
South	Arithmetic	3.86	2.01	0	10	100
	English	2.85	2.20	0	9	
	I.Q	5.03	2.72	0	10	
	Aggregate	11.76	4.72	3	27	
North	Arithmetic	4.58	2.09	1	10	100
	English	3.72	2.71	1	9	
	I.Q	4.85	2.86	0	10	
	Aggregate	13.15	5.77	2	27	
East	Arithmetic	4.07	1.89	1	8	101
	English	3.10	2.26	1	8	
	I.Q	4.41	2.89	0	10	
	Aggregate	11.57	5.29	3	23	
Sikkim	Arithmetic	4.42	2.11	0	10	408
	English	3.41	2.54	0	10	
	I.Q	4.88	2.78	0	10	
	Aggregate	12.71	5.44	2	27	

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Aggregate Marks = 30; Arithmetic (10), English (10), IQ (10).

While gauging a comparison of each district with all Sikkim average, the study found sampled cohorts of East and South district as better performers whereas other pupils from other two districts were lagging in terms of deviation on average between total and acquired scores. The average deviation score of East and South districts were 1.14 and 0.95 points lower than the state average. While it was 1.55 and 0.44 points higher for West and North district compared to the state average (See Table 4.2).

Evidence from summary statistics results provided sampled pupils from East and South district outperforming their fellow 8th graders from West and North Sikkim (See Tables 4.1 and 4.2). This further reveals the existence of substantial differences with respect to cognitive outcomes of sampled pupils between four districts of Sikkim.

With reference to the findings from Tables 4.1 and 4.2, present study made an attempt to further evaluate whether such variation in student performance are subject to statistical significance or not. The study instrumented non-parametric approach to capture disparities between the students test performance that were sampled from West, South, North and East district. Significant disparity to exist within the test scores of the students from respective study areas; an alternative hypothetical statement was anticipated. Results on Kruskal Wallis test has been presented in Table 4.3.

Table 4.3 Kruskal Wallis Test on Standardized Test Scores

District	Rank Sum (Aggregate)	Rank Sum (Arithmetic)	Rank Sum (English)	Rank Sum (IQ)	Observation
West	18516.00	18101.00	19736.50	20396.50	107
South	22424.50	23599.00	22787.00	20017.50	100
North	19400.00	19371.00	19209.00	20625.00	100
East	23095.50	22365.00	21703.50	22397.00	101
χ^2 (3 d.f.)	15.499 (0.0014)	20.056 (0.0002)	9.252 (0.0261)	3.989 (0.2627)	

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures presented in parenthesis indicates p-values; d.f. stands for degree of freedom; I.Q stands for Intelligent Quotient.

Considering disparity for aggregate test score of the students in respective districts, the analysis obtained a considerable difference. Mean difference in aggregate test score between four cohorts was χ^2 (3 d.f.) = 15.499 which was found statistically significant with a probability value of 0.0014. The aggregate test score is inclusive of respective scores from Arithmetic, English and I.Q. Consequently, the study anticipated variations within subject-wise scores.

With reference to the subject wise test score disparity as in Table 4.3, it has been observed that the pupils obtained marks in two out of three subjects which varied across sampled districts. Mean difference was statistically significant for Arithmetic and English with the probabilities of 0.0002 and 0.0261 respectively. However, Kruskal-Wallis H test showed no statistical significant disparity for student performance in I.Q across four districts of study area. Thus, our alternative hypothesis is violated in this respect. Overall, the result of H test is consistent with the findings of Singh and Guha (2018).

4.2 School related input Factors

Section 4.2 presents results on summary statistics for school level factors. The sample of the study comprises total of 23 Government Junior High Schools across four districts of Sikkim. The assessment for school related components included data from 8 GJHS of West; 6 GJHS of South; 6 GJHS of North; and 3 GJHS of East. Mean values for quantitative variables are reported in Tables 4.4 and 4.5, while for qualitative variables results in proportion is reported in Table 4.6.

The schools of North district have been found to be older in terms of age of school institution. The average years of establishment of West, South and East with North district schools differs approximately by 4.75, 4.83 and 7.17 years respectively. The study observed East district schools to be established later amongst other sampled schools (See Table 4.4).

Average years of education were higher for sampled Headmasters of South district while lower for North. However, years of administrative experience (Headmasters) was relatively greater in North Sikkim than other three districts. Headmasters of East district were found to be youngest in terms of administrative experience. Sampled schools of North and East district were ahead with respect to number of classrooms at school. Mean value on the variable was 10.33 classrooms for both the districts. It was lower in the schools of West district. Similarly, the concentration of total staff (Teaching and Non-Teaching) was greater within the sampled schools of East district.

Table 4.4 Summary Statistics of School Level Factors

Variable	West	South	North	East	Sikkim
Years of Establishment	44.75 (13.60)	44.67 (18.26)	49.50 (10.78)	42.33 (33.29)	45.65 (16.37)
Years of Education (HM)	16.25 (1.67)	17.67 (2.16)	15.83 (4.02)	17.00 (2.00)	16.61 (2.55)
Years of Experience (HM)	22.63 (6.82)	24.00 (2.97)	25.00 (8.44)	19.33 (8.33)	23.17 (6.52)
Total No of Classrooms	8.88 (1.25)	10.00 (1.79)	10.33 (1.51)	10.33 (2.52)	9.74 (1.66)
Total No of Rooms for Staffs (Both Teaching And Non-Teaching)	1.75 (1.04)	1.50 (0.55)	1.50 (0.55)	1.00 (0.00)	1.52 (0.73)
Total No of Teaching Staff	12.75 (2.55)	14.67 (3.33)	13.17 (1.47)	16.67 (8.39)	13.87 (3.65)
Total No of Teaching Staff (Male)	6.38 (2.39)	5.83 (1.72)	5.67 (1.51)	5.00 (1.00)	5.87 (1.82)
Total No of Teaching Staff (Female)	6.38 (2.56)	9.83 (6.08)	7.50 (1.38)	11.67 (7.57)	8.26 (4.45)
Total No of Non-Teaching Staff	1.63 (0.74)	1.33 (0.82)	1.33 (0.52)	2.00 (1.00)	1.52 (0.73)
No of Times Organized in a Year (Extra-Curricular Activities)	29.50 (14.56)	26.67 (8.89)	32.00 (5.02)	35.33 (15.01)	30.17 (10.94)
No. of Educational Tours/Excursions Organized (Annually)	0.25 (0.46)	1.00 (0.89)	0.17 (0.41)	0.33 (0.58)	0.43 (0.66)
No. of Times Disruptions Occurred (Annually)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.09 (0.42)
No of Teacher-Parent Meetings (Annual)	2.63 (0.92)	3.33 (0.82)	2.33 (0.52)	3.00 (1.00)	2.78 (0.85)
Total No. of Class Days Missed (Academic Year)	3.00 (3.46)	7.17 (8.50)	5.50 (5.65)	1.33 (1.54)	4.52 (5.66)
Total No. of Desk-Bench In Grade VIII	8.38 (2.33)	11.83 (2.56)	10.00 (3.52)	16.33 (12.66)	10.74 (5.23)
Observations	8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures presented off the bracket are mean values; Figures in the parenthesis represents Standard Deviation.

The study found dominance of female teachers in proportion within total teaching staff of sampled schools across four districts. About 71% of total teaching staff were female in East Sikkim. Accordingly, 63% in South and 57% in North. It was proportionate in ratio for West district.

Extracurricular activities were relatively greater on an average within the sampled schools of East Sikkim. Annual organization of such activities was minimal in the sampled schools of South district. Interestingly, contrary result was noted regarding academic excursions and parental meetings. Across all sampled schools of the study area, number of annual educational tour and teacher-parent meet were found utmost in South district (Table 4.4). Marginal mean value on number of class days missed in an academic year amongst the sampled schools of East Sikkim suggested pupils' significant gains in number of total classes than other districts. Including such gain, Table 4.4 demonstrated greater average on total number of desk-bench in grade VIII (16.33) in East district schools. Respective mean of the variable were 8.38, 11.83 and 10.00 for West, South and North Sikkim.

Findings from Table 4.5 show variation between all four districts in enrolment and classroom accommodation in school. The result suggested higher enrolments within the sampled schools of East Sikkim both overall as well as for grade VIII. Sampled schools in East were occupied with an average enrolment of 212.67 students and 35.33 students in grade VIII. Relatively minimal enrolments of students were found in the sampled Junior High Schools of North and West districts (Table 4.5).

Table 4.5 Summary Statistics of School Related Factors

Variables	West	South	North	East	Sikkim
Total Enrolment in School	85.63 (28.30)	88.33 (36.26)	82.67 (41.27)	212.67 (154.79)	102.13 (70.99)
Total Enrolment (VIII)	14.00 (4.41)	19.33 (5.92)	17.83 (7.78)	35.33 (24.01)	19.17 (11.23)
Student-Classroom Ratio In School	9.75 (3.01)	8.67 (3.08)	7.67 (3.56)	18.67 (11.85)	10.09 (5.74)
Student-Desk Bench Ratio (VIII)	1.88 (0.35)	1.83 (0.41)	1.83 (0.41)	2.33 (0.58)	1.91 (0.42)
Pupil-Teacher Ratio (VIII)	2.50 (0.76)	3.33 (1.03)	3.17 (1.47)	6.00 (4.00)	3.35 (1.90)

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures presented off the bracket are mean values; Figures in the parenthesis represents Standard Deviation.

Consistent with the findings on enrolment, the ratios of student-classroom (SCR), student-desk bench (SDR) and pupil-teacher ratio (PTR) was greater in East district. On an average 18.67 students were found to be accommodated in one classroom with 2.33 students using one set of desk-bench. The average differences of SCR with other district schools were 8.92 (West), 10.00 (South), and 11.00 (North). Both SCR and SDR were comparatively lower amongst the sampled schools of North district. While, the average ratio of pupils per teacher at grade VIII was lowest in West (See Table 4.5).

The Table 4.6 provides percentage share results for qualitative information collected across sampled schools from four districts of Sikkim. The study found that North district has some proportion of schools running with semi-pucca building type. The proportion of such schools out of total sampled schools was 17%. Sampled schools from the remaining three districts were found to be operating on pucca buildings.

All 23 schools across four districts accounted to have a toilet facility for the students. However about 13% of total sampled schools from West was lacking such facilities in terms of gender specific. Toilet facilities for staffs were available in all the sampled schools of North district. About 25, 17, and 33% of sampled schools from West, South, and East were in shortage of the facility. Regarding safe drinking water facility, the study found all three schools of East Sikkim to be well equipped. About one-fourth of total sampled schools with no safe drinking water was found in West district. Proportions were 17% each for South and North district.

Further, some proportion of sampled schools from East district was substantially in shortage of facilities like play-ground, electricity connection, and library. Similarly, accessibility to computer was minimal in West. However, all the schools under sample from West were observed to have a play-ground facility (Table 4.6).

Table 4.6 Percentage Share of School Level Factors

Variables		West	South	North	East	Sikkim
School Building Type	Kutcha	0	0	0	0	0
	Semi Pucca	0	0	17	0	4
	Pucca	100	100	83	100	96
Toilet Facility For Students	Yes	100	100	100	100	100
	No	0	0	0	0	0
Gender Specific Toilets	Yes	87	100	100	100	96
	No	13	0	0	0	4
Toilet Facility For Staffs	Yes	75	83	100	67	83
	No	25	17	0	33	17
Gender Specific Toilets (Staffs)	Yes	37	33	67	67	48
	No	63	67	33	33	52
Safe Drinking Water Facility	Yes	75	83	83	100	83
	No	25	17	17	0	17
Play-Ground Facility	Yes	100	67	83	33	65
	No	0	33	17	67	35
Electricity Connection	Yes	100	100	100	67	96
	No	0	0	0	33	4
Computer Facilities	Yes	50	100	67	67	70
	No	50	0	33	33	30
Library Availability	Yes	13	33	33	0	78
	No	87	67	67	100	22
Landline Connection	Yes	0	0	0	0	0
	No	100	100	100	100	100
Broadband Internet Connection	Yes	0	0	0	0	0
	No	100	100	100	100	100
School Approachability By Road	Yes	87	100	83	100	91
	No	13	0	17	0	0
Type of Road	Kutcha	25	0	33	33	22
	Pucca	62	100	50	67	69
	None	13	0	17	0	9
Extra-Curricular Activities	Yes	100	100	100	100	100
	No	0	0	0	0	0
Disruptions on Regular Classes	Yes	0	0	0	0	0
	No	100	100	100	100	100
Provision of Mid-Day Meal to Students	Yes	100	100	100	100	100
	No	0	0	0	0	0
Observations		8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures are presented in percentage.

Table 4.6 shows considerable share of schools approachability by road in East and South district. While at 13 and 17% of total selected schools in West and North

Sikkim were non-approachable by road. Extracurricular activities and Mid-day meal facilities were profound amongst all the sampled schools of the study area.

4.3 Teacher Related Input Factors

Present section covers a discussion on teacher level factors used in the study. The assessment for teacher related components included information from concerned subject teachers of 8th grade in Mathematics and English across all sampled schools. Tables 4.7 and 4.8 include descriptive statistics for sampled Mathematics teachers. Similar statistical summarization of components related to English teachers is reported in Tables 4.9 and 4.10.

It is evident from Table 4.7, sampled mathematics teachers from East district were younger in terms of age and hold greater years of education. Average age and years of education were 26.27 and 16.33 years respectively. Sampled teachers from South Sikkim were eldest amongst total sampled teachers of study area, while the average year of education was lowest for teachers from West Sikkim. Teaching experiences both as in total teaching career and in present school were found to be highest amongst the teachers of South Sikkim and lowest within East. The finding indicated a positive correlation of age and teaching experience of teacher, which is evident through a result of higher mean value on age variable of the teachers from South. For elementary level schools in West district, sampled mathematics teachers received professional courses/teacher trainings for greater years. The average of the same was lowest in East district.

More number of mathematics classes for grade VIII was found to be conducted by the sampled teachers of South district, whereas for North district the mean value was minimal. Similar observation was marked on daily class duration. The length of aggregate daily classes taken was extensive within South and lower in North district schools. Out of total working days in an academic year of 2016, better consistency in terms of daily school attendance was observed within East and South Sikkim teachers.

Table 4.7 Summary Statistics of Teacher Level Factors (Mathematics)

Variables	West	South	North	East	Sikkim
Age	34.75 (10.39)	38.33 (13.72)	35.00 (15.74)	26.67 (3.51)	34.70 (12.12)
Years of Education	15.88 (1.25)	16.33 (0.52)	16.33 (1.21)	16.33 (0.58)	16.17 (0.98)
Years of Teaching Experience	9.94 (8.16)	13.75 (13.32)	10.67 (13.43)	2.50 (1.80)	10.15 (10.69)
Years of Teaching Experience In Present School	4.31 (4.86)	5.92 (6.00)	4.25 (4.36)	1.50 (0.87)	4.35 (4.68)
Duration of Course/Training (Years)	0.63 (0.79)	0.52 (0.57)	0.40 (0.79)	0.37 (0.55)	0.50 (0.67)
No. of Classes on Specific Subject Taken Daily (Grade VIII)	1.25 (0.46)	1.50 (0.55)	1.00 (0.00)	1.33 (0.58)	1.26 (0.45)
No. of Classes on Specific Subject Taken Weekly (Grade VIII)	7.50 (2.78)	8.50 (2.81)	6.17 (0.41)	8.00 (3.46)	7.48 (2.48)
Hours of Daily Classes (Grade VIII)	0.65 (0.44)	0.82 (0.35)	0.53 (0.23)	0.78 (0.62)	0.68 (0.39)
Number of Classes Taken Daily (All Grades)	4.75 (0.71)	4.17 (1.17)	5.17 (0.75)	4.33 (0.58)	4.65 (0.88)
Number of Classes Taken Weekly (All Grades)	26.88 (5.06)	24.17 (4.40)	30.00 (4.34)	25.67 (2.89)	26.83 (4.74)
Total No. of Working Days (Last Annual Year)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)
Total No. of Days Present (Last Annual Year)	221.38 (9.23)	223.00 (3.10)	219.17 (4.62)	222.33 (3.21)	221.35 (6.10)
Monthly Income from Teaching	29125.00 (23787.38)	39333.33 (31341.13)	32666.67 (31872.66)	14000.00 (1732.05)	30739.13 (26358.05)
Monthly Income from Any Other Profession	750.00 (2121.32)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	260.87 (1251.09)
Total Monthly Income	29875.00 (23259.02)	39333.33 (31341.13)	32666.67 (31872.66)	14000.00 (1732.05)	31000.00 (26193.34)
No. of Times Transferred Since Appointment	1.50 (1.69)	1.17 (1.17)	1.33 (2.42)	1.33 (1.15)	1.35 (1.64)
No. of Academic Assignments Given (Annually)	5.75 (2.55)	9.83 (7.49)	7.33 (2.34)	24.67 (5.03)	9.70 (7.49)
Daily Duration of Self-Preparation (Minutes)	23.13 (16.89)	47.50 (38.44)	45.00 (31.46)	60.00 (0.00)	40.00 (28.84)
No. of Class Test Taken (Monthly)	2.75 (1.39)	7.00 (9.34)	2.67 (1.21)	2.00 (1.00)	3.74 (4.98)
Hours of Internet Use (Daily)	1.25 (1.31)	1.17 (1.44)	1.50 (1.52)	1.33 (0.58)	1.30 (1.26)
Hours of Internet Use on Academic Purpose (Daily)	0.56 (0.42)	0.45 (0.46)	0.67 (0.75)	0.67 (0.29)	0.57 (0.50)
Observations	8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures presented in parenthesis represent Standard Deviation.

Average monthly earning was greater amongst the sampled teachers of South district. The margin of differences on average monthly income with West, North and East was 9458.33, 6666.66 and 25333.33 Indian Rupees.

The status of teacher mobility was supplemented by greater number of transfers by sampled teachers of West district. Comparatively, it was on contrary for South. Table 4.7 revealed sampled mathematics teachers from East district are accustomed to allocate more duration of time for self-preparation prior to classes. They devoted 60 min daily which was highest as compared to teachers from other districts.

With respect to duration of time spent on daily internet use, the sampled mathematics teachers of North district were found to use internet for longer duration, while it was opposite in case of sampled teachers from South. Similarly, the mathematics teachers of South district were reported to conduct more number of monthly class tests in the respective subject (Table 4.7).

Table 4.8 consists qualitative components of sampled mathematics teacher reported in terms of proportion. Except for East, there was a dominant share of male mathematics teachers amongst total teachers in West, South and North districts for the respective subject. The proportion of male teachers amongst aggregate percentage of Mathematics teachers were 88, 83, and 83% in above mentioned districts respectively. The share was 33% in East.

The percentage of sampled mathematics teachers with Hinduism as a religious background, OBC (Other Backward Class) as a caste background and Nepali as an ethnic background were on a greater share amongst all the sampled schools of four districts. While mixed findings in terms of marital status had been obtained as the proportion was dominated by married teachers within the samples of West and South district, and it was opposite in North and East (See Table 4.8).

Table 4.8 Percentage Share of Teacher Level Factors (Mathematics)

Variables		West	South	North	East	Sikkim
Gender	Male	88	83	83	33	78
	Female	12	17	17	67	22
Religion	Buddhist	38	0	17	0	17
	Hindu	62	67	66	100	70
	Christian	0	33	17	0	13
	Others	0	0	0	0	0
Caste	GEN	24	33	17	0	22
	OBC	38	67	66	100	61
	ST	38	0	17	0	17
	SC	0	0	0	0	0
Ethnicity	Nepali	75	67	50	100	70
	Bhutia	12.5	0	0	0	4
	Lepcha	0	0	17	0	4
	Others	12.5	33	33	0	22
Marital Status	Unmarried	38	33	67	100	52
	Married	62	67	33	0	48
Subject Specialization	Yes	75	67	100	100	83
	No	25	33	0	0	17
Degree on Teaching	Yes	37	50	83	33	35
	No	63	50	17	67	65
Professional Training on Teaching (Any Other)	Yes	50	17	50	67	44
	No	50	83	50	33	56
Engagement on Any Other Profession	Yes	12	0	0	0	4
	No	88	100	100	100	96
Nature of Appointment	Regular	38	50	33	0	35
	Adhoc	62	50	67	100	65
Classroom Instructional Mode	Teacher Focused	0	0	0	0	0
	Interactive	88	100	83	100	91
	Student Focused	12	0	17	0	9
Blackboard Use	Yes	100	100	100	100	100
	No	0	0	0	0	0
Self -Preparatory habit for Classes	Yes	100	100	83	100	96
	No	0	0	17	0	4
Prescribed Syllabus Completion	Yes	100	100	100	100	100
	No	0	0	0	0	0
Basic Computer Proficiency	Yes	75	67	67	100	74
	No	25	33	33	0	26
Internet Use	Yes	75	83	67	100	78
	No	25	17	33	0	22
Observations		8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures are presented in percentage.

The study found 75, 67, 100, and 100% of the sampled teachers from West, South, North, and East bearing subject specialization. However, concerns and contradictions mounted from the result of 63 and 67% of teachers being observed with no degree on teaching within West and East Sikkim. Secondly, majority of the sampled teachers from West, North and East reported their appointment status as Adhoc. Relatively, an equivalent share of both Regular and Adhoc teachers were evident in South (Table 4.8). Majority of the sampled mathematics teachers responded to have a habit of self-preparation before classes, to complete the prescribed subject syllabus, to hold proficiency in basic computer applications and to be accustomed of using internet daily across all the sampled schools of four districts during the study period (See Table 4.8).

Table 4.9 gives descriptive statistical information of quantitative aspects related to sampled English teachers across four districts. On an average, sampled teachers from East Sikkim were relatively younger. In addition, their educational attainments were greater in terms of years of education. The study obtained a gap of 7.13, 4.50 and 2.17 years on mean ages of teachers from East with West, South and North districts. Sampled English teachers in the schools of West district were found to hold greater years of teaching experience. The mean value for the same was 15.88 years. Comparatively with 8.83 years of experience, teachers from North were lagging than other district teachers.

The sampled teachers of East district were reported to take more number of classes for English on daily and weekly basis. Whereas, the calculated mean value was minimal for the teachers of North Sikkim. Similar observation was marked on daily class duration. The length of aggregate daily classes was extensive within East and adjudged lower in the sampled schools of North district (Table 4.9).

Out of total working days in an academic year of 2016, better consistency with respect to daily attendance had been evident for cohort of sampled teachers in East Sikkim. On average, monthly earning was greater amongst the sampled teachers of

West district. The margin of difference on average monthly income with South, North and East was 9875.00, 8875.00 and 2541.67 Indian Rupees.

Table 4.9 Summary Statistics of Teacher Level Factors (English)

VARIABLES	West	South	North	East	Sikkim
Age	40.13 (8.90)	37.50 (9.54)	35.17 (6.59)	33.00 (2.65)	37.22 (7.94)
Years of Education	16.00 (0.53)	17.33 (1.63)	18.00 (2.00)	18.33 (1.15)	17.17 (1.61)
Years of Teaching Experience	15.88 (12.18)	13.00 (11.93)	8.83 (7.14)	11.00 (5.29)	12.65 (10.09)
Years of Teaching Experience In Present School	4.00 (2.62)	3.97 (2.80)	3.17 (2.64)	3.67 (2.52)	3.73 (2.50)
Duration of Course/Training (Years)	1.34 (0.80)	1.18 (0.72)	1.83 (0.98)	3.00 (1.00)	1.64 (0.99)
Number of Classes on Specific Subject Taken Daily (Grade VIII)	1.25 (0.46)	1.17 (0.41)	1.00 (0.00)	1.33 (0.58)	1.17 (0.39)
Number of Classes on Specific Subject Taken Weekly (Grade VIII)	7.25 (2.96)	6.67 (2.16)	6.00 (0.00)	8.00 (3.46)	6.87 (2.32)
Hours of Daily Classes (Grade VIII)	0.64 (0.44)	0.63 (0.33)	0.62 (0.30)	0.78 (0.62)	0.65 (0.38)
Number of Classes Taken Daily (All Grades)	4.75 (1.28)	3.83 (1.17)	3.83 (2.23)	4.00 (1.00)	4.17 (1.50)
Number of Classes Taken Weekly (All Grades)	26.25 (6.14)	21.50 (4.93)	20.67 (11.20)	23.33 (2.08)	23.17 (7.23)
Total No. of Working Days (Last Annual Year)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)	233.00 (0.00)
Total No. of Days Present (Last Annual Year)	220.50 (7.95)	221.67 (4.97)	220.33 (3.01)	223.33 (3.21)	221.13 (5.45)
Monthly Income from Teaching	38875.00 (25119.36)	29000.00 (18761.66)	30000.00 (19328.74)	36333.33 (18717.19)	33652.17 (20444.18)
Monthly Income from Any Other Profession	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Total Monthly Income	38875.00 (25119.36)	29000.00 (18761.66)	30000.00 (19328.74)	36333.33 (18717.19)	33652.17 (20444.18)
No. of Times Transferred Since Appointment	3.63 (3.81)	1.67 (1.21)	1.50 (1.87)	3.67 (3.79)	2.57 (2.86)
No. of Academic Assignments Given (Annually)	7.25 (4.89)	11.17 (5.31)	11.33 (6.77)	20.00 (5.00)	11.00 (6.55)
Daily Duration of Self-Preparation (Minutes)	38.13 (20.34)	25.83 (8.61)	40.00 (15.49)	33.33 (25.17)	34.78 (17.15)
No. of Class Test Taken (Monthly)	2.50 (0.93)	2.67 (1.51)	2.33 (1.03)	2.33 (0.58)	2.48 (1.04)
Hours of Internet Use (Daily)	0.63 (0.52)	1.25 (1.08)	1.50 (1.05)	2.33 (2.52)	1.24 (1.22)
Hours of Internet Use for Academic Purpose (Daily)	0.30 (0.25)	0.37 (0.38)	0.58 (0.38)	1.00 (1.00)	0.48 (0.48)
Observation	8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures off the bracket are mean values; Figures presented in the parenthesis represents Standard Deviation.

Subject teacher of English in East Sikkim reported to experience more number of transfers since their appointment date. Comparatively, the status was on contrary in West. Table 4.9 revealed sampled English teachers from North district are accustomed to allocate more duration of time for self-preparation before taking classes. They devoted 40 min daily on average which was highest as compared to sampled English teachers of other districts. In case of daily internet use, teachers from East were reported longer duration of internet usage and the habit was minimal amongst the teachers of West Sikkim. Result with respect to number of monthly class tests is in line with the earlier finding of Table 4.7. Similar to their teaching colleagues of Mathematics, sampled English teachers of South conducts more number of monthly class tests in specific subject (Table 4.9).

Table 4.10 presents percentage share of qualitative variables related to sampled English teachers of the study area. About 67% of total sampled teachers in English were males in South and East district. The share was parallel in West while similar figure of 67% were female teachers in North Sikkim.

Except for North Sikkim, the study adjudged Hinduism, OBC, and Nepali as a dominant religious, caste, and ethnic backgrounds of English teachers from the sampled schools of West, South, and East district. Buddhism, ST and Lepcha determined such backgrounds in North Sikkim. Robust proportion of married teachers was found in two districts excluding South and North. An equal percentage of both married and unmarried teachers were observed in the schools of latter districts.

Sampled Teachers across four districts responded on holding subject specialization and teaching degree. However, the response was apprehended by 25, 17 and 17% of total sampled English teachers in West, South and North Sikkim respectively. They reported with no possession of professional degree on teaching. Notably, share of regular/permanent teachers were higher in West and East districts, while it was proportionate in other two districts (See Table 4.10).

Table 4.10 Percentage Share of Teacher Level Factors (English)

Variables		West	South	North	East	Sikkim
Gender	Male	50	67	33	67	52
	Female	50	33	67	33	48
Religion	Buddhist	38	17	83	33	44
	Hindu	50	83	17	67	52
	Christian	12	0	0	0	4
	Others	0	0	0	0	0
Caste	Gen	38	17	0	0	17
	OBC	38	66	17	67	44
	ST	24	17	83	33	39
	SC	0	0	0	0	0
Ethnicity	Nepali	88	83	17	67	66
	Bhutia	12	17	17	33	17
	Lepcha	0	0	66	0	17
	Others	0	0	0	0	0
Marital Status	Unmarried	0	50	50	33	30
	Married	100	50	50	67	70
Subject Specialization	Yes	100	100	100	100	100
	No	0	0	0	0	0
Degree on Teaching	Yes	75	83	83	100	83
	No	25	17	17	0	17
Professional Training on Teaching (Any Other)	Yes	88	50	67	100	74
	No	12	50	33	0	26
Engagement on Any Other Profession	Yes	0	0	0	0	0
	No	100	100	100	100	100
Nature of Appointment	Regular	63	50	50	67	56
	Adhoc	37	50	50	33	44
Classroom Instructional Mode	Teacher Focused	0	0	0	0	0
	Interactive	88	100	100	100	96
	Student Focused	12	0	0	0	4
Blackboard Use	Yes	100	100	100	100	100
	No	0	0	0	0	0
Self-Preparatory for Classes	Yes	100	100	100	100	100
	No	0	0	0	0	0
Prescribed Syllabus Completion	Yes	100	100	100	100	100
	No	0	0	0	0	0
Basic Computer Proficiency	Yes	75	83	100	100	87
	No	25	17	0	0	13
Internet Use	Yes	75	83	83	67	78
	No	25	17	17	33	22
Observation		8	6	6	3	23

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures are presented in percentage.

Majority of the sampled English teachers responded to comprise the habit of self-preparation prior to classes, to finish the prescribed subject syllabus, to hold proficiency in basic computer applications and habit of using internet daily across all the sampled schools of the study area (Table 4.10).

4.4 Student Individual Related Input Factors

Summary statistics results as presented and discussed in Section 4.4 are students individual specific informations. The evaluation on student related factors comprised individual level information of all 408 sampled students. Table 4.11 includes descriptive statistics results of quantitative information further a separate statistical estimates of quantitative data have been presented in Table 4.12(a) and (b).

The Table 4.11 reported average age of the students from East Sikkim as 13.78 years. The findings revealed that the respective mean figure as minimal amongst all other considered samples from three districts. It was 14.13 years for the students of North district which comparably was slightly higher than the average age of sampled cohorts from other sampled districts.

The study found greater accessibility to schools for students in East than other districts. Sampled pupils from East were travelling an average of 0.98 km (1.96 km on both ways) daily within duration of 8.30 min (16.6 min on both ways). These students were travelling 1.73, 1.19, and 1.33 km lesser compared to pupils from West, South, and North. This further unfolds relative disparities between districts on tangible daily hardships of students. The sampled pupils of West Sikkim were reported to spend around 45 min in average on travelling before and after school hours. Apparently, such factors could provide more fatigue to pupils which eventually hampers academic concerns.

As for student accessibility to computer, it can be noticed (Table 4.11) that pupils attending JHS in East Sikkim were more familiar and habitual with computers. It was minimal amongst the students from other three districts. On an average, more number of textbooks availability at home was reported by the sampled cohort from North.

Table 4.11 Summary Statistics of Student Level Factors

Variables	West	South	North	East	Sikkim
Age	13.80 (1.22)	14.05 (1.20)	14.13 (1.28)	13.78 (1.05)	13.94 (1.20)
Weight (Kgs)	36.81 (7.32)	42.70 (7.16)	41.65 (7.85)	40.68 (5.24)	40.40 (7.30)
Duration on Going School (Minutes)	22.51 (28.81)	20.18 (19.24)	18.29 (17.86)	8.30 (4.98)	17.39 (20.48)
Distance to School from Home (Kilometers)	2.71 (3.87)	2.17 (2.14)	2.31 (2.35)	0.98 (0.76)	2.05 (2.63)
Order of Birth	2.83 (1.86)	3.02 (1.85)	3.22 (2.16)	2.21 (1.11)	2.82 (1.82)
Total No. of Course Textbooks Available at Home	7.04 (1.08)	9.10 (3.17)	12.02 (1.30)	11.34 (1.27)	9.83 (2.73)
Minutes of Computer Used Daily	0.51 (3.36)	0.90 (4.29)	1.00 (4.38)	2.58 (7.80)	1.24 (5.26)
Minutes of Support Daily	20.28 (38.20)	22.80 (30.19)	20.60 (35.76)	20.30 (25.85)	20.98 (32.83)
Tutorial Classes Duration (Hours)	0.11 (0.50)	0.04 (0.20)	0.51 (0.92)	1.03 (0.94)	0.42 (0.81)
Monthly Expenses on Tutorials (in Rupees)	24.30 (103.79)	7.50 (43.45)	41.00 (93.31)	194.55 (178.59)	66.42 (137.01)
No. of Study Support Materials/Stationary Used (Monthly)	4.41 (2.23)	4.31 (1.94)	4.88 (3.40)	6.54 (3.06)	5.03 (2.85)
No. of Days Remained Absent during Last Month	3.05 (3.38)	4.04 (3.34)	3.80 (3.48)	1.92 (1.90)	3.20 (3.19)
No. of Siblings	2.95 (1.95)	2.80 (1.88)	3.15 (1.85)	2.11 (1.30)	2.75 (1.80)
Mark Attained In Mathematics (Previous Grade)	50.54 (12.16)	52.40 (8.58)	53.44 (9.44)	57.79 (9.76)	53.50 (10.42)
Mark Attained In English (Previous Grade)	57.50 (13.60)	56.02 (8.34)	58.96 (9.84)	63.95 (11.02)	59.09 (11.28)
Total Percentage Acquired in All Subjects (Grade Vii)	57.13 (12.60)	54.97 (8.90)	57.01 (9.16)	63.02 (10.70)	58.03 (10.87)
Time Devoted Daily in Study at Home (Minutes)	89.02 (61.89)	79.20 (46.03)	73.50 (57.11)	60.25 (43.66)	75.69 (53.71)
Time Spend on Household Works (Minutes)	83.55 (48.59)	52.25 (32.66)	59.10 (35.79)	28.51 (31.43)	56.26 (42.68)
Time Spend on Playing (Minutes)	45.70 (45.21)	31.80 (32.98)	23.10 (26.23)	33.56 (29.17)	33.75 (35.21)
Time Spend on Study during Weekend (Minutes)	63.79 (60.67)	53.11 (49.14)	45.61 (47.37)	45.00 (45.99)	52.06 (51.68)
No. of Desk mates in Classroom	0.93 (0.43)	1.50 (5.41)	0.91 (0.38)	1.00 (0.00)	1.08 (2.69)
No. of Friends at Home	1.39 (1.29)	1.31 (1.12)	1.12 (1.00)	1.40 (0.88)	1.31 (1.09)
Age of Best Friend	10.64 (6.72)	10.96 (6.59)	10.78 (6.61)	13.20 (3.62)	11.39 (6.10)
Educational Level of Best Friend (Grade)	5.96 (3.86)	6.32 (3.88)	5.92 (3.65)	7.89 (2.22)	6.52 (3.56)
Time Spend With Best Friend Daily (Hours)	0.82 (0.75)	0.74 (0.61)	0.53 (0.38)	0.81 (0.37)	0.73 (0.57)
Time Spend on Internet Daily (Minutes)	2.71 (10.33)	10.55 (19.90)	3.25 (10.11)	16.19 (14.34)	8.10 (15.19)
Time Spend on Watching Television Daily (Minutes)	51.82 (44.68)	51.90 (30.71)	41.71 (26.58)	32.08 (19.56)	44.48 (32.90)
Time Spend on Sleeping Daily (Hours)	8.23 (1.13)	8.40 (0.87)	8.30 (0.70)	8.00 (0.57)	8.23 (0.86)
Duration on Mathematics Practice Daily (Minutes)	18.04 (19.96)	22.65 (17.74)	22.35 (21.65)	23.66 (20.19)	21.62 (19.98)
Observation	107	100	100	101	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures off the bracket are mean values; Figures presented in the parenthesis represent Standard Deviation.

The growing tutorial business in academics has not been popularly evident within the sampled pupils of the study areas. The duration of time spent on tutorial classes were observed higher only amongst the sampled students of East Sikkim. Tendency of school absenteeism has been found higher in the students of South district. At least 4 school days in a month was missed by the pupils. Comparatively, pupils from East maintained better consistency in terms of daily school attendance.

While gauging the differences on past academic performances, cohort of sampled students within East outperformed others. They attained better academic grades in previous class (VII) on subject-wise and on aggregate as well. Academic attainments in previous grade were relatively lower amongst the students of West and South district.

Interestingly, greater time was devoted by the pupils of West district on home study which contradicts with previous observation of academic performance. However, they spent relatively more time on household works and playing. It was totally opposite for 8th graders from East district, they responded to devote more of their time on using internet and practicing mathematics (See Table 4.11).

Tables 4.12a and b describes student related information those of qualitative nature being summarized in percentage. Majority of the sampled students were female in all the 23 schools across four districts. The proportion was highest in South Sikkim with 59% of pupils as females. Students with Hinduism as a religious background, OBC as a caste background, and Nepali as an ethnic background were on a greater share across three districts except North. Buddhism, ST and Lepcha had been obtained on majority in North Sikkim. Similarly, unlike other districts, 44% of pupils responded to use ethnic language at home within North (Table 4.12(a)).

Sampled children were found living with parents across all districts. However, some proportions were living with other relatives such as Aunts and Uncles, Grandparents, Cousins etc. As for pupil's interests about school, the study adjudged samples to be attracted by peers and teachers in schools. 55% of total pupils in South Sikkim responded to be influenced by their friends to attain school. While 48, 40, and 46% of students were accounted to be motivated by teachers in sampled schools of West, North, and East Sikkim. For majority of 8th graders in West, South, and North Sikkim, newspapers, magazines and general knowledge books facilities at home were found on deficit. They were deprived of computer facilities as well. 96 (West), 95 (South), 91 (North), and 87 (East) percent of pupils reported unavailability of computers at home. In addition, they received less academic support at home. Higher proportion of sample reported to do self-study at home and no private tutorial classes were being attended. However, the share of students attending private tuitions was 57% in East district (Table 4.12(a)).

Almost all the sampled students from 23 JHS participated in extracurricular activities at school. The study found games and sports to be more popular choice of our sample amongst all such activities. Higher proportion of pupils responded on daily study habit at home, nonetheless majority of them had to provide support in household works. Most of the support was for kitchen works, farms and cattle rearing (See Table 4.12(b)).

To summarize the physical health status, the marginal share of sample reported to hold physical and health limitations (See Table 4.12(b)). Most of the physical limitation was related to vision and as for health, the problem of gastric and headaches were common.

Table 4.12 Percentage Share of Student Level Factors

(a)

Variables		West	South	North	East	Sikkim
Gender	Male	43	41	48	43	44
	Female	57	59	52	57	56
Religion	Buddhist	23	11	59	21	28
	Hindu	67	58	34	68	57
	Christian	7	31	7	6	13
	Others	3	0	0	5	2
Caste	Gen	2	0	1	11	3
	OBC	47	66	23	65	50
	ST	40	24	72	17	38
	SC	11	10	4	7	9
Ethnicity	Nepali	82	97	53	81	78
	Bhutia	2	2	2	1	2
	Lepcha	12	0	44	2	15
	Others	4	1	1	16	5
Language spoken at home	Nepali	88	99	56	85	82
	Ethnic	12	1	44	15	18
	English	0	0	0	0	0
Living with	Mother	5	5	6	4	5
	Father	7	2	2	2	3
	Both	63	73	68	86	72
	Others	25	20	24	8	20
Parental literacy in Nepali	Yes	64	70	53	81	66
	No	36	30	48	19	34
Parental literacy in English	Yes	18	23	16	42	25
	No	82	77	84	58	75
Interest on going school	Yes	98	98	99	97	98
	No	2	2	1	3	2
Things liked about school	School building	1	0	0	0	0.2
	Playground	6	5	26	14	13
	Teachers	48	39	40	46	43
	Peer	44	55	33	41	43
	Others	1	0	1	0	0.6
	None	1	1	0	0	0.2
Language used in school	Nepali	59	0	37	0	25
	English	14	32	28	100	18
	Both	27	68	35	0	57
	Others	0	0	0	0	0
Newspaper at home	Yes	23	22	10	57	28
	No	77	78	90	43	72
Magazine/GK at home	Yes	20	41	49	81	47
	No	80	59	51	19	53
Computer at home	Yes	4	5	9	13	8
	No	96	95	91	87	92
Study support at home	Yes	30	46	44	49	42
	No	70	54	56	51	58
Study guide at home	Father	1	2	8	14	5
	Mother	2	2	4	5	3
	Elder sibling	20	32	21	22	24
	Others	7	11	12	8	10
	Self	70	53	55	51	58
Tutorial classes	Yes	6	3	25	57	23
	No	94	97	75	43	77
School Absenteeism	Yes	77	82	94	77	82
	No	23	18	6	23	18
Reason of Absenteeism	Health	48	71	45	46	52
	Household work	29	11	49	28	29
	None	23	18	6	26	19

(b)						
Variables		West	South	North	East	Sikkim
Dropout status (elder siblings)	Yes	36	45	42	23	36
	No	64	55	58	77	64
Dropout status (younger siblings)	Yes	3	1	1	0	1
	No	97	99	99	100	99
Availability of separate study room at home	Yes	18	6	2	3	8
	No	82	94	98	97	92
Bed sharing	Yes	40	21	19	29	27
	No	60	79	81	71	73
Extracurricular activities at schools	Yes	99	100	99	100	99.5
	No	1	0	1	0	0.5
Extracurricular activities type	Sports	82	39	65	0	47
	Singing/dancing	0	0	0	0	0
	Essay/quiz	15	0	0	13	7
	Others	0	0	0	0	0
	All first three	3	61	35	87	46
Promoted from previous grade	Yes	100	100	100	100	100
	No	0	0	0	0	0
Daily study habit	Yes	84	93	88	87	88
	No	16	7	12	13	12
Daily support at household work	Yes	94	86	92	54	82
	No	6	14	8	46	18
Support type	Kitchen work	56	39	44	41	45
	Carrying water	2	2	1	0	1
	Cattle rearing/farm land	29	25	33	10	24
	Others	7	20	14	9	13
	None	6	14	8	41	17
Dropout status of best friend	Yes	7	0	4	7	4
	No	93	100	96	93	96
Physical limitations	Yes	8	13	5	6	8
	No	92	87	95	94	92
Limitation type	Vision	7	12	5	8	8
	Hearing	2	1	0	0	1
	Orthopedically	0	0	0	0	0
	None	91	87	95	92	91
Health limitations	Yes	7	2	5	8	5
	No	93	98	95	92	95
Limitation type	Communicable	2	2	1	1	1
	Non-communicable	5	0	4	7	4
	None	93	98	95	92	95
Internet use	Yes	7	26	12	67	28
	No	93	74	88	33	72
Purpose of internet use	Academic	5	5	5	33	12
	Social networking	1	19	6	14	10
	Gaming	2	2	1	21	6
	None	93	74	88	33	72
Favorite subject	Nepali	0	0	0	0	0
	English	51	44	36	36	42
	Mathematics	12	20	15	14	15
	General science	24	31	39	39	33
	Social science	12	5	10	12	10
	Hindi	0	0	0	0	0
Observation		107	100	100	101	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures are presented in percentage.

It can be noticed (Table 4.12(b)) that pupils attending JHS in East were more familiar and habitual with internet utilities. The use of internet was for academic and online gaming purpose. Relatively, such habit was less popular amongst the samples from other three districts.

4.5 Parental and Household Related Input Factors

The present section discusses socio-economic backgrounds related to sampled pupils' family. It presents summary statistics results for parental/household level factors. Evaluation of household components included information from 408 families of sampled students across four districts. Table 4.13 reported findings in mean and standard deviation for quantitative variables while for qualitative variables results in percentage has been presented in Table 4.14.

Table 4.13 reported parental age of sampled pupils from East district as relatively higher than other three districts. The mean age was 47.15 years for fathers and 41.33 years for mothers. The average family size of the sampled household was found higher within North and lower in South Sikkim. Parents from East reported to hold 16.81 years of education (On aggregate of father and mother), which was found to be 6.01, 3.12, and 4.15 years higher than the educational years of parents from West, South, and North district respectively.

With reference to dependents and earners within family, it was observed that sampled households from North possessed higher number of dependents and the average earner in the family was greater for West district. The families from South and East accounted the mean of 1.93 and 1.82 on total earners. Total family income was found to be greater amongst the sampled households of East district. Whereas it was lower amongst the sampled families of West district. The average monthly income of 107 sampled families from West Sikkim was Rs 10060.70. It was Rs 16049.50 for the households of East Sikkim.

Table 4.13 Summary Statistics of Parental and Household Level Factors

Variables	West	South	North	East	Sikkim
Age (Father)	46.53 (9.97)	46.60 (9.61)	46.33 (8.86)	47.15 (9.25)	46.65 (9.41)
Age (Mother)	40.21 (8.40)	39.89 (7.93)	40.74 (8.32)	41.33 (8.65)	40.54 (8.32)
Family Size	5.82 (2.16)	5.67 (1.98)	5.87 (1.79)	5.74 (1.71)	5.78 (1.92)
Years of Education (Husband)	6.31 (2.99)	7.37 (2.36)	6.66 (3.14)	8.91 (3.00)	7.30 (3.05)
Years of Education (Mother)	4.49 (3.04)	6.32 (2.27)	5.64 (3.33)	7.90 (3.22)	6.06 (3.23)
Total No. of Dependent in Family	3.83 (1.71)	3.74 (1.57)	3.93 (1.38)	3.91 (1.28)	3.85 (1.50)
Total No. of Earner in Family	1.99 (1.28)	1.93 (0.92)	1.95 (0.88)	1.82 (0.82)	1.92 (0.99)
Fathers' Income (Monthly in Rs.)	6154.21 (5345.34)	8280.00 (4694.36)	7796.00 (5873.33)	11707.92 (5990.94)	8452.45 (5843.21)
Mothers' Income (Monthly in Rs.)	2056.08 (2401.19)	1630.00 (2320.99)	1825.00 (2344.54)	2202.97 (3162.42)	1931.37 (2579.49)
Total Family Income (Monthly in Rs.)	10060.75 (5937.06)	13730.00 (6529.43)	13480.00 (7322.62)	16049.50 (8287.49)	13280.64 (7359.10)
Monthly Educational Expenditure (in Rs.)	1445.79 (718.79)	1761.00 (1082.26)	1619.00 (1579.91)	1642.57 (1281.98)	1614.22 (1201.41)
Health Expenditure (Monthly in Rs.)	376.64 (817.68)	165.00 (497.75)	80.00 (297.12)	99.01 (387.43)	183.33 (554.12)
Monthly Educational Expenditure On Particular Child (in Rs.)	605.14 (939.86)	667.50 (294.34)	458.00 (236.10)	599.01 (272.49)	582.84 (537.33)
Monthly Health Expenditure On Particular Child (i Rs.)	42.06 (308.08)	25.00 (179.44)	30.00 (222.70)	9.90 (99.50)	26.96 (217.22)
Total Family Expenditure (Monthly in Rs.)	8635.51 (3761.50)	11895.00 (4528.97)	11090.00 (4563.46)	12638.61 (4901.08)	11026.96 (4687.85)
No. of Rooms in House	3.37 (1.54)	3.77 (1.56)	3.89 (1.78)	3.87 (1.53)	3.72 (1.61)
No. of Years Residing in The House	12.20 (10.63)	12.41 (9.04)	12.64 (9.59)	11.28 (9.18)	12.13 (9.62)
No. of Years Residing in the Village/Locality	37.93 (15.91)	43.16 (12.92)	36.02 (13.76)	38.09 (15.33)	38.78 (14.74)
Monthly Electricity Expenditure (Rs)	75.93 (135.77)	98.00 (98.62)	49.10 (72.86)	414.51 (652.26)	158.58 (367.27)
No. of Times of School-Parental Meet Attended (Yearly)	2.20 (0.95)	2.31 (0.69)	1.72 (0.95)	2.35 (0.67)	2.14 (0.86)
No. of Times of Interaction with Childs' Teachers (Yearly)	1.91 (1.06)	1.93 (0.95)	1.37 (0.97)	2.06 (0.73)	1.82 (0.97)
No. of Times of Interaction with School Headmaster (Yearly)	1.80 (1.11)	1.90 (0.94)	1.32 (1.02)	2.02 (0.79)	1.76 (1.01)
No. of Days Remaining Out-Station as of Job Nature (Monthly)	2.40 (6.53)	1.81 (6.01)	1.61 (5.63)	0.57 (2.62)	1.61 (5.45)
Total Family Wealth Concentration (in Rupees)	815537.40 (832584.80)	927595.00 (825672.10)	1078265.00 (1108426.00)	1008629.00 (925815.60)	955196.10 (930354.00)
Observation	107	100	100	101	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures off the bracket are mean values; Figures presented in the parenthesis represents Standard Deviation.

Higher the income, higher was the expenditure; the samples from East incurred greater monthly family expenditure. Comparatively, the expense has been obtained Rs 4003.10, Rs 743.61 and Rs 1548.61 higher than West, South and North respectively.

However, an average monthly educational expenditure was adjudged greater for the samples of South district. Again, families from West Sikkim were observed with lower expenses on education (Table 4.13).

Sampled households in North Sikkim were observed with more number of rooms in their houses. The study found 3.89 rooms on average within the sampled households of the district. Similarly, houses in East, South, and West Sikkim were concentrated with 3.87, 3.77, and 3.37 average numbers of rooms respectively.

It seems that sampled parents from East district hold greater concerns on child's academic. They were reported to interact with child's teacher and school administration at around 4 times annually (Table 4.12). Relatively, the engagement was greater in terms of attendance in school-parents or teacher-parents meetings than other three districts of the study area. The parents from North interacted only 1 time with school administration in an academic calendar of 2016.

As for total family wealth concentration, sampled families from East district were observed to hold a higher concentration of wealth. They were embraced with the assets valued over 1 million Indian currency on average. East was followed by North and South Sikkim. Samples from West were lagging than all other districts. Comparatively, the district was lowest in a tally of family assets concentration (See Table 4.13).

In consistent with the findings from Table 4.12a, Table 4.14 shows similar domination of Hinduism, OBC and Nepali in religious, caste and ethnic settings of the respondents across three districts. There were higher proportions of Buddhist and ST amongst the respondents from North. In South district, the share was succeeded by the percentage of Christians and ST up to an extent.

Table 4.14 Percentage Share of Parental and Household Level Factors

Variables		West	South	North	East	Sikkim
Religion	Buddhist	23	11	59	21	28
	Hindu	67	58	34	68	57
	Christian	7	31	7	6	13
	Others	3	0	0	5	2
Caste	General	2	0	1	11	4
	OBC	47	66	23	65	50
	ST	40	24	72	17	38
	SC	11	10	4	7	8
Ethnicity	Nepali	82	97	53	81	78
	Bhutia	3	2	2	1	2
	Lepcha	11	0	44	2	14
	Others	4	1	1	16	6
Family Nature	Nuclear	77	65	83	77	75
	Joint	23	35	17	23	25
Fathers' Occupation	Unemployed	1	0	0	0	0.25
	Farmer	43	37	30	15	31
	Daily Labour	16	5	15	2	10
	Govt. Service	9	15	12	31	17
	Pvt. Service	6	8	5	15	8
	Business	7	3	3	21	9
	Others	7	29	26	17	19
	NA	11	3	9	0	5.75
Mothers' Occupation	Housewife	39	57	51	58	51
	Farmer	21	12	7	8	12
	Daily Labour	26	17	31	10	22
	Govt. Service	4	5	4	5	4
	Pvt. Service	1	1	1	8	3
	Business	3	2	0	9	3
	NA	7	6	6	2	5
House Type	Kutcha	33	10	10	2	14
	Semi-Pucca	53	70	80	32	59
	Pucca	14	20	10	66	27
Indigenous Residence	Yes	83	91	62	66	76
	No	17	9	38	34	24
Migrated From	Outside India	3	3	32	6	11
	Outside Sikkim	14	6	5	27	13
	None	83	91	62	67	76
Electricity Connection	Yes	94	99	97	100	97
	No	6	1	3	0	3
Health Limitation (Father)	Yes	10	3	0	1	4
	No	90	97	100	99	96
Health Limitation (Mother)	Yes	7	2	0	2	3
	No	93	98	100	98	97
Divorce Status	Yes	2	2	0	0	1
	No	98	98	100	100	99
Widow/Widower Status	Yes	18	7	15	9	12
	No	82	93	85	91	88
Observation		107	100	100	101	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: Figures are presented in percentage; NA represents not applicable.

Nuclear family nature was predominant in all four districts of the study area. However, out of 100 households 35 responded to stay as a joint family in South. Occupational status of parents was more diverse between four districts. Majority of the fathers from West, South and North Sikkim reported being engaged in farming activities, while the share of government employee and businessmen were greater in

East district. Other than farming, 29 and 26% (South and North district respectively) of fathers were working as a carpenter, tailor and taxi driver. As for the mothers' occupational engagements, greater share of housewives in all four districts were obtained. The proportion of daily labors was found succeeding to housewives in West, South and North Sikkim (Table 4.14).

In terms of house type 33 and 53 out of 107 sampled families found residing in kutcha and semi-pucca houses respectively within West Sikkim; 80 out of 100 houses as semi-pucca in North; 70% of houses as semi-pucca in South district; and 66 amongst 101 households were pucca type in East. Relatively, the study adjudged proper and better residential infrastructure of samples in East district while the situation was on contrast in West Sikkim.

About one-third of the families were non-indigenous in North and East district. Immigrants from Nepal, West Bengal, and Bihar comprised the share of 32% in North and 27% in East Sikkim. Economic activities were reported as the major reason behind migration. Social components such as divorce and widow/widower status had been observed to be minimum within the study area. A marginal proportion of 2% divorcee respondents were recorded in West and South district. While 18 and 15% of sampled parents from West and North Sikkim occupied the share of widow/widower.

4.6 Conclusion

Overall, the chapter highlighted some observable differences in multiple aspects related to student learning. The sampled 8th graders of East and South districts were evidently better performers in terms of standardized test scores, while the selected cohort from West Sikkim relatively provided a deficient performance in standardized test on an average. Further the sampled students of West district were characterized with minimal accessibilities to computer and internet facilities, long distance travelling to school, maximum engagement of time in domestic/household activities, lower parental educational background, and humble economic status as compared to pupils from other sampled districts. The latter findings at some extent specify the genesis of less satisfactory performances by 8th graders of West Sikkim. Moreover, the result of Kruskal-Wallis test statistic provided statistical confirmation on considerable existence of variation in the learning outcomes of students at inter-district level given parallel academic settings. However, along with the divergences in test scores and other components of sampled students at spatial premise, this chapter provided further space of analysis to understand and identify the determinants from educational and non-educational aspects those explaining cognitive mechanism and outcomes of sampled students in the study area. Upcoming chapter is focused in this direction.

Chapter 5

Determinants of Students Learning Outcomes

Present chapter made an attempt to study the factors influencing the students learning outcome and the determinants of technical inefficiency of student performance. Here learning outcome of the students has been assessed in terms of student performance in standardized test. The chapter comprises of three sections. The first section collectively covers the discussion of predictors of students learning outcome in the study area in terms of student, school, teacher, parents and peer levels respectively. The determinants of technical inefficiency for student performance have been covered in the successive sections. Conclusion of the chapter has been summarized in final section.

5.1 Predictors of Standardized Test Score

Majority of the empirical strategy under education production function approach following conventional Ordinary Least Square (OLS) estimation technique are characterized with examining average influences of inputs to with educational output, wherein explanatory variable holds similar mean effect throughout the structure of outcome variable (Hanushek, 1979). Such estimates could end up missing the vital observation of explaining varied effects of any given input at different end of the outcome variable (Eide & Showalter, 1998). To address such limitation, present study along with OLS used quantile regression estimation technique, specifically to explore the association and influence of given independent variables on student learning outcome across the conditional distribution of test score at different quantiles. This further will provide the understanding of how the inputs are related with learning outcome of sampled students who are classified as poor, average and better performer in terms of their respective test score.

The study estimated separate sets of regression models to capture the deterministic behavior of factors from the respective aspect of student individual level, school level, teacher level, parental/family level and peer level. Results presented in Tables 5.1–5.6 consist of OLS estimates and quantile regression estimates at 0.10, 0.50 and 0.90 quantiles of standardized test score distribution. Additionally, the precise observation of trend in predictors effect across different quantiles have been captured using quantile graph those presented in Figs. 1.5–1.13. Y axis in the graph represents respective estimated coefficients of independent covariates while X axis reports quantiles.

5.1.1 Student Individual Level Determinants

Results of regression estimate (Table 5.1) suggests that there is greater association of time allocation and management aspects within student individual level with their learning outcomes. The coefficients of tutorial classes duration, time devoted in study at home, time spent on household/domestic activities and time spent on playing were observed statistically significant in OLS model and within majority of the quantile estimates. Distance to school and total marks attained in previous grade (VII) were other strong predictors.

The coefficient of age was observed with its varied effect across the conditional distribution of standardized test score. It exhibited a negative association at lower and median quantiles but was positive at 0.90 quantile. Further, an inverse effect of age on low and average performing sampled students suggest maturity in terms of age has minimal influences on driving cognitive capabilities at elementary level education in the study area. Similarly, the negative coefficient of gender throughout the quantiles indicated male students as better performer relatively. The effect was found greater in higher quantile which means considerable numbers of boys were present amongst top achievers in the conducted standardized test. Likewise, more academic tool in the form of textbook availability at home seems more instrumental for low achievers as the estimated coefficient values are positive at lowest ends of the performance distribution (See Fig. 1.5).

Table 5.1 Student Level Determinants of Test Score

DEPENDENT VARIABLE: TEST SCORES				
INDEPENDENT VARIABLES	OLS Coefficient	Quantile (0.10) Coefficient	Quantile (0.50) Coefficient	Quantile (0.90) Coefficient
Age	-0.179 (0.173)	-0.176 (0.403)	-0.078 (0.216)	0.077 (0.302)
Gender: 0=Male; 1=Female	-0.664 (0.434)	-0.590 (0.831)	-0.674 (0.546)	-0.850 (0.832)
Distance to School	-0.130* (0.077)	-0.158 (0.135)	-0.163* (0.089)	-0.189* (0.110)
Health Limitation (0= Yes; 1=No)	-0.329 (0.865)	-2.460 (1.585)	0.295 (1.077)	-0.009 (1.626)
Total number of course textbooks at home	0.050 (0.078)	0.285** (0.145)	-0.066 (0.097)	-0.102 (0.150)
Number of days remain absent during last 30 days	-0.108* (0.066)	-0.469*** (0.143)	-0.020 (0.825)	-0.085 (0.135)
Tutorial classes duration	1.354*** (0.277)	1.484** (0.588)	1.490*** (0.352)	1.693*** (0.484)
Total marks attained in previous grade (VII)	0.117*** (0.021)	0.093* (0.054)	0.118*** (0.027)	0.083** (0.042)
Time devoted in studies at home (Daily)	0.051*** (0.004)	0.042*** (0.011)	0.054*** (0.005)	0.063*** (0.007)
Time spend on household/domestic activities (Daily)	-0.012** (0.006)	-0.023** (0.010)	-0.017** (0.007)	0.006 (0.012)
Time spend on playing (Daily)	-0.015** (0.007)	-0.017* (0.010)	-0.015* (0.008)	-0.015 (0.011)
Time spend on using internet (Daily)	0.020 (0.014)	0.001 (0.025)	0.035** (0.017)	0.039 (0.025)
Constant	10.868*** (3.056)	9.223 (6.208)	9.891** (3.804)	14.976*** (5.039)
R-squared	0.517			
Pseudo R-squared		0.326	0.334	0.287
F(12, 395)	35.24			
Prob > F	0.000			
VIF	1.29			
MSS test for heteroskedasticity χ^2 (2)	1.850	2.825	1.173	0.125
Prob > χ^2	0.397	0.244	0.556	0.939
Observations	408	408	408	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively.

School absenteeism or class attendance seems to have some observable influences. The variable was strongly significant within lower ends of the test score distribution. Moreover, estimated coefficient values were remarkably negative at all quantiles (Fig. 1.5). Other variables such as tutorial class duration, total marks attained in previous grade (VII), and time devoted in studies at home were directly associated with test score of students across the quantiles. However, trend in effect of previous grade marks (VII) across quantiles were inconsistent. The pattern was strongly positive around quantiles 0.40–0.70 but eventually volatile at upper points (Fig. 1.5). Further, the influence of tutorial class and home study durations were relatively larger at median and higher quantiles which shows an extra self-effort with an aid by tutorial classes in academics plays beneficial for better cognitive achievements.

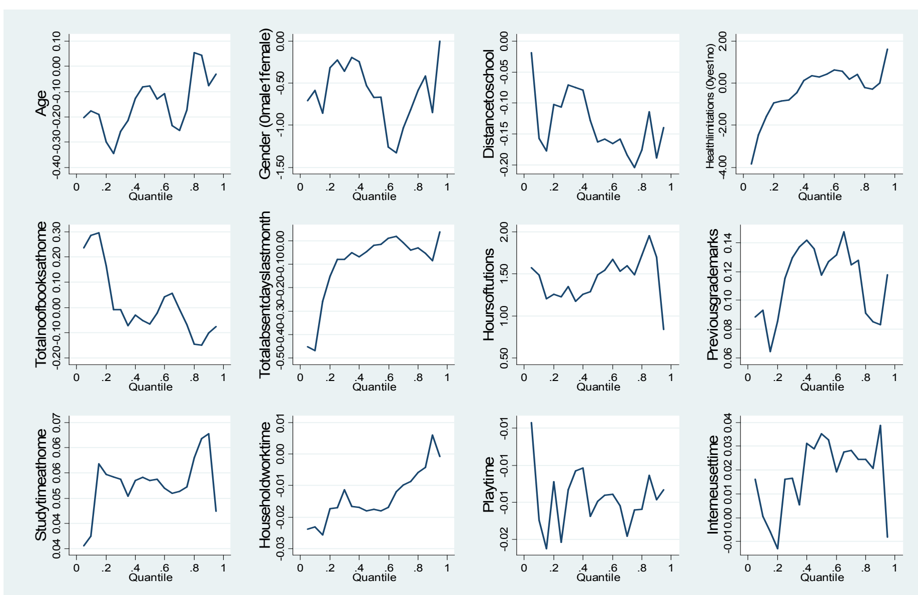

Fig. 1.5 Student individual level inputs and standardized test score quantiles.

With regard to time spent in household/domestic activities and playing, the significant negative impact was found diminishing at upper ends of the conditional distribution.[8] This explains that the sampled pupils with average or better academic cognizance

[8] Both the mentioned variables were statistically insignificant at 90th percentile.

were independent of any adverse effects from such factors. Nonetheless, the negative impact on low performers establishes a matter of concern suggesting better academic centric time routine formation needful to follow by such students. In line with this Metcalfe, Burgess and Proud (2011) reported greater time allocation for leisure and non-academic activities results in reduced study time of students which further hampers their exam scores to fall.

The overall finding from Table 5.1 fosters the conceptual understanding as advocated in related literature. Factors such as classroom attendance, self-study time, and internet accessibility were consistently reported to influence the cognitive levels and outcomes constructively. Such finding is evident in various prior studies of Schmidt (1983), Marburger (2001), Carvin (2006), Stance (2006), Chen and Lu (2009), Grave (2011) and Arulampalam, Naylor and Smith (2012). However, Noraini and Kong (2011) observed tutorial classes after school hours to be less helpful on improving learning outcomes those provided with non-willingness and lower interests of students on such.

5.1.2 School Institutional Level Determinants

This section made an attempt to discuss the determinants of overall student test score taking the institutional factors of sampled schools in the study area given its conditional distribution and on average. The effect of years of school establishment was found positive and significant in OLS model and across all three estimated quantile models. This indicate the overall robust influence of school inheritance complimented with academic and administrative attributes explaining students learning outcomes at elementary level education in the study area. Such association might be a contribution of effective policy initiatives to certain limit which are focused on fostering quality education in public elementary schools across all the states of country.[9]

With respect to gender of school head master, the estimates of OLS and quantile regressions confirmed female head master to be more favorable for average and better achievers in the study area. The coefficient was statistically significant and positive in both OLS models, model II of 50th percentile, and models I and II of 90th percentile. However, the negative association at 10th percentile (model I) suggests pupils with lower test score being benefitted by male head masters. Complete illustration on variable's effect across different quantiles have been presented in Figs. 1.6 and 1.7, where except for 0.10 quantile (Fig. 1.6) the covariate can be seen to be different from negative values on other percentiles. Overall, it has been evident through prior investigations that such differences are characterized with distinctive managerial approaches between male and female leaderships. Riger and Galligan (1980) argued uncommon psychological and behavioral factors lead differences in male and female leaderships which further results in unique outcomes. Similarly, meta-analysis of Eagly, Makhijani, and Klonsky (1992) confirmed female managerial characteristics to be more driven by lower aggression, kindness, low risk taking and care intensive.

The estimated effect of head master years of education was negative but statistically insignificant for all type of achievers. However, the extent of impact was declining from 0.10 quantile to 0.90 quantile which indicates highly qualified head masters at sampled elementary schools are favorable for high performing students (Fig. 1.6).

[9] For example, Sarva Siksha Abhiyan (SSA) a flagship programme launched by Government of India in the year 2001–02 which is devoted towards provision of quality education, better school infrastructure, universal enrolment etc. at elementary schools. The policy is functional since 2001–02 in Sikkim and covers all Government Junior High Schools of all four districts.

Table 5.2 School Institutional Level Determinants of Students Test Score

DEPENDENT VARIABLE: TEST SCORES								
INDEPENDENT VARIABLES	OLS Model I Coefficient	OLS Model II Coefficient	Quantile (0.10) Model I Coefficient	Quantile (0.10) Model II Coefficient	Quantile (0.50) Model I Coefficient	Quantile (0.50) Model II Coefficient	Quantile (0.90) Model I Coefficient	Quantile (0.90) Model II Coefficient
Years of Establishment	0.070***	0.092***	0.077**	0.092**	0.085***	0.104***	0.065	0.081**
(School)	(0.018)	(0.019)	(0.040)	(0.037)	(0.027)	(0.014)	(0.043)	(0.032)
Gender of Head Master	1.953*	2.297**	-0.754	2.560	2.127	2.552***	2.945**	3.291*
(0=Male; 1=Female)	(1.178)	(1.57)	(2.603)	(1.753)	(1.482)	(0.804)	(1.486)	(1.746)
Years of Education	-0.311*		-0.401		-0.226		-0.113	
(H.M)	(0.139)		(0.266)		(0.192)		(0.194)	
Years of Experience		0.067		0.114		0.078*		-0.191**
(H.M)		(0.058)		(0.119)		(0.047)		(0.077)
Total Enrolment	-0.004		-0.137		-0.032		-0.0001	
(Grade VIII)	(0.005)		(0.107)		(0.049)		(0.069)	
Total Enrolment		-0.016		0.005		0.003		-0.002
(School)		(0.027)		(0.009)		(0.003)		(0.047)
Total Number of	0.758	0.613	0.456	2.183*	0.240	0.006	1.848**	2.442**
Staffrooms	(0.517)	(0.588)	(1.055)	(1.162)	(0.709)	(0.474)	(0.881)	(0.931)
Total number of Female	0.104		0.294		0.192		-0.078	
Teachers	(0.105)		(0.235)		(0.139)		(0.200)	
Total number of		-0.578**		-1.300**		-0.788***		-0.269
Male Teachers		(0.281)		(0.619)		(0.193)		(0.364)
Students' gender specific	-5.129***	-6.163***	-0.986	-5.862	-6.654***	-7.632***	-7.859**	-8.504**
toilets (0=Yes; 1=No)	(1.623)	(2.043)	(2.452)	(4.236)	(2.250)	(1.510)	(2.753)	(3.306)
Safe drinking water facility	1.473*	1.388	-0.342	-0.783	3.380***	2.088**	1.589	0.553
(0=Yes; 1=No)	(0.873)	(1.021)	(0.950)	(2.350)	(1.65)	(0.736)	(1.434)	(1.394)
Playground facility	1.706**		4.069**		2.016**		0.161	
(0=Yes; 1=No)	(0.649)		(1.731)		(0.931)		(0.980)	
Library Facility		-0.166		0.576		-0.225		1.185
(0= Yes; 1= No)		(0.935)		(2.202)		(0.730)		(1.230)
Computer facility	-3.135***	-2.531***	-5.307***	-3.402**	-3.736***	-3.593***	-1.659	-2.016*
(0=Yes; 1=No)	(0.821)	(0.818)	(1.373)	(1.314)	(1.029)	(0.568)	(1.322)	(1.074)
No. of times extra-curricular	0.052	0.048	0.094*	0.044	0.014	0.038	0.071	0.027
activities organized (Annually)	(0.038)	(0.035)	(0.054)	(0.073)	(0.043)	(0.026)	(0.059)	(0.062)
School approachability by road	-3.510**	-2.072	-3.289	-5.668*	-2.899	-1.916	-4.404*	-3.555
(0=Yes; 1=No)	(1.480)	(1.420)	(2.504)	(3.525)	(2.183)	(1.220)	(2.516)	(2.868)
Constant	15.797***	12.322***	10.645*	6.356	14.894***	14.390***	18.181***	21.155***
	(3.277)	(2.025)	(5.613)	(4.823)	(4.244)	(1.520)	(6.057)	(2.790)
R-squared	0.195	0.185						
Pseudo R-squared			0.144	0.142	0.141	0.137	0.085	0.094
F(12, 395)	8.97	7.97						
Prob > F	0.000	0.000						
VIF	2.21	2.42						
MSS Heteroskedasticity test χ^2 (2)	6.005	4.450	7.885	7.894	3.729	4.253	1.361	0.099
Prob > χ^2	0.050	0.108	0.019	0.019	0.155	0.119	0.506	0.952
Observations	408	408	408	408	408	408	408	408

Source: Self-estimates based on field survey data collected fromMarch 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively; Heteroskedasticity corrected robust standard errors presented for OLS Model I and Model II; Bootstrapped standard errors for Quantile (0.10) Model I and II.

Such observation was contrary for years of administrative experience. The coefficient was positively significant at 0.50 quantile but was negative in 0.90 quantile. The finding further implies, unlike previous variable, the administrative experience seems to be of greater utility for low and average achievers in the study area. In a pioneering attempt to gauge the principal level factors influences on student achievement at elementary level with educational production function mechanism, Eberts and Stone (1988) found principals' administrative experience to alter student achievement positively and significantly. Meanwhile, highly qualified principals were observed less beneficial at elementary schools in their analysis. Contrary to this, Brewer (1993) obtained no significant relationship between principal administrative experience and student standardized test score. The variable yielded negative association in regression analysis of the study. Similar finding in case of principals' experience in actual school and student efficiency scores in reading and mathematics is evident in the analysis of Masci, Witte, and Agasisti (2018). The study also confirmed principal with higher educational degree are linked with lower efficiency scores of pupils those enrolled in middle schools.

The variable of total enrolment at grade VIII was inversely related with overall test score in all the points of conditional distribution. It implies, greater the class size lower will be the learning outcome. Coleman report (1966) in this specific context claimed the factor as less influential in determining student cognitive outcome. Various other researchers post Coleman report attempted to understand the effect of class size on student cognitive achievement but the findings eventually have been less certain. For example, the effect was found negative for IVth, Vth, and VIth graders of Texas public schools in the study of Rivkin, Hanushek, and Kain (2005). On contrary, the estimated effect was positive at 10th, 50th, and 75th percentiles of mathematics achievement distribution in the analysis of Levin (2001). Similarly, Jackson and Page (2013) claimed beneficial impact of smaller class size for high performing students. On the other side, investigation of Dustman, Rajah, and Van (2003) reported minimal influence of the variable on student achievement. Regardless of ambiguity in terms of earlier findings factors related to class size or classroom enrolment holds conventional importance while measuring deterministic behavior of school or classroom related inputs.

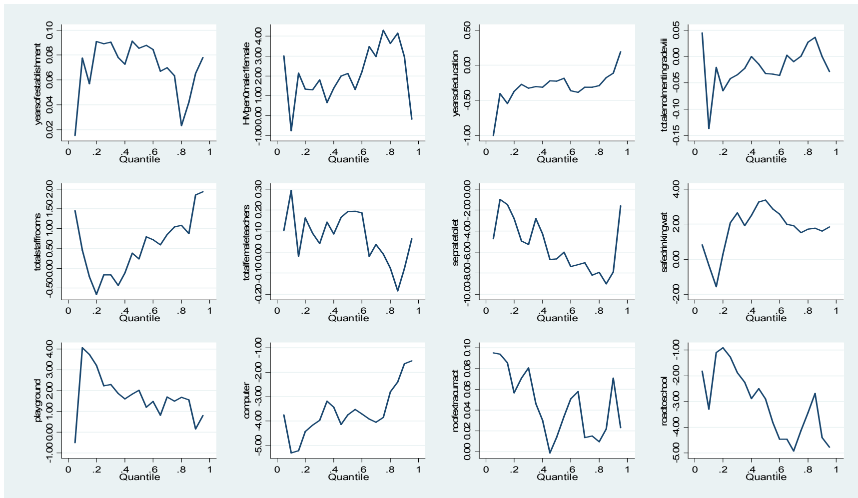

Fig. 1.6 School level inputs and standardized test score quantiles (Model I).

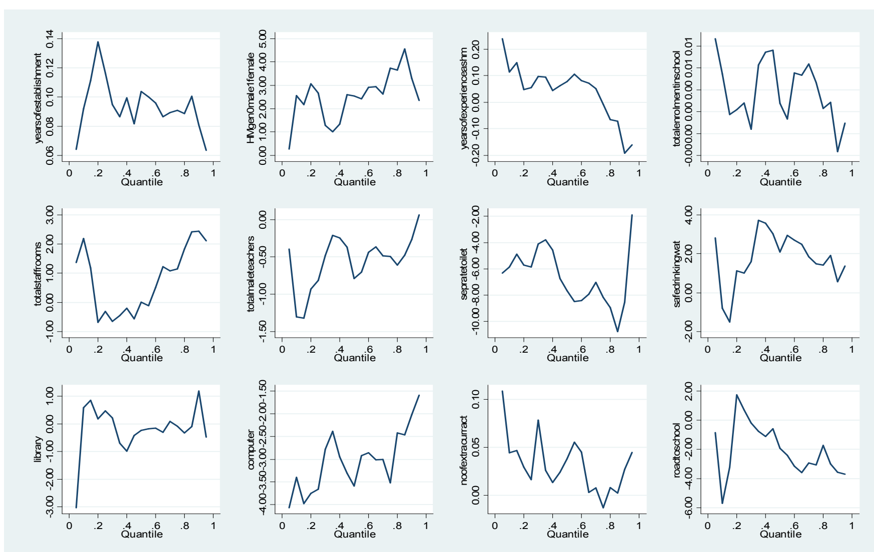

Fig. 1.7 School level inputs and standardized test scoreq (Model II).

School size or total enrolment at school has also been aspect of interest for researchers investigating determinants of student learning outcome (See Eide & Showalter, 1998; Levin, 2001; Welsch & Zimmer, 2016). From the regression experiment of present study, the effect of total school enrolment was non-negative at 0.10 and 0.50 quantiles but the degree of impact was minimal and statistically insignificant. The estimated coefficient was negative at 0.90 quantile. This simply provides an idea that increased number of students at schools excels the probability of greater academic arrangements to occur which ultimately could be more of a supportive component for low and average learners. In line with this observation Eide and Showalter (1998) found school enrolment as a significant positive predictor of student performance. The study reported strong positive association of respective covariate with pupil achievement at median and lower quantiles. Further, Levin (2001) confirmed positive impact of school enrolment on scholastic achievement of IVth graders at various quantiles such as 0.10, 0.25, 0.50, and 0.75. However, it was a negative predictor across these quantiles for 8th graders. Similarly, recent investigation of Welsch and Zimmer (2016) explained the relationship as positive and significant at elementary schools.

Amongst infrastructural covariates, gender specific toilet and computer facilities were the significant predictors of standardized test score for all types of performer. Non availability of such school infrastructural components seem to deteriorate sampled students academic performance in general. This provides an understanding that provision of proper sanitation and technological facilities in schools play influential role on motivating pupil cognitive outcome up to an extent in the study area. Various earlier researches have been vocal on the significance of proper school infrastructural settings while predicting better learning outcome of students especially in the context of developing countries (Suryadarma, Suryahadi, Sumarto, & Rogers, 2006; Banerjee, Cole, Dulfo, & Linden, 2007; Javier & Marcelo, 2011; Sprietsma, 2012; Lee, Rhee, & Rudolf, 2017). Other than these two variables, school approachability by road was found vital from the analysis. The coefficient was negative and significant in OLS model I, model II of 0.10 quantile estimates, and model II of 0.90 quantile estimates. The effect was obtained maximum at lower and upper ends within the conditional distribution of outcome variable (Figs. 1.6 and 1.7). The result further implies better infrastructure in terms of road connectivity to schools influences student cognitive outcome to excel which is probably attributed by lesser time spent on daily travelling before and after school hours especially in rural areas of the study area.

5.1.3 Teacher Level Determinants

The influence of teacher level factors determining student performance in the study area being analyzed in this section with special reference to Mathematics and English teachers.

Given the teachers aspect, relationship and its effect with learning outcome differ substantially at subject level in the study area. For instance, variable such as age of English teacher was a positive predictor of overall test score, while a negative association was observed in case of Mathematics teacher across conditional distribution of the dependent variable. So far, the literature understanding with regard to teacher age effect have been in line with the latter finding of the study suggesting younger teacher to proffer more effort and enthusiasm in teaching. Prior investigation of Lodewijiks (2015) witnessed similar result.

With respect to teacher gender, in both the subject sampled male English teachers were found significantly beneficial for low and average performing pupils, whereas a female teacher in Mathematics seems to have a greater impact on overall cognitive achievement of pupils. This indicates the role of teacher gender being central within learning mechanism of students. Scholars such as Ehrenberg, Goldhaber, and Brewer (1995) argued teacher gender could hold crucial effect on subject specific assessments of the students. However, earlier studies have been inconclusive over decades on its significance and association with student outcome. The review of Ehrenberg, Goldhaber, and Brewer (1995) over National Educational Longitudinal Survey data of 1988 concluded the impact to be ineffective. Similarly, no significant relationship with pupils cognitive achievement was evident in the studies of Bloom (2008), Holmlund and Sund (2008) and Neugebauer, Helbig, and Landmann (2011). On the other side, findings of Lam, Tse, Lam, and Loh (2010) and Winters, Haight, Swaim, and Pickering (2013) suggested students to propel more under female teachers. Likewise, researchers such as Klein (2004), Dee (2007), Helbig (2010), Rawal and Kingdon (2010) and Lee, Rhee, and Rudolf (2017) emphasized same gender teachers are potent to elevate academic performance of pupils. Contradicting with all these school of thoughts in the sense that, present study obtained teacher gender effect on entire distribution of students test score ranging from low to high performers (Figs. 1.8–1.11) which revealed the influences could vary given the student cognitive ability and to generalize the association for entire student structure is less rational. For example, the coefficient of gender in case of English teacher was positively significant at 0.90 quantile (Model II) which signifies female teacher effect is strongly beneficial for high scorers in the study area. The relationship was inverse at 0.10 and 0.50 quantiles.

Surprisingly, years of teaching experience in specific school was insignificant in either case. Moreover, the coefficient was negative across quantiles for English teacher but with declining magnitude at upper ends of the conditional distribution (Figs. 1.8 and 1.9). Such result provides contradiction to standard theoretical wisdom and might be apprehensive in a way for quality educational outcomes at public schools.

Table 5.3 Teacher Level Determinants of Students Test Score (English Teachers)

DEPENDENT VARIABLE: TEST SCORES								
INDEPENDENT VARIABLES	OLS Model I Coefficient	OLS Model II Coefficient	Quantile (0.10) Model I Coefficient	Quantile (0.10) Model II Coefficient	Quantile (0.50) Model I Coefficient	Quantile (0.50) Model II Coefficient	Quantile (0.90) Model I Coefficient	Quantile (0.90) Model II Coefficient
Age	0.136**	0.204**	0.111	0.130	0.116	0.183	0.098	0.124
	(0.070)	(0.091)	(0.092)	(0.121)	(0.082)	(0.135)	(0.081)	(0.118)
Gender (0=Male; 1=Female)	-1.537**	-0.725	-3.300***	-2.916***	-1.944*	-0.858	0.737	2.474**
	(0.665)	(0.662)	(0.993)	(1.060)	(1.014)	(1.091)	(0.884)	(0.968)
Years of Teaching experience in specific school	-0.238	-0.141	-0.353	-0.162	-0.312	-0.213	-0.164	0.015
	(0.159)	(0.152)	(0.230)	(0.219)	(0.196)	(0.177)	(0.191)	(0.174)
Duration of professional teachers training course	-0.577	-0.236	-1.426**	-0.656	-0.844	-0.237	0.049	0.286
	(0.437)	(0.455)	(0.595)	(0.713)	(0.650)	(0.601)	(0.648)	(0.672)
No. of daily classes taken on specific subject	3.011***	2.255**	3.435***	2.989**	2.763	2.240	4.347***	3.277***
	(0.937)	(0.936)	(1.188)	(1.368)	(2.181)	(2.042)	(1.324)	(1.204)
Nature of Appointment (0=Regular; 1=Adhoc)	-2.618**		3.173*		-2.288**		3.239**	
	(1.055)		(1.906)		(1.176)		(1.333)	
Monthly Income from Teaching		0.000		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)		(0.000)
No. of transfers since appointment	-0.542***	-0.499***	-0.750***	-0.816***	-0.365	-0.381*	-0.375**	-0.184
	(0.172)	(0.173)	(0.248)	(0.257)	(0.260)	(0.233)	(0.192)	(0.223)
No. of academic assignments given (Annually)	0.109*	0.130**	0.202*	0.266***	0.034	0.087	0.126	0.151*
	(0.061)	(0.064)	(0.107)	(0.090)	(0.090)	(0.101)	(0.086)	(0.090)
Hours of internet use (Daily)	0.755**	0.489	0.589	-0.248	1.434**	0.887	-0.137	-0.321
	(0.366)	(0.366)	(0.692)	(0.559)	(0.596)	(0.578)	(0.584)	(0.596)
Constant	11.098***	6.947**	7.612	3.010	12.622***	7.971*	16.336***	12.465***
	(3.074)	(2.964)	(4.461)	(4.313)	(3.926)	(4.441)	(3.972)	(4.295)
R-squared	0.147	0.132						
Pseudo R-squared			0.130	0.107	0.131	0.122	0.057	0.051
F(9, 398)	9.30	8.43						
Prob > F	0.000	0.000						
VIF	3.31	3.90						
MSS heteroskedasticity test χ^2 (2)	10.617	10.214	7.871	6.890	11.921	11.717	0.744	2.835
Prob > χ^2	0.005	0.006	0.020	0.032	0.003	0.003	0.689	0.242
Observations	408	408	408	408	408	408	408	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively; Heteroskedasticity corrected robust standard errors presented for OLS Model I; OLS Model II; Quantile 0.10 Model I; Quantile 0.10 Model II; Quantile 0.50 Models I and II.

There was a divergent effect of professional teacher training duration on students test score for both English and Mathematics teachers. The positive effect of professional training by English teacher was confined within high performing students, while the strong beneficiaries from such trainings by Mathematics teacher were only the low achievers within sampled pupils. Earlier findings so far hold uncertainty in this direction. For example, Dildy (1982) argued teacher trainings to act constructively on augmenting student academic outcomes. Later, Cohen and Hill (2000) claimed its impact to be negligible. Further, the study of Rawal and Kingdon (2010) observed the negative effect. Quite parallel to Rawal et al., (2010), the analysis of Lee, Rhee, and

Rudolf (2017) found teacher initial vocational trainings as a negative predictor of pupil test score in ten francophone African nations. Thus, the coherent implication from the literature and quantile estimates of present study indicate nature and specification of teacher trainings might play pivotal while gauging its influences over student performance those based on their individual scholastic cognizance.

Instructional duration in classroom hold central position amongst various input elements of learning outcomes. Huebenera, Kuger and Marcus (2017) explained instructional time acts instrumental to curtail performance gap between low and high achievers. Their result indicated instructional time requirement of students differ given their cognitive capabilities and for such, provision of higher instructional duration will help necessitate low achievers to perform better with greater subject understandings. In line with this, the estimated coefficient of number of daily classes taken was significantly positive at 10th and 90th percentiles (Table 5.3). Similar to it, the covariate exerted strong direct association with overall test score of sampled pupils at 0.10 and 0.50 quantiles (Table 5.4). Undoubtedly the variable seems to be instrumental for students in the study area regardless of performance type (See Figs. 1.8–1.11).

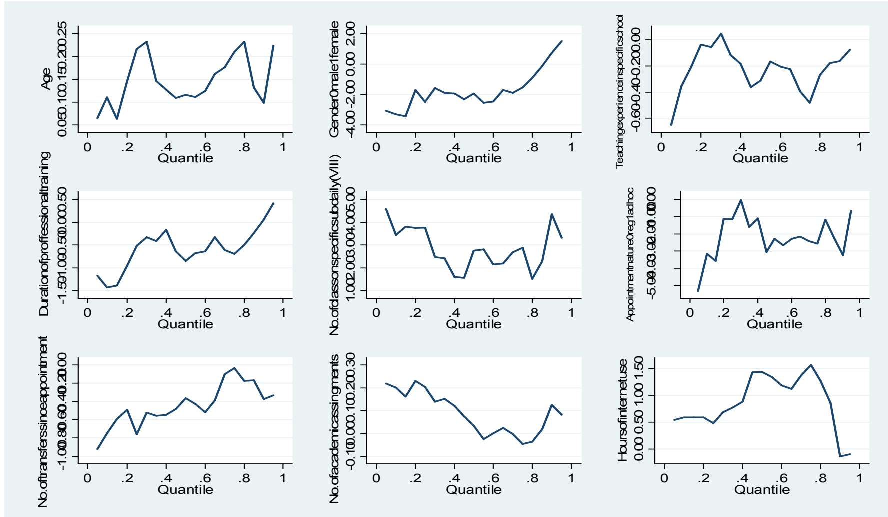

Fig. 1.8 Teacher level inputs (English) and standardized test score quantiles (Model I).

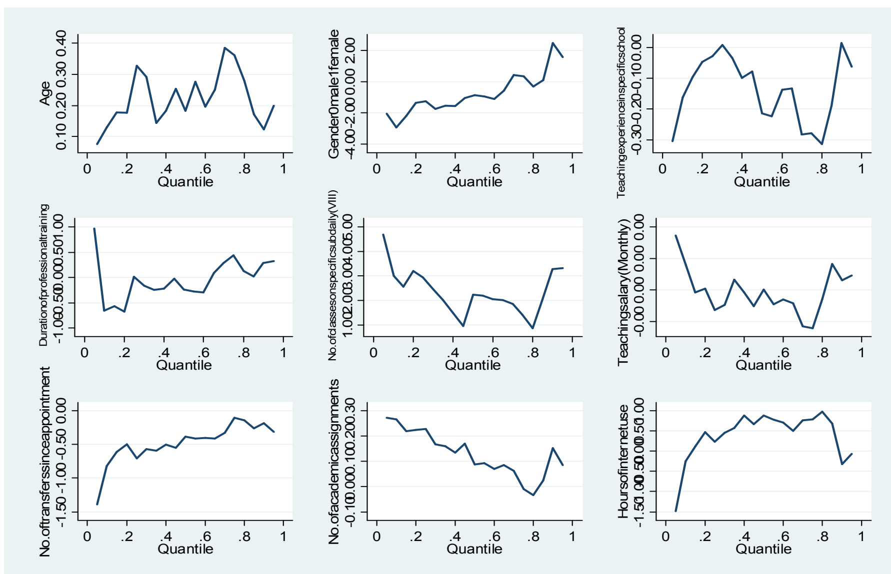

Fig. 1.9 Teacher level inputs (English) and standardized test score quantiles (Model II).

In terms of appointment nature, sampled teachers with regular employment status were found more favorable predictor of students learning outcomes in the study area. Present study concurs and confutes with Lee, Rhee, and Rudolf (2017) and Rawal and Kingdon (2010) respectively in this regard. Monthly income of Mathematics teacher from teaching was statistically significant despite its estimated values being lowest amongst non-negative integers across different ends of test score distribution. The variable was found insignificant in Table 5.3. Prior investigation of Kingdon et al., (2007) recorded no empirical or statistical significance of teacher wages on academic achievement of grade VIII students in public schools of India.

Table 5.4 Teacher Level Determinants of Students Test Score (Mathematics Teachers)

DEPENDENT VARIABLE: TEST SCORES								
INDEPENDENT VARIABLES	OLS Model I Coefficient	OLS Model II Coefficient	Quantile (0.10) Model I Coefficient	Quantile (0.10) Model II Coefficient	Quantile (0.50) Model I Coefficient	Quantile (0.50) Model II Coefficient	Quantile (0.90) Model I Coefficient	Quantile (0.90) Model II Coefficient
Age	-0.113* (0.061)	-0.205** (0.101)	-0.227** (0.103)	-0.471 (0.319)	-0.159 (0.100)	-0.140 (0.134)	-0.049 (0.090)	-0.079 (0.110)
Gender (0=Male; 1=Female)	2.669*** (0.813)	2.565*** (0.820)	4.027*** (1.277)	5.310*** (1.539)	1.486 (0.980)	1.212 (0.995)	3.356*** (1.099)	3.304*** (1.128)
Years of Teaching experience in specific school	0.108 (0.116)	0.186** (0.093)	-0.184 (0.224)	0.230 (0.197)	-0.074 (0.147)	0.059 (0.127)	0.143 (0.182)	0.160 (0.150)
Duration of professional teachers training course	-0.902 (0.718)	-0.369 (0.783)	0.807 (1.006)	1.692** (0.846)	-2.235** (0.824)	-2.081** (0.940)	-1.208 (1.241)	-1.223 (1.192)
No. of daily classes taken on specific subject	2.920*** (0.762)	2.796*** (0.763)	2.767*** (0.997)	1.539 (1.789)	3.529*** (0.860)	3.169*** (0.861)	1.604 (1.114)	1.686 (1.137)
Nature of Appointment (0=Regular; 1=Adhoc)	-4.247** (2.006)		-10.873*** (2.718)		-7.486** (2.915)		-1.503 (2.598)	
Monthly Income from Teaching		0.000** (0.000)		0.000* (0.000)		0.000* (0.000)		0.000 (0.000)
No. of transfers since appointment	0.584* (0.314)	0.752** (0.294)	0.208 (0.617)	0.796 (1.104)	0.484 (0.347)	0.733** (0.334)	0.370 (0.452)	0.449 (0.466)
No. of academic assignments given (Annually)	-0.010 (0.032)	-0.024 (0.033)	0.015 (0.069)	-0.068 (0.098)	0.013 (0.039)	0.032 (0.041)	-0.116** (0.054)	-0.129** (0.057)
Hours of internet use (Daily)	0.541 (0.358)	0.668* (0.370)	0.101 (0.801)	0.436 (0.722)	0.436 (0.386)	0.597 (0.415)	0.193 (0.556)	0.249 (0.565)
Constant	17.777*** (3.616)	14.598*** (2.491)	20.756*** (5.193)	14.363 (9.869)	22.866*** (5.567)	12.955*** (3.044)	23.468*** (5.104)	22.103*** (3.809)
R-squared	0.159	0.159						
Pseudo R-squared			0.124	0.136	0.140	0.132	0.068	0.071
F(9, 398)	9.20	9.11						
Prob > F	0.000	0.000						
VIF	4.16	5.72						
MSS heteroskedasticity test χ^2 (2)	11.908	11.506	5.681	12.080	7.945	6.088	4.223	4.136
Prob > χ^2	0.003	0.003	0.058	0.002	0.019	0.048	0.121	0.126
Observations	408	408	408	408	408	408	408	408

Source: Self-estimates based on field survey data collected fromMarch 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively; Heteroskedasticity corrected robust standard errors presented for OLS Model I; OLS Model II; Quantile 0.10 Model I; Quantile 0.10 Model II; Quantile 0.50 Model I and II.

Mobility of English teacher in terms of transfers in number was identified as a significant negative predictor, but the relationship was insignificant in the quantile estimates of Table 5.4.[10] Academic assignment of English subject was of greater utility for low performing sampled pupils. The degree of association was higher within the lower part of conditional distribution (Figs. 1.8 and 1.9). On contrary, significant negative values of the covariate was substantial at 90th percentile (Table 5.4). It implies, increase in number of assignment for a subject like Mathematics could stagnate the learning outcome of better performing students at greater extent. The adverse effect of mounting academic burden on students mental health and academic achievement was discussed in the studies of Kralovec and Buell (2001) and Galloway and Pope (2007).

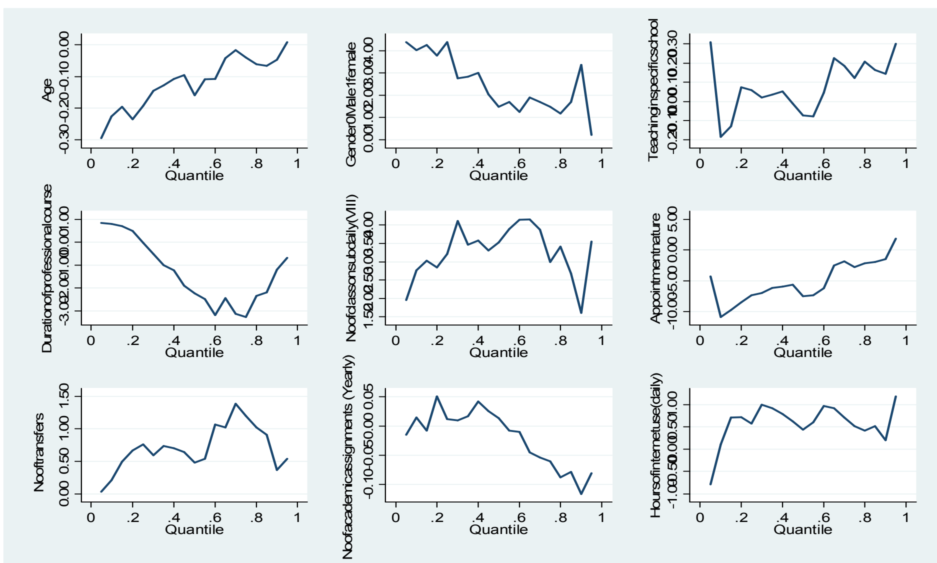

Fig. 1.10 Teacher level inputs (Mathematics) and standardized test score quantiles (Model I).

[10] The estimated coefficient of number of transfers since appointment in case of Mathematics teacher was positively significant in model II of 0.50 quantile.

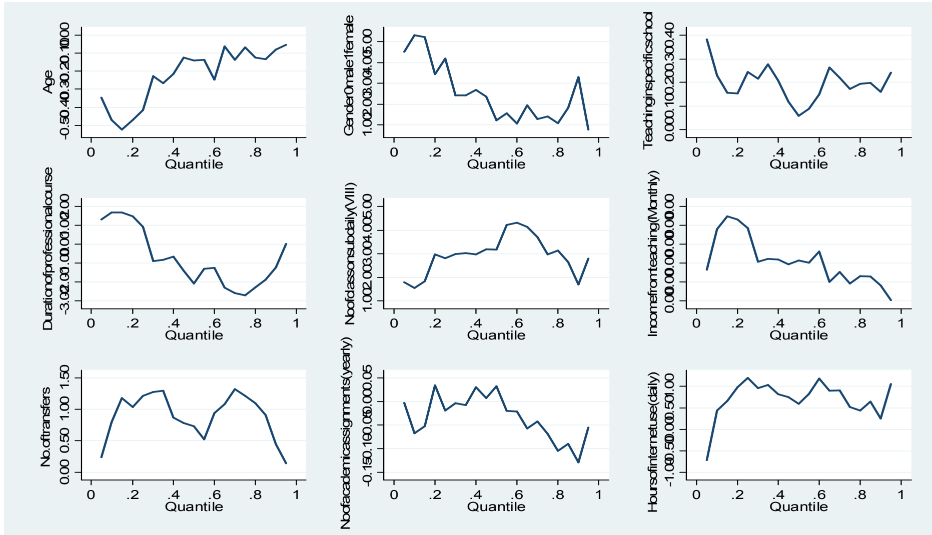

Fig. 1.11 Teacher level inputs (Mathematics) and standardized test score quantiles (Model II).

5.1.4 Parental and Household Level Determinants

Coleman et al., (1966) provided an understanding on importance of family level factors within multiple determinants of student academic outcome. The report on specific was one amongst initial investigations to identify and advocate the effect of parental or family background. Later, considerable attempts emphasized household or parental characteristics to be crucial on defining academic achievement of student (White, 1980; Hanushek & Luque, 2003; Duncan & Magnuson, 2005; Giambon & Porcu, 2015; Li & Qui, 2018).

Table 5.5 provides the result of OLS and quantile estimates. Ethnic background of the family was statistically significant in OLS and quantile regression models. It was identified as a positive predictor of student test score in 0.50 and 0.90 quantiles. This implies sampled pupils from non-nepali community were on majority within average and high performing students in the study area.

Table 5.5 Parental and Household Level Determinants of Student Test Score

DEPENDENT VARIABLE: TEST SCORES				
INDEPENDENT VARIABLES	OLS Coefficient	Quantile (0.10) Coefficient	Quantile (0.50) Coefficient	Quantile (0.90) Coefficient
Ethnicity (0= Nepali; 1=Others)	0.655**	-0.028	0.865*	0.494*
	(0.280)	(0.497)	(0.492)	(0.284)
Fathers' Occupational Status	0.107	0.436	1.285	-1.925
(0=Unemployed; 1=Employed)	(1.475)	(2.355)	(2.586)	(1.750)
Mothers' Occupational Status	-0.687	0.392	0.262	-3.308***
(0=Unemployed; 1=Employed)	(0.974)	(1.512)	(1.690)	(0.825)
No. of dependents in the family	-0.621***	-0.592*	-0.847**	-0.155
	(0.187)	(0.316)	(0.329)	(0.282)
Monthly Income (Father)	0.0002***	0.0002*	0.0002**	0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.000)
Monthly Income (Mother)	0.0001	0.0001	0.0001	0.0001***
	(0.0001)	(0.0002)	(0.0003)	(0.0001)
Total Family Expenditure (Monthly)	0.0001*	0.0002**	0.0001	0.0001**
	(0.000)	(0.0001)	(0.0001)	(0.0001)
Years of residence (Village/Locality)	-0.027	-0.044	-0.034	0.032
	(0.020)	(0.031)	(0.036)	(0.020)
State Citizenship (0=Yes; 1=No)	-1.717**	-2.845**	-1.654	-1.431**
	(0.671)	(1.074)	(1.193)	(0.706)
Daily study support to child (0=Yes; 1=No)	0.395	0.055	0.578	-0.191
	(0.522)	(0.933)	(0.925)	(0.543)
Divorce Status (0=Yes; 1=No)	3.555	0.055	5.091	8.593***
	(2.618)	(1.809)	(4.096)	(0.649)
Widow/Widower Status (0=Yes; 1=No)	0.258	-0.466	-0.147	-0.143
	(1.026)	(1.674)	(1.815)	(1.266)
Constant	13.404***	10.526***	11.877**	16.361***
	(2.923)	(2.937)	(4.855)	(1.750)
R-squared	0.154			
Pseudo R-squared		0.098	0.099	0.069
F(12, 395)	5.98			
Prob > F	0.000			
VIF	1.83			
MSS test for heteroskedasticity χ^2 (2)	0.553	0.028	0.295	4.754
Prob > χ^2	0.758	0.986	0.863	0.093
Observations	408	408	408	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively; Heteroskedasticity corrected robust standard errors presented for Quantile 0.90.

Fathers' occupational status was insignificant but exerted direct relationship with the dependent variable at lower and median ends of conditional distribution. Similar pattern of influences was observed in case of mothers' occupational status. It suggests that parental employment status of being employed is beneficial to sampled pupils with lower and average cognitive abilities. Surprisingly, the association was less favorable in case of high achievers (Fig. 1.12).

Number of dependents in family had some considerable negative impact across quantiles. The estimated coefficient was statistically significant at 10th and 50th percentiles. This endorses the conventional understanding that, higher the number of dependents in family greater will be the probability of child's engagement in occupational activities those perceived as an economic aid to the family. Thus, the outcomes from such will hamper academic achievements of the student up to greater extent.

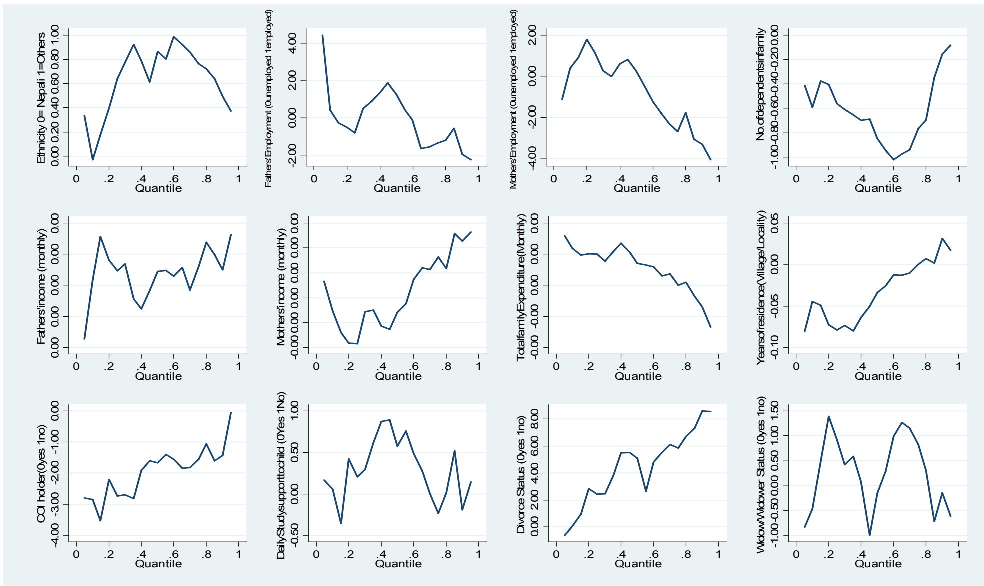

Fig.1.12 Parental/household level inputs and standardized test score quantiles.

Monthly income of father and monthly family expenditure were observed with positive effects. However, the extent of impact was minimal at all three quantiles. Local residential status of the sampled household was identified as another strong predictor of students learning outcome in the study area. The covariate of state citizenship was inversely related with pupil overall test score regardless of performer type. Moreover, the impact was relatively greater in lower quantiles, which indicate family residential background characterized with local inhabitant also explains the student learning up to some level in the study area. The primary reason behind this result is families with state citizenship of Sikkim are entitled with the provision of public benefits in education at public institutions, employment, housing, and other allied areas which might relatively provide an extra utility for local residents on their living standards to thrive than the non-locals. Overall, majority of the result (Table 5.5) concurs the findings of Lazear (1999), Li and Qui (2018), Duncan and Mgnuson (2005) and Giambon and Porcu (2015).

5.1.5 Peer Level Determinants

Literature so far had provided ample evidences on empirical and conceptual contexts about the influences of friends within classroom, school, and neighborhood on student learning (Epple & Romano, 1998; Zimmer & Toma, 2000; Wilkinson et al., 2000; Lazear, 2001; Burke & Sass, 2013). Table 5.6 presents regression results of peer effect on students overall test scores.

Table 5.6 Peer Level Determinants of Students Test Score

DEPENDENT VARIABLE: TEST SCORES				
INDEPENDENT VARIABLES	OLS Coefficient	Quantile (0.10) Coefficient	Quantile (0.50) Coefficient	Quantile (0.90) Coefficient
No. of desk mates at classroom	-0.112 (0.096)	0.018 (0.034)	-0.088*** (0.025)	-0.273*** (0.025)
Previous grade total percentage (Desk mate)	0.062*** (0.015)	0.044* (0.026)	0.081*** (0.091)	0.035* (0.020)
No. of friends at home	0.138 (0.304)	-0.283 (0.508)	0.457 (0.401)	0.545* (0.334)
Age (Best Friend)	0.075 (0.064)	0.230* (0.136)	0.073 (0.086)	-0.034 (0.089)
School dropout Status of best friend (0=Yes; 1=No)	5.155*** (1.274)	4.470** (2.150)	5.601*** (1.690)	7.551*** (1.278)
Time spend with friend at neighborhood (Daily)	-1.916*** (0.606)	-2.832** (1.168)	-2.242** (0.816)	-2.085** (0.868)
Constant	9.602*** (1.589)	3.531 (2.633)	8.230*** (2.117)	16.449*** (2.012)
R-squared	0.112			
Pseudo R-squared		0.038	0.077	0.084
F(6, 401)	8.46			
Prob > F	0.000			
VIF	1.47			
MSS test for heteroskedasticity χ^2 (2)	3.693	0.381	2.501	2.383
Prob > χ^2	0.158	0.827	0.286	0.304
Observations	408	408	408	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels respectively.

The coefficients related to total number of desk-mate and daily time spending with friends at neighborhood was significant and negative. Greater concentration of students in single desk was found as a hindering factor to better achievers, the effect was substantially negative at upper quantiles (Fig. 1.13). This further explains that overcrowding of pupils in classroom and desk are negative predictors of student learning outcome, an increment on such hampers overall academic performance of students in general.

Likewise, academic background of desk mate and school dropout status of best friend was observed exhibiting a robust influence across all the ends of test score distribution. Both the coefficients were positive and statistically significant. The result implies that desk sharing with better academic performers could be persuasive and motivational for one to improve. Similarly, a companion of friend with no school dropout status was strongly instrumental to foster overall learning outcome of the sampled students. The trend of impact was relatively higher at upper points of the conditional distribution (Fig. 1.13).

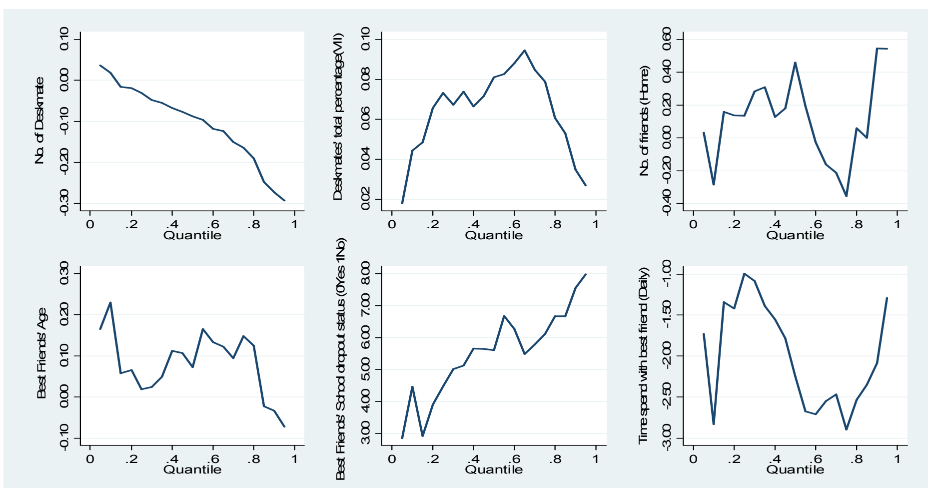

Fig. 1.13 Peer/friend level inputs and standardized test score quantiles.

5.2 Educational Production Frontier and Predictors of Technical Inefficiency

The primary motivation behind the estimation of stochastic frontier and censored tobit regression models was to analyze the determinants of technical inefficiency in learning outcome of the sampled students. Frontier model in the study considered inputs from the aspect of school, teacher, and household along with student individual. Two variations of both frontier and inefficiency models were estimated considering different sets of independent covariates to avoid the incidence of multicolinearity. Further, to prevent any possibility of heterogeneity in the inefficiency components the study obtained robust standard errors of all the estimated coefficients.

Factors determining technical inefficiency for overall test scores of sampled 8th graders were evaluated through simultaneous estimation of the stochastic production frontier (SPF) model together with technical inefficiency model based on education production function framework. The estimated regression models are as follows;

Model I: $\ln(TS_i) = \beta_0 + \beta_1 \ln(SA_i) + \beta_2 \ln(DTS_i) + \beta_3 \ln(NADS_i) + \beta_4 \ln(PGP_i) + \beta_5 \ln(TDSH_i) + \beta_6 \ln(TDP_i) + \beta_7 \ln(YOES_i) + \beta_8 \ln(YEH_i) + \beta_9 \ln(PTR_i) + \beta_{10} \ln(SCR_i) + \beta_{11} \ln(SDBR_i) + \beta_{12} \ln(ANAD_i) + \beta_{13} \ln(ANT_i) + \beta_{14} \ln(FA_i) + \beta_{15} \ln(MA_i) + \beta_{16} \ln(FS_i) + \beta_{17} \ln(NAPTM_i) + \beta_{18} \ln(EEPS_i) + v_i - u_i$

The inefficiency model which was simultaneously estimated stochastic educational production frontier model for the study is as follows;

$$u_i = \delta_0 + \delta_1 (SG_i) + \delta_2 (OOB_i) + \delta_3 (DTC_i) + \delta_4 (ATA_i) + \delta_5 (TG_i) + \delta_7 (AYTE_i) + \delta_8 (YFE_i) + \delta_9 (YME_i) + w_i$$

Where, TS_i is the standardized test score of the sampled students; SA_i is student age; DTS_i is distance to school; $NADS_i$ is number of absent days of a student in during last

30 days; PGP_i is previous grade percentage acquired by a student; $TDSH_i$ is time devoted in studies at home on daily basis; TDP_i is time devoted in playing daily; $YOES_i$ is years of establishment of school; YEH_i is years of experience of head master; PTR_i is pupil-teacher ratio in grade VIII; SCR_i is student-classroom ratio at school; $SDBR_i$ is student desk-bench ratio at grade VIII; $ANAD_i$ is average number of absent days during present academic calendar (Teachers); ANT_i is average number of transfers since appointment (Teachers); FA_i is fathers' age; MA_i is mothers' age; FS_i is family size; $NAPTM_i$ is number of attendance on parent-teacher meet; $EEPS_i$ is educational expenditure on particular student (Monthly).

Similarly, u_i is technical inefficiency score for overall test score of the sampled students; SG_i is student gender; OOB_i is order of birth of the student; DTC_i is duration of tutorial class; ATA_i average teachers' age; TG_i Teacher gender; $AYTE_i$ is average years of education (Teacher); YFE_i is years of fathers' education; YME_i is years of mothers' education.

Model II: $$\ln(TS_i) = \beta_0 + \beta_2 \ln(NTH_i) + \beta_3 \ln(TDHA_i) + \beta_4 \ln(TDWT_i) + \beta_5 \ln(TDPOG_i) + \beta_6 \ln(DOC_i) + \beta_7 \ln(NET_i) + \beta_8 \ln(TCMD_i) + \beta_9 \ln(TNDM_i) + \beta_{10} \ln(ADDSPT_i) + \beta_{11} \ln(NS_i) + \beta_{12} \ln(TFI_i) + v_i - u_i$$

The inefficiency model which was simultaneously estimated stochastic educational production frontier model for the study is as follows;

$$u_i = \delta_0 + \delta_1 (DCUD_i) + \delta_2 (WD) + \delta_3 (SD) + \delta_4 (ND) + w_i$$

Where, NTH_i is number of textbooks at home; $TDHA_i$ is time devoted in household activities on a daily basis by student; $TDWT_i$ is time devoted in watching television daily; DOC_i is duration of class; NET_i is number of educational tours from school (annually); $TCMD_i$ is total class days missed in an academic calendar; $TNDM_i$ total number of desk-mate in a class (VIII); $ADDSPT_i$ is average daily duration of self-preparation by teacher; NS_i is number of siblings; TFI_i is total family income (Monthly).

Likewise, $DCUD_i$ duration of computer used daily; *WD* is West district; *SD* is South district; *ND* is North district.

The result of the frontier models I and II reported in columns A and B explains academic background of greater achievements in previous grade (VII) and time spending on self-study helps students on cognitive accumulations. The covariates such as total percentage acquired in previous grade (VII) and time devoted in studies at home were positive and statistically significant. The result is similar with the findings of Bressoux, Kramarz and Prost (2009) and Dolton, Marcenaro and Navarro (2003). The study of Bressoux et al., (2008) found initial test scores of students establishing positive effect on their final scores. Similarly, Dolton et al., (2003) obtained significant direct impact of self-study time on academic performance.

Improper utilization of time by spending more hours in playing or engagement of child in domestic or household activities for longer duration hampers overall academic performance. The significant negative coefficient of variables like time devoted in playing and household activities supports the assumption. The study of Ng, Zakaria, Lai and Confessore (2016) confirmed negative correlation of time mishandling with academic grades of secondary level students in Malaysia.

Variables such as student age and number of textbooks at home were positive but insignificant. However, the direct association of these factors on overall test score indicates maturity in age and higher concentration of books at home will positively supplement student academic performance in the study area. Prior researchers in this regard obtained a mixed observation as Michaelowa (2001) found an inverse relationship of student age and test score, while there was a positive effect of age on student achievement in the analytical result of Dolton et al., (2003). With regard to number of textbooks at home, present study concurs with Kingdon et al., (2007) and Kuecken and Valfort (2013).

The effect of travelling duration to school and classroom attendance was negative but was statistically insignificant in the frontier model. However, these factors have often been considered as obstructions for student cognitive attainments. Lukkarinen et al., (2016) and Viera et al., (2018) confirmed them as the negative predictors of student academic achievement.

Amongst the inputs within school level, covariates of years of school establishment, headmaster years of experience, and duration of class were strongly instrumental for students learning outcomes in the study area. This finding coincides with the observation of quantile estimates discussed in previous section (Tables 5.2–5.4). Additionally, Braun, Gable and Kite (2011) confirmed positive effect of school head teacher experience on student outcome of K8 schools in United States. Similarly, while measuring the impact of class duration with student achievement using PISA 2006 data, Lavy (2015) found classroom instructional time as a significant positive determinant of student test score. On the other side, overcrowding in schools and classrooms were identified as the hindering elements in production process of elementary education in the study area. The estimated coefficients of pupil-teacher ratio, student-classroom ratio, student-desk bench ratio, and total number of desk mate were negative with greater statistical significance in the frontier models. This gives an impetus to conventional understanding about probability of lower class or school sizes creating better overall academic environment in classroom or school with greater availability and reach of provided educational facilities. Numerous scholars with empirical evidences advocated such congestions to provide inverse impact on students learning (Correa, 1993; Koc & Celik, 2015; Welsch & Zimmer, 2016; Shirley, 2017).

Table 5.7 Maximum Likelihood Estimation of Educational Production Frontier

Mean vif for Model I – 1.81 Mean vif for Model II – 1.36	Dependent Variable: Standardized Test Score	
Variable	Model I	Model II
Frontier Model	**(A)**	**(B)**
Constant	10.847 (8.899)	23.355*** (4.309)
Student Age	0.010 (0.115)	
Distance to School	-0.063 (0.046)	
Number of textbooks at home		0.055 (0.149)
Number of absent days (Student)	-0.045 (0.051)	
Previous grade percentage	0.090*** (0.014)	
Time devoted in studies at home (Daily)	0.022*** (0.004)	
Time devoted in playing (Daily)	-0.009*** (0.004)	
Time devoted in household activities		-0.029*** (0.008)
Time devoted in watching Television		-0.011(0.009)
Time devoted in playing online games		-0.010(0.018)
Years of Establishment (School)	0.051*** (0.011)	
Years of Experience (Head Master)	0.090*** (0.030)	
Duration of Class		1.737* (1.001)
Number of educational tours		-0.883* (0.496)
Total Class days missed		-0.097* (0.054)
Pupil-Teacher Ratio (Grade VIII)	-3.681*** (1.445)	
Student-Classroom Ratio	-0.068*** (0.033)	
Student-Desk Bench Ratio	-1.751*** (0.548)	
Total number of desk mate		-0.102*** (0.030)
Average number of absent days (Teacher)	-0.0002 (0.035)	
Average number of transfers (Teacher)	-0.333*** (0.103)	
Average duration of daily self-preparation (Teacher)		0.037** (0.019)
Fathers' Age	0.044** (0.214)	
Mothers' Age	-0.008 (0.025)	
Family Size	-0.213*** (0.685)	
Number of Siblings		-0.459*** (0.135)
Number of attendance on parent-teacher meet	1.975*** (0.215)	
Total family Income		0.0001*** (0.000)
Educational expenditure on particular student	0.001*** (0.0001)	
Inefficiency Model	Dependent Variable: Technical Inefficiency for Overall Test Score	
Constant	8.698** (3.319)	8.421*(4.564)
Student Gender	0.365(0.282)	
Order of birth	-0.191*** (0.065)	
Duration of tutorial classes	-0.692*** (0.186)	
Duration of Computer used daily		-0.028 (0.059)
Average Teachers' Age	0.027 (0.076)	
Teachers' Gender	-0.341 (0.401)	
Average Years of Education (Teacher)	0.057 (0.116)	
Average Years of Teaching experience	-0.142** (0.065)	
Years of fathers' education	-0.388*** (0.069)	
Years of mothers' education	-0.415*** (0.067)	
District West		-1.842* (1.128)
District South		-5.875*** (2.338)
District North		-1.822* (1.098)
Parameters for Compound Error		
σ_u	0.119* (0.064)	3.942*** (0.878)
σ_v	2.472*** (0.094)	3.312*** (0.935)
λ	0.048 (0.113)	1.190 (1.603)
$-2(\log_R - \log_U)$	152.218***	28.248***
Observations	408	408

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.

Note: ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively; Logs used for all variables in frontier model; robust standard error figures in parenthesis; vif stands for variance inflation factor.

Surprisingly, the effect of number of annual educational tour was unfavorable to students test scores. Respective covariate was negative and weakly significant on statistical terms in the estimated frontier model II. This opposite association found in the study area might be attributed by lack of educational excursions or minimal arrangements of such tours at elementary schools.

Numerous studies over the decades recommended teacher characteristics to be influential and vital on production mechanism of student cognizance (Hanushek, 1971, 1986; Wayne & Young, 2003; Feng, 2009). With literature recommendation, present study made an experiment to capture the relationship and impact of some teacher related inputs on student overall test score. The result obtained in Table 5.7 suggests teacher mobility and the duration of self-preparation by teacher holds substantial association with student learning in the study area. The coefficient of average number of transfers since appointment was negative but statistically significant. This further implies that increment in frequency of teacher transfer hampers student scholastic developments which ultimately might be persuaded by volatility in pedagogical practices. Average daily duration of self-preparation by teacher was positive and significant at 0.05 level of statistical significance (Model II).

With respect to inputs from household/parental level present study observed fathers' age, family size, number of siblings, attendance on parent-teacher meet, monthly family income and monthly family expenditure as considerable contributors in production mechanism of student academic outcome in the study area. Fathers' age was found to be positive which implies paternal maturity in terms of age provides greater utility to cognitive development of child especially during schooling years. Similar positive relationship was obtained in the studies of Hassan et al., (2011) and Raj et al., (2015).

Learning environment for a child is not only confined within classroom, school or tutorial classes, a suitable academic atmosphere in home could prominently propel student academic outcome. Given the family size, larger concentration of members or overcrowding in the family will provide unsuitable circumstances for academic activities. Ultimately, this will hamper overall academic performance of pupils. The result of frontier estimates provided similar inverse association of covariates such as family size and number of siblings with overall test score of sampled students. The estimated coefficients of both the variables were statistically significant which further shows the robust deterministic behavior of those input elements in student learning outcome of the study area. Present study concurs the findings of Blake (1989), Black, Devereux and Salvanes (2004), Kean (2005) and Karwath, Relikowski and Schmitt (2014).

Number of attendance on parent-teacher meet in one year, monthly family income and expenditure were positive determinants of pupils test scores in the study area. In other words, parental academic concerns for child and family socio-economic status were found instrumental in cognitive mechanism of 8th graders in the study area. Proper parental engagements in child's academic affairs and better socio-economic background will significantly aid and motivate the student performance for better educational achievements. The positive impact of effective parental communication with school authorities is evident in the earlier investigations of Henderson and Mapp (2002) and Pong, Hao and Gardner (2005). However, Chu and Williams (1996) obtained relatively minimal effect of parent-school meet on academic achievement of 8th graders. Similarly with regard to socio-economic status, Sun, Liu and Sun (2009) found significant positive impact family income on student academic achievement of primary schools in China. Likewise, Gross (1993) documented a direct relationship between parental socio-economic status and child's cognitive abilities. Present study is in line with the literature.

Prior explaining the determinants of technical inefficiency of student learning outcome as reported in Table 5.7, a likelihood ratio test is a necessary requisite to understand the relevance of estimated stochastic frontier models in the analysis. In general words, to check the validity whether technical inefficiency components account for any variation in output or not. The study conducted the test statistic under the recommendation of Kumbhakar, Wang and Horncastle (2015) based on Chi^2 distribution. The estimated value was highly significant at 1 percent level (Kodde & Palm, 1986) for both the models. This gives an implication for rejection of null hypothesis and suggests significant presence of inefficiency components within total error term (See Table 5.8). Thus, both the estimated stochastic frontier model holds statistical relevance in the analysis.

Table 5.8 Test Statistic for Technical Inefficiency Effect

Null Hypothesis	$-2(\log_R - \log_U)$	Decisions
$H_0 : \delta_0 = \delta_1 = \delta_2 = \delta_3 \ldots\ldots\ldots = \delta_9 = 0$	152.218***	Reject H_0
$H_0 : \delta_0 = \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$	28.248***	Reject H_0

Under the assumption of Battese and Coelli (1988) present study estimated simultaneous technical inefficiency models (Table 5.7) with the motivation of capturing the determinants those explaining inefficiencies in production mechanism of student learning outcome in the sampled schools of the study area. The variables such as order of birth, duration of tutorial classes, average years of teacher teaching experience, parental years of education, and all three district dummies were identified defining technical inefficiency of student learning outcome substantially. All these mentioned covariates were negative and statistically significant. This implies a unit increment of such inputs at individual level will contribute on reduction of inefficiency in the course of scholastic development of sampled 8th graders. Further, the result stimulates conceptual consideration about how an educational or cognitive fabrication is attributed by multidimensional factors of production those inclusive of student inherent aspects to school and teacher characteristics, and of parental elements to locational components.

So far, noticeable literature evidences are available explaining deterministic effect, association and significance of above mentioned covariates on cognitive developmental process of pupils. For example, the study of Steelman and Powell (1985) found no considerable effect of birth order of students on their academic outcomes. On contrast, Black, Devereux, and Salvanes (2004) advocated the significance of student birth order in their learning process and educational outcome. Similar contradiction on duration of tutorial class could be observed between the findings of Dolton et al., (2003) and Gidey (2015), where the former study observed an opposite association with student cognitive outcome and the latter confirmed the effect to be positive especially for female students. However, Dolton et al., (2003) suggested the need of tutorial class aid to pupils with lower cognitive capabilities. With respect to the impact of teacher teaching experience, prior investigations of Woods (1990) and Corney and Arguea (2008) witnessed an influential positive effect. Likewise, Hanushek (1986) emphasized and categorized parental literacy and family wealth concentration as strong determinants amongst non-school factors those explaining student academic outcomes. Later, similar findings were advocated by Dolton et al., (2003), Ogunshola and Adewale (2012) and Raj et al., (2015).

Having identified the deterministic associations of some selected variables with technical inefficiency constituents of students overall test scores within frontier estimates, the study attempted similar empirical assessment using tobit regression model. Primarily, the experiment was motivated for analogous understanding on effect and relationship of variables given the estimates of both SFA and tobit models. Further, the latter regression experiment provides a scope of understanding the marginal effect of determinant components on technical inefficiency for students test performance. The functional formation of regression models in tobit estimates is identical with prior inefficiency models. Table 5.9 provides the estimated results of censored tobit models I and II.

Table 5.9 Determinants of Technical Inefficiency

Mean vif for Model I : 3.47 Mean vif for Model II : 1.40	Dependent Variable: Technical Inefficiency for Overall Test Score	
Variable	Model I	Model II
Censored Tobit Model	**(A)**	**(B)**
Constant	1.997*** (0.214)	0.771*** (0.029)
Student Gender	0.009 (0.018)	
Order of birth	-0.018*** (0.005)	
Duration of tutorial classes	-0.029*** (0.011)	
Duration of Computer used daily		-0.007* (0.004)
Average age of Teacher	-0.002 (0.076)	
Teachers' Gender	-0.072*** (0.019)	
Average Years of Education (Teacher)	-0.018** (0.007)	
Average Years of Teaching experience	-0.018*** (0.003)	
Years of fathers' education	-0.030*** (0.004)	
Years of mothers' education	-0.049*** (0.004)	
District West		0.076* (0.041)
District South		-0.098** (0.047)
District North		0.025 (0.041)
Parameters for Compound Error		
F (9, 399)	56.29	4.61
Prob > F	0.000	0.001
Pseudo R^2	2.054	0.091
Log pseudo likelihood	122.664	-105.549
Observations	**408**	**408**

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.
Note: ***, **, and * denotes significance at the 0.01, 0.05, and 0.10 levels, respectively; Logs used for all variables in frontier model; robust standard error figures in parenthesis; vif stands for variance inflation factor.

Estimated coefficients of covariates in models I and II such as average age (Teacher), average years of education (Teacher), and district dummies of West and North district were different from prior estimates of Table 5.7. The coefficients for teacher average

age and average years of education were negative in censored tobit model I. Moreover, the latter variable was strongly significant at 0.05 level of statistical significance providing observable evidence of ambiguity in findings. However, such empirical uncertainty could not limit conceptual notion about factors related to teacher quality being crucial for student academic achievement. A teacher with genuine academic quality could always be instrumental in the course of student cognitive development especially during elementary levels of schooling. Earlier studies of Rivkin, Hanushek and Kain (2005) and Clotfelter, Cadd and Vigdor (2007) advocated the effect of teacher quality on student achievement to be substantial. Likewise Blomeke, Olsen and Suhl (2016) observed teachers with graduation degree were considerable determinants of students achievements in Western Asian countries. Thus, highly qualified teachers are often subject to lower inefficiencies in educational production mechanisms provided they must be characterized with better pedagogical specifications.

The duration of computer use in daily basis was related with lower inefficiency in student learning outcome. Unlike Table 5.7, the coefficient was statistically significant. Similarly, the district dummies of West and North districts were found positive, while the observation on coefficient of South district corresponds with the finding of Table 5.7. The major implication out of the result suggests that the test scores of sampled students from South district were relatively complimented with better scholastic abilities. This finding concur the result of Table 4.1 (Chapter IV) in this respect. In addition, the average technical inefficiency scores as evident in Table 5.10 confirms the findings that sampled 8th grade cohort of South district to characterized with greater cognizance.

Table 5.10 District-Wise Average Technical Inefficiency Scores for Students Overall Test Scores

District	Inefficiency Scores
West	0.20
South	0.33
North	0.21
East	0.25
Sikkim	0.24

Source: Self-estimates based on field survey data collected from March 2017 to March 2018.

5.3 Conclusion

Present chapter made an attempt to empirically discuss the determinants of students learning outcomes and the factors explaining technical inefficiency on same. The analysis was purely based on primary data under which the standardized test score of sampled 8th grade pupils from 23 Government Junior High Schools across four districts were considered as an outcome variable. The selection of explanatory variables was inclusive of both academic and non-academic aspects related to student learning process. The estimated results of OLS, quantile, and stochastic frontier regression models identified some substantial predictors from all the selected dimensions. Factors related to student academic background and time managements in playing, self-study at home and household activities were the potential inputs within student individual level explaining their cognitive attainments. Likewise, age of school institution, gender of head master and teacher, administrative experience of head master, pupil-teacher ratio, student-classroom ratio, availability of computer facility, gender specific toilets, playground facility, teachers' nature of appointment, teacher mobility in number of transfers, duration of self-preparation prior to classes by teacher, cognizance levels of desk-mate, number of desk mate etc. were found significant for scholastic production mechanism of 8th graders in the study area. Other than the educational aspects, social and economic parameters like parental age, family size, number of siblings, monthly family income and expenditure, number of dependents in family, local residential status, parental engagements on child's academics in the form of their attendance in parent-teacher meets or interactions with school administration, school dropout status of best friend, and time spending with friends at neighborhood were evident with their substantial influences on overall test scores of sampled pupils. Further, findings from quantile estimates suggested the impact of considered input factors could vary with scholastic capabilities of students. For example, the significant negative impact of time spending on household/domestic activities was found diminishing at upper ends of the conditional distribution. Similarly, female head master was more favorable for average and better performing students in the study area. The coefficient was negative at 0.10 quantile. The covariate of total school enrolment exerted a negative association with student performance at 0.90 quantile of the conditional distribution. The relationship was opposite at lower and median quantiles. In case of teacher gender (English), positive effect was confined within high scoring pupils in the study area. Consequently it can be confirmed that results obtained from quantile estimates provided greater utility on understanding the predictive nature of input factors on student learning outcome given the type of performer. Lastly the inefficiency models estimation results from Tables 5.7 and 5.9 reported student inherent factor like their birth order is negatively related with the technical inefficiency. This means, younger the student amongst the siblings lower will be the cognitive inefficiencies. In addition, the study observed enrolment in tutorial classes and greater average years of teacher teaching experience and parental years of education are significantly associated with lower inefficiencies for learning outcomes of sampled pupils in the state. Amongst three locational indicators of students, sampled cohort of 8th graders from South district were relatively found with higher scholastic efficiency. This further suggests elementary educational production or cognitive developmental process of sampled students is characterized with greater efficiency in South Sikkim. An extensive discussion about the findings given the research questions of present study is evident in next chapter.

Chapter 6

Conclusions and Policy Implications

This chapter summarizes the overall findings, some policy implications, and research limitations of present study. This chapter consists of three sections. The first section covers discussions on findings of the study based on primary and secondary data. Inferences of the research outcomes on policy perspective have been provided accordingly in the subsequent section. The limitations of present study and the scope for further research inquiry have been covered in the final section.

6.1 Findings of the Study

Present study has attempted to understand the factors explaining students learning outcomes in Sikkim within production mechanism of their cognitive developments. The selected inputs were inclusive of family and friends level components other than educational aspects. The study underpinned four different aims and research questions in the course of investigation. Apparently, the conclusive discourses on findings with respect to research objectives and questions are evident in the subsequent sub-sections.

6.1.1 Status of Elementary Education in Sikkim

Prior to understanding the predictors of students learning outcomes in Sikkim, the study examined the status of elementary education across districts of the state. In other words, an inter-district comparison was done with a motivation of understanding that how the components of educational development differ across four districts and what has been the status on productivity change and educational efficiency. The objective was fulfilled using secondary data for a reference period of 11 years (2003–

04 to 2014–15). The overall development of elementary education in terms of accessibility of schools, infrastructural availability, teacher components and educational outcomes were found satisfactory in North and South Sikkim. In addition, productivity growth in transforming available educational resources into outcomes was greater in these districts within the reference period. Surprisingly, the elementary educational system of East district was lagging in both the parameters except educational efficiency. On an average, EDI value of East Sikkim was lowest amongst all other districts. Similarly, the productivity change was minimal. This might be attributed by higher enrolments of students in schools and within classrooms. The overall population density of East Sikkim is relatively greater than others. However, overcrowding or higher enrolments at schools could be addressed with a provision of educational resources like more numbers of teaching and non-teaching staff, classroom, and other related components in schools at larger scale. Further, quality monitoring of student-focused educational mechanism could be a greater utility for productive outcomes.

6.1.2 Inter-district Variation in Standardized Test Scores

Present study conducted a standardized test based on the questions covering basic Arithmetic, English, and Intelligent Quotient. Total of 408 pupils of 8th grade participated covering 23 Government Junior High Schools across four districts. There was a clear statistical evidence of differences in the performances of sampled cohorts at the inter-district level. Such variations were mainly profound in the Aggregate, Arithmetic and English scores of pupils. The test scores of sampled students from West Sikkim were relatively deficient to other three districts. Minimal accessibilities to computer and internet facilities at home or school, long distance travelling to school, maximum engagement of time in household/domestic activities, lower parental years of education, humble economic background of the family, lack of academic support at home, non-enrolment in tutorial classes, and living with foster guardians were common attributes related with the sampled pupils of West Sikkim. Apparently, such factors might be a source of obstructions for scholastic developments of students in the district. An appropriate academic initiative characterized with the provision of special educational aid such as tutorial classes within schools or at community level for students deprived of social, economic and cognitive advantages could curtail the void of learning outcomes at inter-school, inter-block, or inter-district levels up to certain extent.

6.1.3 Factors Determining Students Learning Outcomes and Technical Inefficiency of Overall Test Score

The empirical strategy for determining the factors predicting students learning outcomes and technical inefficiency in overall test scores was based under educational production function approach. Aggregate test score of the sampled pupils was an outcome variable, while factors related to school, teacher, student individual, parents/household, peers within classroom and neighborhood were selected as an input variables in the regression framework. In case of inefficiency models, technical inefficiency scores within total attained test scores of sampled students was a dependent variable and predictors from multiple components those related with students learning mechanism including locational aspects were characterized as explanatory variables. Econometric regression models such as OLS, Quantile regression, Stochastic frontier and Censored tobit were estimated to fulfill the objectives. The general findings from parametric empirical exercises of present study support the literature on idea that how the dimension of inputs for students cognitive developments or attainments are independent of limits within educational components. Indicators like travelling duration to school, order of birth, student gender, time spend on domestic household activities and playing, father age, family size and number of siblings, monthly family income and expenditure, and state citizenship status were significant inputs from non-academic elements explaining pupils scholastic outcomes and inefficiencies in the study area.

Within the educational perimeter student academic achievements of previous grade, time devoted in self-study at home and tutorial class, years of school establishment, gender of headmaster and teacher, teacher teaching experience, administrative experience of head master, educational background of teacher, infrastructural accessibilities in school like gender specific toilets and computers, pupil-teacher ratio, academic assignments, job status of teacher as permanent, monthly educational expenditure of student, scholastic capability of desk-mates, and parental years of education were substantially associated with pupils performances.

In addition, quantile regression results provided an understanding about inconsistencies in the impact of mentioned input variables with respect to students cognizance. The relationship and effect of predictors were different across the spectrum of students learning outcomes. For example, administrative experience of head master was a positive predictor of students test score those were identified as low and average performers. The covariate was inversely related with top performing pupils. Similarly, the beneficial effect of professional training on teaching by English teacher was confined within high achievers. Likewise, an academic assignment in a subject like Mathematics was relatively of greater utility for pupils with low and average cognitive abilities. The dummy covariate of library facility in school was negative only at 0.50 quantile of conditional distribution. In other words, it signifies that unavailability of library in school will only hamper the scholastic developments of average achievers in standardized test of study area. This further indicates, either low performers are non-customary to access the facility or they inherit casual concerns on such, on the other side students with better cognitive abilities might be habituated with less dependency on school library. However, majority of the sampled schools were on shortage of proper library facility for students in the study area. The study found, only 5 out of 23 sampled Government Junior High Schools are equipped with the facility. Amongst these 5 schools, 2 were from South, 1 from West and 2 from North district.

Pupils enrolled in public elementary schools especially at rural areas are deprived of learning environment based on technological parameters which have been a retarding element in human capital formation at basic level in developing economies to match up with fundamental standards. The inefficiency models of SFA and Censored tobit regression estimates reported, sampled students from South district as relatively efficient with greater scholastic abilities than the cohorts from West and North Sikkim. This implies that the sampled schools of South district are operating efficiently with regard to transformation of educational resources into better cognitive outcomes of 8th graders. Other than the policy variables, the inherent factors of student like gender as male and order of birth were related with reduced inefficiency. This unfolds the concern about the performance of female students. The relationship was similar in the quantile estimates as well. The coefficient of gender was negatively associated with aggregate test scores of pupils across all the points of conditional distribution.

Lastly, some of the factors related to age of school institution, student-desk bench ratio, teacher mobility in terms of number of transfers since appointment, state citizenship status of Sikkim and school dropout status of best friend were identified as prominent predictors of pupils learning outcomes in the context of the study area. There have been minimal empirical and conceptual evidences in the literature identifying deterministic characteristics of such constituents explaining scholastic fabrication of elementary level students. Present study is unique in this respect.

6.2 Policy Implications of the Study

Two major policy measures might be suggestible with respect to the findings of the study in the course of further improvements in scholastic developments of students enrolled in Government Junior High Schools of the state. Firstly, the course of quality education should be skill oriented based on provision of basic informatics and technological elements. For such, accessibility of appropriate and essential resources such as computers, library with general knowledge based magazines, daily newspaper reading sessions in school assembly and internet facilities at school could boost the scholastic proficiencies of pupils up to greater extent. Secondly, the matter of concern is independent of those non-available resources. Instead, the effective monitoring of operating inputs is an area to focus. In this respect, consistent organization of standardized test based on standard format for elementary level students on half yearly or annual basis is recommended. This further could be instrumental on recognizing cognitive levels or gaps within the cohort of pupils.

6.3 Research Limitations and Future Implications

Given the scarcity of resources and time at individual level, present study is embodied with certain research constrains. At first, selected sample of students were exclusively of 8th grade. Present study failed to cover pupils from other grades of elementary schools in the study area. This further will obstruct the research understanding about behavioral and functional effects of given resources or input factors on learning outcomes of students those from other grades of elementary level education.

Likewise, the analytical configuration was independent of comparative evaluations and understandings. Present study did not cover the analysis of factors explaining overall test scores of sampled 8th graders in terms of gender, subjects, types of school based on ownership (Public and Private), and location (Rural and Urban).

Present study is based on cross-section data which will not allow us to understand the learning outcomes or scholastic developments of students with respect to time dimension. A longitudinal study will provide the advantage on examining the effect of time factor on student cognitive attainments.

Despite of some limitations, present study made an attempt to investigate the mechanism of human capital formation at its basic level in the state of Sikkim. Research initiatives on such direction could provide insightfulness about future human capital pervasiveness of the state along with its present status. Nonetheless, successive researches should be mindful of prescribed research limitations.

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Appendix

Components and variables under Educational Development Index

Components (X_i)	Variables
Accessibility	No. of schools available per thousand population of age 6-14 years; ratio of primary to upper primary schools; percentage of schools approachable by all road types.
Infrastructure	Student-classroom ratio; percentage of schools with student-classroom ratio greater than or equal to 35; percentage of schools with drinking water facilities; percentage of schools with girls toilet; percentage of schools with boys toilet.
Teacher	Percentage of female teachers; pupil-teacher ratio; percentage of schools with pupil-teacher ratio greater than or equal to 35; percentage of professionally trained teachers.
Outcome	Gross enrolment ratio; repetition rate; dropout rate; percentage of students passed in an annual examination; transition rate from primary to upper primary level.

Standardized Test Questions

Name:

Grade: VIII

School:
Duration: 20 minutes

Full Marks: 30

Note: The Question Pattern is divided into three sections each comprising different tasks

Section I: Arithmetic Tasks (10 marks)

1. Recognize the following numbers and write in its word form

   7 =
   68 =
   492 =
   1345 =

2. Add the following numbers

   $\begin{array}{r} 57 \\ +\ 83 \end{array}$ $\qquad$ $\begin{array}{r} 168 \\ +\ 371 \end{array}$

3. Subtract the following numbers

   $\begin{array}{r} 91 \\ -\ 39 \end{array}$ $\qquad$ $\begin{array}{r} 771 \\ -\ 283 \end{array}$

4. Multiply the following numbers

   $\begin{array}{r} 68 \\ \times\ 9 \end{array}$ $\qquad$ $\begin{array}{r} 1265 \\ \times\ 29 \end{array}$

5. Divide the following numbers

   $\frac{982}{9} =$ $\qquad$ $\frac{1598}{11} =$

Section II: English Tasks (10 marks)

1. A.) Mention the vowels of the English letters.
   Answer =

   B.) What does the following words resembles?

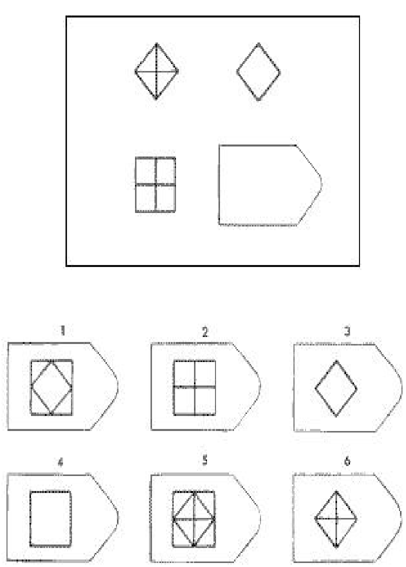
   i. Cat =
   ii. Tree =
   iii. Blackboard =
   iv. Potato =
   v. Yellow =

2. Make adjective phrases using the ‘ing and ed’ forms.
   i. Bird that is flying =
   ii. Bread that is sliced =
   iii. Car that is painted =
   iv. Water that is boiling =
   v. Star that is shining =

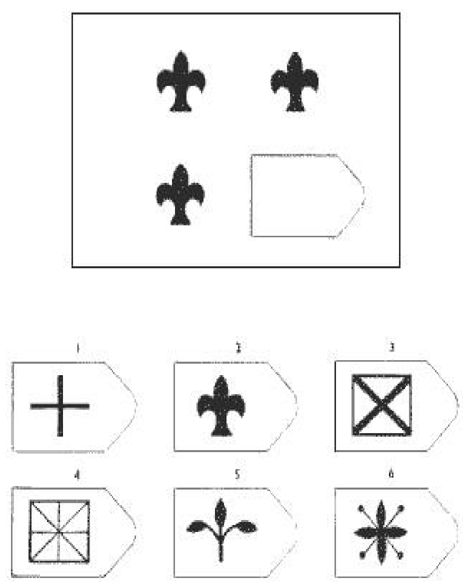
Section III: Intelligent Quotient Tasks (10 marks)

1. Tick marks the appropriate figure from the options for the blank box.

A.

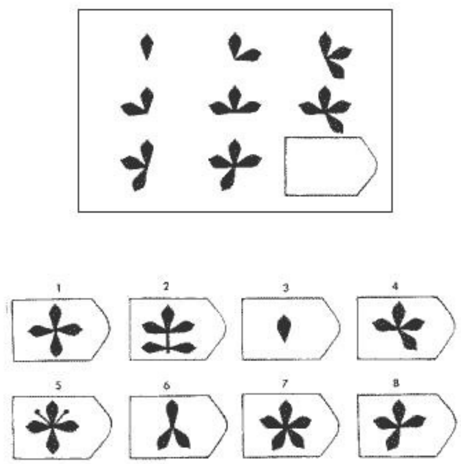


B.



Contd..

C.



D.