Factors influencing quality of education: A case study of eighth grade students' mathematics learning achievement in Nepal

By

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Abbreviations

ADB	:	Asian Development Bank
BPEP	:	Basic and Primary Education Project/Program
CBS	:	Central Bureau of Statistics
CDC	:	Curriculum Development Center
DEO	:	District Education Office
CERID	:	Center for Educational Research Innovation and Development
CIP	:	Core Investment Program
CPA	:	Comprehensive Peace Accord
CREATE	:	Consortium for Research on Educational Access, Transitions and Equity
DOE	:	Department of Education
ECD	:	Early Childhood Development
ECED	:	Early Childhood Education and Development
EDSC	:	Educational Development Service Center
EFA	:	Education for All
EFA NPA	:	Education For All National Plan of Action
EMIS	:	Educational Management Information System
ERDP	:	Education for Rural Development Project
EU	:	European Union
GDP	:	Gross Domestic Product
GPI	:	Gender Parity Index
HDI	:	Human Development Index
HPI	:	Human Poverty Index
IEA	:	International Association for the Evaluation of Educational Achievement
ILO	:	International Labor Organization

JICA	:	Japan International Co-operation Agency
MOE	:	Ministry of Education
MOF	:	Ministry of Finance
NAEP	:	National Assessment of Educational Progress
NESP	:	National Education System Plan
NER	:	Net Enrollment Ratio
NFEC	:	Non- Formal Education center
NGO	:	Non-Governmental Organization
NLSS	:	Nepal Living Standard Survey
NPA	:	National Plan of Action
OECD	:	Organization for Economic Co-operation and Development
PCA	:	Principal Component Analysis
PEP	:	Primary Education Project
PISA	:	Programme for International Student Assessment
PTA	:	Parent Teacher Association
PTR	:	Pupil Teacher Ratio
RC	:	Resource Center
SACMEQ	:	The Southern and Eastern Africa Consortium for Monitoring Educational Quality
SES	:	Socio-Economic Status
SESP	:	Secondary Education Support Program
SIP	:	School Improvement Plan
SIMPOC	:	Statistical Information and Monitoring Programme of Child Labour
SLC	:	School Leaving Certificate
SMC	:	School Management Committee
SSRP	:	School Sector Reform Plan

TA	:	Technical Assistance
TEP	:	Teacher Education Program
TEVT	:	Technical Education and Vocational Training
TIMSS	:	Trends in International Mathematics and Science Studies
UMCE	:	Unit of Educational Quality Measurement
UNDP	:	United Nations Development Programme
UNICEF	:	United Nations Children’s Fund
UNESCO	:	United Nations Educational, Scientific and Cultural Organization
UPE	:	Universal Primary education
VDC	:	Village Development Committee
VEC	:	Village Education Committee
VIF	:	Variance Inflation Factor
WB	:	World Bank

Chapter 1 Introduction

1.1 Background

Improving the quality of education, which is generally measured by higher test scores in examinations (Chapman, Weidman, Cohen, & Mercer, 2005), is a major policy concern, particularly for developing countries. The benefit of providing education to individuals and society is enhanced when the quality is higher (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2005). For example, better learning outcomes, as represented by students' test scores, are said to be closely related to higher earnings in the labor market; thus, differences in the quality of education are likely to indicate differences in individual worker's productivity. Furthermore, substantial evidence shows that students who do better in school, either in grades or standardized achievement tests, tend to have better school attendance (Hanushek, 1996), which leads to better school completion and continuation to higher education (Rivkin, 1995). Hence, improving the quality of education is the core objective of most developing countries, as it benefits individuals and society as a whole, which leads to higher earnings, higher productivity and higher economic growth (Hanushek & Kimiko, 2000).

Since the international commitments made on Education for All[1] (EFA) in 1990 at Jomtien, Thailand and the Dakar World Education Forum in 2000[2], developing countries

[1] Education for All is the global movement led by UNESCO, aiming to meet the learning needs of children, youths and adults. The movement was launched in 1990 at the World Conference on Education for All (EFA) in Jomtien, Thailand. It reaffirmed education as a fundamental human right and adopted six goals: universal access to learning, a focus on equity, emphasis on learning outcomes, broadening the means and the scope of basic education, enhancing the environment for learning and strengthening partnerships by 2000.

[2] In 2000, the target set by Education for All (EFA) was assessed at the World Education Forum at Dakar, Senegal. The Forum agreed on the Framework of Action, which reaffirmed their commitment to achieving Education for All by 2015 and set six measurable goals. The goals are to: 1) Expand early childhood care and education; 2) Provide free and compulsory primary education for all; 3) Promote learning and life skills for young people and adults; 4) Increase adult literacy by 50 percent; 5) Achieve gender parity by 2005 and gender equality by 2015; and 6) Improve the quality of education.

especially have made remarkable progress in improving access at all levels of education. However, millions of school age children are still out of school and most of them are in sub-Saharan Africa and South Asia (UNESCO, 2010). Improving school participation is one of the measures of overall progress towards universal primary education, but large numbers of children drop out before completing a full cycle of primary education. Furthermore, many children fail to master basic literacy and numeracy skills, even when they complete a full cycle of primary education, which is a loss of human capital that undermines economic growth and public health, deepens social division, and weakens the foundations of social participation and democracy (UNESCO, 2010).

Nepal has made remarkable progress in improving access at all levels of school education, particularly after the establishment of democratic government in 1990[3], which is also the benchmark year for the commitment made in the EFA forum to provide quality basic education to its entire people. This is demonstrated by the fact that the net enrolment ratio (NER) at the primary level increased from 67% in 1990 to 95% in 2012 (Department of Education, [DOE], 2012). However, the quality of education as measured by test scores in examinations is still low, particularly in core subjects. So, in the context of low quality of education, this dissertation examines the factors affecting the learning achievement in mathematics of eighth grade students in Nepal. Learning achievement in mathematics is examined because Nepalese students continuously perform poorly, even though it is the basis for modern scientific and technological development and an important means of communication (Cockcroft, 1982; Ndimbirwe, 1995).

[3] In 1990, multiparty democracy was re-established by the people's popular movement. It was a multi-party movement that brought an end to an absolute monarchy and a beginning of constitutional democracy. A new democratic constitution was drafted and came into effect in November 1990.

1.2 Statement of Problem

After the commitment made to EFA in 1990, the government in Nepal selected education as a priority sector and increased its resources to provide a basic quality of education for its people. The gross domestic product (GDP) allocated to the education sector increased from 2.1% in 1990 to 3.3% in 2009, and during the same period, overall education expenditures increased from 13% to 17.5%. With the support of internal and external resources, various programs such as the Basic and Primary Education Project (BPEP I) (1992-1998), the Basic and Primary Education Program (BPEP II) (1999-2004), Education for All (EFA) (2004-2009), the Secondary Education Support Program (SESP) (2003-2008), the Community School Support Program (CSSP), and the Teacher Education Program (TEP) were implemented. Several innovative policies and programs were introduced, such as expanding early childhood care and development, scholarships for girls and ethnic minorities and vulnerable children, improving school physical facilities, performance-based grants to schools, provision of additional teachers, curriculum reform, provision of textbooks and instructional materials, the institutionalization of the technical support for teachers, and improvements in the management of school education.

One of the key results of these initiatives has been greater participation of children and students at all levels of school education, which is demonstrated by the fact that the net enrolment ratio (NER) at the primary level increased from 67% in 1990 to 95% in 2012 and gender parity has been almost achieved at all levels of school education (DOE, 2012). Despite the substantial progress in expanding educational opportunities, considerable challenges still remain. First, nearly six percent of primary school-aged children do not participate in schooling and this proportion sharply increases for higher levels of school education. Internal efficiency at all levels of school education continues to be poor, with nearly 16% of children dropping out and 20% repeating grade 1. The survival rate for the primary education level is

65% and many students who complete grade five do not transit to grade six. Second, improving the quality of education is a large daunting challenge. Many children and young people leave school without developing their potential and without acquiring basic skills which are necessary for raising their standards of living and the knowledge needed to effectively function in society.

More importantly, systematic measurements of learning achievements of internationally acceptable standards are still absent. However, Nepal has carried out national assessments at regular intervals. An assessment conducted by the Research Center for Educational Innovation and Development (CERID) in 1999 and another by the Educational Development Service Center (EDSC) in 2008 revealed that the quality of education, which is generally measured by higher levels of learning achievement in examinations, was low, and inequalities between students, particularly with gender, ethnic minority, types of school and locations, were common. Table 1.1 presents the average score of learning achievement in mathematics of eighth grade students in 1999 and 2008.

Table 1.1 Average learning Achievement in Mathematics of Eighth Grade Students in 1999 and 2008 in Nepal

Subject	1999	2008
Mathematics	28.9	31.7

Source: Education Development Service Center, 2008, p. 8

Table 1.1 indicates the average learning achievement in mathematics of eighth grade students in Nepal. It shows that out of possible 100 marks, the average mark in mathematics of eighth grade students was 28.9 in 1999, and with a little increase it was 31.7 in 2008. In the context of globalization and the knowledge-based economy, the low level of learning achievement in Nepalese children is a serious concern for policy makers, teachers and other stakeholders. Studies are carried out to assess the level of learning achievement, particularly in core subjects; however, none of them have either examined the factors affecting learning achievement or analyzed the mathematics test itself.

1.3 Objective of Study

Based on the problems mentioned above, I first examine the factors affecting the quality of education with a specific focus on learning achievement in mathematics of eighth grade students in Nepal. I particularly examine the effects of four sets of factors: family characteristics, student characteristics, parental involvement, and school characteristics on mathematics learning achievement of eighth grade students in Nepal. Second, I analyze the areas of mathematics learning such as arithmetic, algebra, geometry, and data management which is known as the content domain that students are expected to learn by the end of academic year. Similarly, I analyze the knowledge and development of mathematical skills which is considered as cognitive domain of learning. There are four types of cognitive domain (knowledge, comprehension, application, and problem solving) which specify the domains or thinking process to be assessed while students engage with mathematical content (Trends in International Mathematics and Science Studies [TIMSS], 2011). I further examine the mathematics knowledge and concepts that are associated with each-others.

It is of interest to examine the determining factors for learning achievement in mathematics because it informs policy makers and teachers about various factors that affect children’s performance. At the same time, analyzing mathematics test will provide useful information to policy makers, curriculum developers, teachers, and other stakeholders to identify areas, concepts and topics of mathematics that need more focus and effort to improve the quality of education in Nepal. Similarly, policy makers and curriculum developers, including teachers, will benefit from knowing what are the mathematical knowledge and concepts associated with each other and which concept needs focus to improve mathematics learning.

The objectives of this dissertation are as follows:

1. To examine factors affecting learning achievement in mathematics of eighth grade students in Nepal.

2. To determine the extent to which differences in learning achievement in mathematics are associated with family characteristics, student characteristics, parental involvement and school characteristics.

3. To analyze the mathematics learning of eighth grade students by the areas of knowledge and mathematical skills.

4. To examine the mutual relationships among mathematical knowledge, concepts and skills to solve problems.

1.4 Research Questions

To fulfill the objectives stated above, this dissertation attempts to answer the following research questions.

1) What are the factors affecting mathematics learning achievement of eighth grade students in Nepal?

2) What are the mathematical knowledge/concepts and skills associated with each other, and which are the knowledge and skills essential to develop further mathematical knowledge onto them and, then, to improve the mathematics learning of eighth grade students in Nepal?

As I mentioned in the statement of problem, Nepal has made remarkable progress in improving access to education at all levels of school. However, improving quality of education which is generally measured by higher test scores in examinations is a major challenge for educational development of Nepal (Table 1.1). So, in the context of low quality of education, I answer the first research question which examines the factors affecting mathematics learning achievement of eighth grade students' in Nepal. Answering the first research question is not sufficient because it only explain the factors affecting overall scores of mathematics tests. So in addition to examining the factors affecting mathematics test, I will further examine the mathematics knowledge, concepts and skills that are associated one another, and which knowledge and skills need to be developed primarily so that students can build further mathematical learning onto them. Answering these two research questions are important because the first research question will inform the factors associated with overall mathematics learning achievement, while the second research question will identify specific areas and skills of mathematics which are associated with one another which constitute students' mathematical learning.

1.5 Research Methodology

This study is quantitative in its data analysis because the purpose is to estimate the relationship between a dependent variable (learning achievement in mathematics) and a set of independent variables (family characteristics, student characteristics, parental involvement and school characteristics), and to analyze the mathematics learning of eighth grade students in Nepal. A multi-stage random stratified sampling method was used to select the samples. Initially, two stages of sampling –ecological zones and districts –were identified. Based on the proportion of students in three ecological zones –mountain, hill and lowland (Tarai) –nine districts were selected: one mountain district, four hill districts, and four lowland (Tarai) districts. Altogether, the samples consisted of 21 secondary schools with 762 eighth grade students (400 girls). Out of the total 21 sample secondary schools, four secondary schools are privately managed and 10 secondary schools are in urban areas. The urban area in the context of Nepal also includes the district headquarters. One head teacher and one mathematics teacher from each school participated in the study. Four types of instruments -mathematics tests, and questionnaires for students, head teachers, and mathematics teachers -were developed to collect the data for this dissertation.

Three types of methods were used to analyze the data for this study. First, multiple regression analysis is used to answer the first question, which predict the relationship between the dependent variable (mathematics score) and the independent variables (family characteristics, student characteristics, parental involvement and school characteristics). Second, before answering the second research question, by using the weighted mean, I analyze the areas of mathematics learning (arithmetic, algebra, statistics, and geometry) known as content domain, and cognitive domain (knowledge, comprehension, application, and problem solving). Furthermore, I used one-way ANOVA to examine the differences in areas of mathematics learning such as arithmetic, algebra, statistics, and geometry (content domain) and cognitive domain (knowledge, comprehension, application, and problem solving) by gender, ethnic background of students, types of school and location. Finally, principal component analysis (PCA) is used to answer second research question which examines the mutual relationships among the mathematics knowledge, concepts and skills for students to answer test questions. This last analysis is expected also to contribute to identify areas of mathematics which require to be focused to improve overall mathematics learning. The details of methods are explained in Chapter 3.

1.6 Organization of Dissertation

This dissertation is organized in seven chapters. The introduction explains the overview of this study. It explains the background of the study, the statement of problem, the objective of the study, the research questions, and methodology that this study has adopted. Chapter 2 presents the theoretical framework for this study. It explains how family characteristics, student characteristics, parental involvement, and school characteristics are associated with students' learning achievement. Furthermore, it explains the theoretical framework for assessments, particularly for mathematics learning.

Chapter 3 explains the methodology that this study has adopted for data analysis. It describes the sampling strategy, development of instruments for data collection, and methods for data analyze. It mainly explains the multiple regression analysis and principal component analysis (PCA) which are the main methods used for data analysis of this study.

Chapter 4 presents an overview of educational development in Nepal, focusing particularly on the period after the 1990s. It describes the history of educational development, the current development status of school education, the educational structure, and current educational policies in Nepal.

Chapter 5 answers the first question, which examine the determining factors for the quality of education (learning achievement in mathematics). Using the multiple regression analysis, it specifically examines the effects of family characteristics, student characteristics, parental involvement, and school characteristics on eighth grade students' learning achievement in mathematics in Nepal. It further analyzes to what extent variances in learning achievement in mathematics is associated with family characteristics, student characteristics, parental involvement and school characteristics.

Chapter 6 answers the second research question. Before answering the second main research question, it particularly analyzes the distribution of scores among sample students in terms of the areas of mathematics knowledge such as arithmetic, algebra, statistics, and data management (content domain) and development of mathematics skills such as knowledge, comprehension, application, and problem solving (cognitive domain). It further examines the differences in content and cognitive domains of mathematics learning by gender, ethnic background of children, types of school, and location of school. Finally, it examines the mathematical knowledge, concepts and skills that are associated with one another, and the knowledge and skills which constitute the basis for further mathematical learning and require more focus in teaching so as to improve the overall level of mathematics learning of eighth grade students in Nepal. Based on the findings of Chapter 5 and 6, Chapter 7 concludes findings of this study and implications are discussed, for educational development particularly improving mathematics learning of eighth grade students in Nepal.

Chapter 2 Theoretical Framework of the Study

2.1 Introduction

Chapter 2 presents the theoretical framework for this study. There are three sections in this chapter. The first section conceptualizes the quality of education. The second section explains the factors that affect the quality of education, which is the first objective of this study. It reviews the previous studies on the relationship between children's learning achievement and the four factors such as family characteristics, student characteristics, parental involvement and school characteristics. Despite the fact that most of previous studies focused on the cases of developed countries, it is still useful to know factors that are associated with the learning achievement of children in order to conceptualize the framework of the study in different contexts. The third section explains the assessment practices of mathematics learning. It particularly focuses on assessment on areas of mathematics learning (arithmetic, algebra, data management, and geometry) known as content domain and cognitive domain (knowledge, comprehension, application, and problem solving).

2. 2 Dimension of the Quality of Education

After the Jomtien conference on Education for All in 1990, many countries have experienced the expansion of educational opportunities, mainly in relation to universal access, participation, retention, and the completion of basic education. However, improving the quality of education is still a major challenge. The importance of the quality of education has been increasingly recognized since it contributes to national development (Hanushek & Woessman, 2007), sustainable livelihoods (Bangay & Blum, 2010), and individual capabilities (Lanzi, 2007). However, discussions regarding the quality of education lack both clarity and a common understanding of what is actually meant by the term quality (Tawil, Akkari, & Macedo, 2011), as well as the determining factors for the quality of education. Questions relative to the aspects of quality and the ways to measure them have been raised since long in the past and are still widely debated.

In fact, the quality of education is a notion rather than an operational concept, which implies that it cannot be captured through any single definition or approach. The understanding of the quality of education differs according to the view point of people (Motala, 2001). Different stakeholders such as policy makers, school principals, teachers, parents, and students may have different understandings, although there is likely to be a common core of interest in educational outcomes that is relevant for all (Scheerens, 2004).

Parents and communities may value outcomes such as school promotion and employment as proof of the quality of education. Similarly, "national government officials, employers and international aid agencies may view outcomes as socio-economic development such as the increased productivity of workers, economic growth, poverty reduction, and stronger integration of national economics in globalized knowledge societies and others may value the civic and political outcomes in terms of greater freedom, strengthened social cohesion, respect for cultural diversity, and the development of active and responsible citizenship" (Tawil et al., 2011, p. 13).

Similarly, understanding of the quality of education also varies according to tradition, such as the humanistic tradition that rejects prescribed standards and externally defined curricula. Meanwhile, the behaviorist tradition is just the opposite of the humanistic tradition, as it accepts tests and examinations as a major component of understanding and examining the quality of learning and the performance of education systems. On the other hand, there are multiple approaches based on different views about the notion of the quality of education and how education should lead to change in society. The adult education approach emphasizes experiences leading to critical thinking as an important aspect of the quality of education. An indigenous approach to quality education focuses on the importance of education's relevance to the socio-cultural circumstances of the nation and learners (UNESCO, 2005).

The existing notions of the quality of education and their understanding can be categorized into two traditions: the economic view of education and the progressive/humanist tradition (Barrett, Chawla-Duggan, Lowe, Nikel, & Ukpo, 2006). The progressive/humanist tradition emphasizes learning as the center of the quality of education. It focuses on the educational processes. Judgments of the quality of education are based on what happens in schools, and inside the classrooms. Learning of basic cognitive skills, literacy, and numeracy, as well as general knowledge, are considered vital for the quality of education. This idea is close to the objective of UNESCO and UNICEF, inspired by a human rights approach to promote education for humanity, peace and security (Tawil et al., 2011).

The second, economic view of education emphasizes education as an investment for the acquisition of knowledge and skills which will increase earnings or provide long term benefits for individuals (Barrett et al., 2006). It examines the relationship among the different school inputs and relates education as a production function of input-process and output. Input generally refers to the investment in the salary of teachers and administrative staff as well as non-salaried activities relating to the production of textbooks, school facilities, teaching and learning materials, and so on. Process is usually interpreted as the forms of interaction between teachers and students with a particular focus on classroom practices. Output typically refers to changes in student achievement, especially in domains of knowledge and skills, completion rates, certification, attitude and values. Outcome consists of long-term consequences of education such as employment, earning, and changes in attitudes, values, and behaviors (Barrett et al., 2006).

The economic view of education uses quantitative, measurable outputs as the indicator of the quality of education, such as enrolment ratios, retention rates, completion rates, learning achievements, and rates of return in terms of investment in education. This approach is close to the idea of the World Bank that looks at education as an investment and calculates the efficiency of the education system in terms of public services that are proficient in the use of resources for the delivery of education as a public good.

2.3 Determining Factors for the Quality of Education

Empirical evidence clearly indicates that education is the foundation for the development of individuals and society as a whole. Education is a key factor for the improvement of people's economic and social condition (Barro, 1996; Krueger & Lindhahl, 2001). According to human capital theory, "the investment in education leads to the formation of human capital, which is an important factor for economic growth" (Tilak, 2002, p. 191). Education and training enhance skills and productive knowledge, and transforms human beings into more valuable human capital. The skills and productive knowledge imparted through education increases the productivity of people, and thereby their earnings (Tilak, 2002).

In contrast to human capital theory, the basic needs approach during the mid-1970s recognized education as a basic need. According to (International Labour Organization [ILO], 1977, p. 28) "Education is itself a basic need and equality of access to educational services, particularly in rural areas, is therefore important ingredient of basic need strategy". It supports to fulfill other basic necessities for instance food and housing which helps to improve the quality of life. This has the positive effect on women's behaviors such as housing, use of water and sanitation, and decisions on fertility, family welfare, and health (Lieras-Muney, 2005), which increases productivity and reduces poverty (Tilak, 2002).

Hence, providing access to education for all people has significant implications for the development of individuals and society, but Vegas and Petrow (2008, p. xxii) argued that “expansion of educational opportunity has not markedly reduced income inequalities, underdevelopment and poverty, possibly because of the poor quality of education”. Similarly, Hanushek and Woessman (2007, p. 21) concluded that “the quality of education as measured by student achievement on standardized test scores, correlates more strongly with economic growth than simply spent in school”.

Since the international commitment on Education for All in 1990, many developing countries have made progress in improving the access and participation of children at all levels of school education. However, improving the quality of education, which is generally measured by the higher levels of learning achievement in examinations (Chapman et al., 2005) is still low and inequalities between and within countries are wide. Differences in the quality of schooling have a dramatic impact on productivity and national growth rates (Hanushek & Kimiko, 2000). These authors found a very strong relationship between test performance and national growth rate and a smaller relationship between the quantity of education and national growth. Test score provides an important measure of how well the curriculum is being learned and indicates an achievement at the exit point of the school system. There is mounting evidence that the quality of education measured by test scores is related to individual earning, productivity, and economic growth (Hanushek, 1992; Hanushek & Kimiko, 2000; Hanushek & Woessman, 2007).

In addition to individual earning, productivity, and economic growth, the quality of education is also associated with school continuation. There is a substantial evidence which throws light on the fact that students who do better in school, either through grades or standardized achievement tests, tend to stay longer (Manski & Wise, 1983). Rivkin (1995) found that variations in test scores contribute to a considerable proportion of the systematic variation in high school completion and in continuation to higher education, and that it is also associated with the school attendance (Bishop, 1989; Hanushek, 1996).

For a long time educators and researchers have tried to explore what constitutes to the quality of education. What are the determinants of educational quality? There is no consensus or common understanding and the quest to better understand and examine the quality of learning and the performance of education systems still continues. The school is a formal institution where children and youth learn however, other informal institution such as families and communities are equally important for children's learning (Rothstein, 2000). Most of the findings have highlighted the importance of family characteristics for children's school learning, whereas the effect of school characteristics have minimal on children's learning achievement (Brooks-Gunn & Duncan, 2000; Coleman et al., 1966). However, debates are continued on the importance of home and school characteristics (Chevalier & Lanot, 2002; Schiller, Khmelkov, & Wang, 2002). A significant number of studies have shown the importance of both family and school characteristics responsible for the learning achievement of children (Griffith, 1999; Mancebon & Mar Molinero, 2000).

Two influential research reports have initiated the debate on the importance of family characteristics and school characteristics on children's educational achievement. The first is the "Equality of Educational Opportunity" by Coleman et al. (1966) in the United States, and the second is the "Plowden Report" by Peaker (1971) in Great Britain. They examined the aggregate effect of quality of school on learning achievement after controlling the children's socio-economic status (SES). Their common conclusion was that the amount of variance in academic achievement accounted for by the socio-economic status of children and pre-school experiences substantially exceeded the impact of all aspects of school quality taken together. Although highly controversial, these studies have promoted the debate on the effects of school characteristics and family socio-economic status on students' academic achievement (Gamoran & Long, 2006). Since then, many researchers have tried to argue against these findings. Although many of these attempts have failed and reconfirmed the earlier conclusion, few researchers found some counter-evidence in the context of developing countries.

Adopting a design similar to Coleman et al. (1966) in the United States, Heyneman (1976) in his study called "Coleman Report for a Developing Country" looked at students from 67 schools in Uganda and found a significant effect of school characteristics and weak effects of family characteristics on students' academic achievement. Furthermore, using the data of International Association for the Evaluation of Educational Achievement (IEA) Heyneman and Loxley (1983) conducted a research in 29 developing and developed countries, which is commonly known as H-L effect, and advocated that the "proportion of variance in achievement attributable to family background was generally much smaller and that [the part] attributable to school quality [was] generally much larger in developing versus industrialized countries" (p. 1172). They further mentioned that "the predominant influence on student learning is the quality of schools and teachers to which children are exposed" (p. 1162) and "the poorer the country, the greater the impact of school and teacher quality on achievement" (p. 1180). The findings of other studies are in line with the findings of the H-L effect for example, Fuller (1987) examined 60 multivariate studies of the effect of school resources in developing countries and concluded that increasing school resources improves school performance in poor countries. Fuller and Clark (1994, p. 122) concluded that "even when family background is controlled, school factors such as infrastructure, class size, teachers' experience and qualifications and the availability of instructional materials increase the student performance".

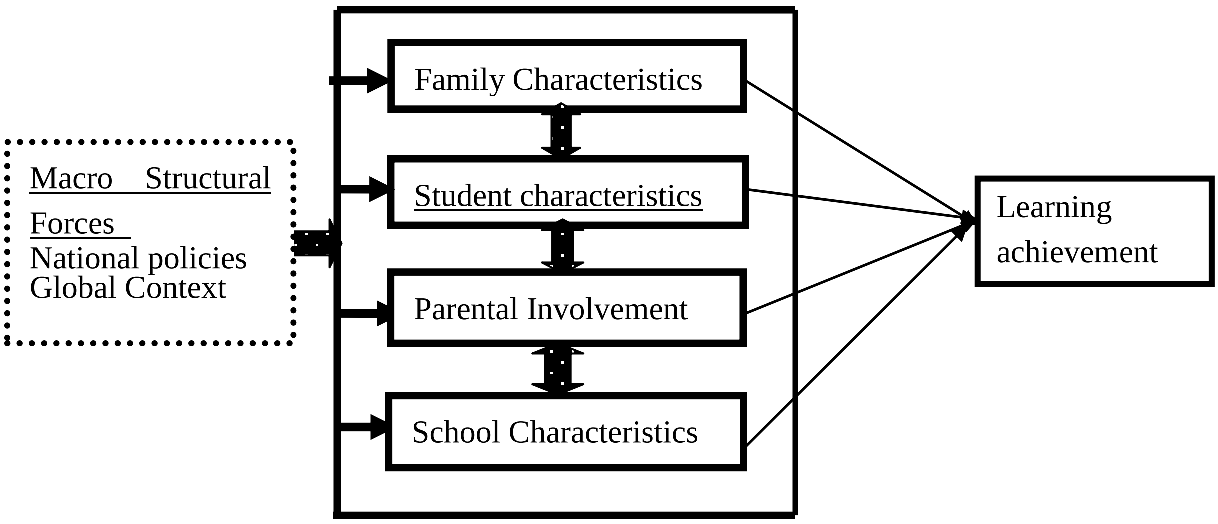
Challenging the H-L effect, other studies claimed that the impacts of school characteristics do not vary according to the income or level of development of a country. For example, Baker, Goesling, and Letendre (2002) and Hanushek and Luque (2003) didn't find any evidence of the H-L effect in the Third International Mathematics and Science Study (TIMSS) among grade 8 students. They further mentioned that the finding of Heyneman and Loxley 1983 with regard to weak effects of family background in less developed countries is not consistent. They estimated the strong effect of family background on the school performance of children but found that school performance declined with the increase in the age of children. Similarly, using the data of 1790 students from 60 schools of the Cebu Longitudinal Health and Nutrition Survey (CLHNS) in the Philippines, Huang (2010, p. 295) criticized the H-L effect and mentioned that "the school level accounted for approximately only three to five percent of the variance in overall student achievement". The larger part of the variance was at the student level, as other studies have found in developing countries.

Gamoran and Long (2006) criticized findings of TIMSS with regard to H-L effect. They mentioned that the findings of TIMSS rely on teachers and school heads' subjective judgments about the level of school resources in different countries. They further mentioned that school resources variables collected by the TIMSS "tell us little about objective differences in levels of resources between different countries" (p. 11). Even though Heneyman in 1976 found a weak effects of family background in less developed countries however, there is a significant evidence that socio-economic status have considerable effects on children's mathematics and language achievement (Lockheed, Vail, & Fuller, 1986; Niles, 1981). Similarly other studies found significant disparities in enrolment and attainment associated with socio-economic status: Sather and Lloid (1993) in Pakistan, Stash and Hannum (2001) in Nepal, and Patrinos and Psacharopoulos (1995) in Bolivia and Guatemala.

In addition to the influence of the socio-economic status of children such as parental education, occupation, and family income, the academic achievement of children is also influenced by students' characteristics. This includes gender, ethnicity, perception of the school environment, school absenteeism, involvement in household chores, homework completion and level of motivation (Keith, Reimers, Fehrmann, Pottebaum, & Aubey, 1986; Konu & Rimpela, 2002; Ma, 1997; Veenstra & Kuyper, 2004). Similarly, parental involvement in their children's study to support and provide opportunities to explore and express ideas were found to be vital for academic achievement (Astone & McLanahan, 1991; Barnard, 2004 ; Fehrmann, Keith, & Reimers, 1987; Iverson & Walberg, 1982).

Finally, although several studies have highlighted the importance of various factors that are associated with the academic achievement of children, Buchmann and Hannum (2001) included family characteristics, student characteristics, and school characteristics as the factor affecting students' learning achievement. In addition to these three factors, previous literature highlighted the importance of parental involvement in children's learning achievement. So, in the conceptual framework presented in Figure 2.1, I have included parental involvement as another category of factors that affects students' learning achievement.

Figure 2.1 Conceptual Framework for Factors Affecting Learning Achievement



Source: Buchmann & Hannum, 2001, p. 79, author edited.

2.3.1 Family Characteristics and Learning Achievement

The effect of SES of the family on the child's learning achievement is one of the most frequently examined factors. It is because family plays an important role in shaping a child's educational experiences and learning achievement (Buchmann, 2002), but this can differ in several ways (Singh, 1995). A widely accepted view is that SES consists of the financial, social and cultural capitals that are transmitted from one generation to the next (Buchmann, 2002). The concept of cultural capital generally refers to people's knowledge, skills, and education level that may influence the status of an individual in the community. Differences in cultural capital indicate the differences in the socio-economic status of family between different status groups (Bourdieu, 1986).

Similarly, family life styles and cultural resources establish the intellectual climate for children's educational aspirations and motivations for better performance in school. The argument behind the relationship between SES and learning outcomes is that families with higher SES are more likely to have greater access to a wide variety of economic and social resources (family structure, home environment, and parent-child interaction) and invest more in education (Becker, 1964). Children in these families are more likely to succeed in school (Buchmann, 2002) and exhibit higher levels of performance (Veenstra & Kuyper, 2004) because higher SES family can invest more in education (Behrman & Knowles, 1999). Similarly, educated parents place high value on child's education and be more capable and also more willing to help their children.

Although SES has been at the core of the concept of family background, over time the concept has expanded to include other aspects of family in order to explain the complex and multi-dimensional relationship which influences the children's learning outcome. Generally, family socio-economic status (SES) comprises by three components- "parents' education, parent's occupation and family income" (Buchmann, 2002, p. 153).

In the early 1970s, status attainment research in the United States set down the foundation for the conceptualization of socio-economic status and methodology to investigate the intergenerational transmission of status (Buchmann, 2002). The classic study by Balu and Duncan (1967) presented a basic model for the stratification process, in which a father's education and occupational status explain his son's educational outcome. In the University of Wisconsin, Sewell and Hauser (1997) conducted a research on the impact of family background and schooling on children's educational and occupational attainment, which is known as Wisconsin model. An important aspect of Wisconsin model is that it attempted to specify mediating mechanisms by including factors such as aspirations and motivation, by which family socio-economic status influenced individual educational and occupational attainment. These classical models provided a framework for the study of family socio-economic status and students learning outcomes in different contexts. However, the recent studies have included reading habits at home, number of books at home, and home environment as measures of cultural capital (Kingston, 2001).

White (1982) included parents' occupation, education, and income as traditional indicators of student's SES. As a part of his meta-analysis, White examined the correlations between the SES and scores on standardized mathematics tests from 143 studies. He found an average correlation of .25 for all the studies. Yando, Seitz, and Zigier (1979) computed a correlation between the SES and arithmetic achievement for 8-year-old students and obtained a positive correlation of .029. Additional evidence of the positive relationship between the SES and mathematics performance was found by Welch, Anderson, and Harris (1982), who analyzed data from the National Assessment of Educational Progress (NAEP) Second Mathematics Assessment and found that home and community characteristics responsible for 24% of variance in mathematics learning achievement of 17-year-old students. Even if several studies have estimated the positive relationship between the SES and the school attainment and achievement, Programme for International Student Assessment (PISA) results indicated that “poor performance in school does not automatically follow from a disadvantaged socio-economic status, despite the fact that socio-economic status does appear to be a powerful influence on performance” (Organization for Economic Cooperation and Development [OECD], 2003, p. 191) and it is not necessarily true that children from the households with low SES perform worse in school than do children of families with high SES; results vary by subjects, gender, age and other factors (Heyneman, 1980).

Earlier studies by Coleman et al. (1966) examined 650,000 students from 4,000 schools in the United States and found that family characteristics significantly influence students educational attainment and achievement because these students had access to greater economic and social resources to support academic success compared to families with lower levels of parental education (Hanushek, 1992; McLanahan & Sandafur, 1994; Peters & Mullis, 1997). Most of the earlier studies on the relationship of SES and academic achievement are concentrated in developed countries, so less is known about the relationship between SES and children’s learning achievement in developing countries. Generally, in developing countries, fathers’ occupations and level of education exhibit little variation because parental education is uniformly low and occupations are predominantly in agriculture. In addition to socio-economic status (SES), social class differences (e.g. land ownership, caste, and district of residence) were strongly associated with school attendance in Nepal (Heyneman, 2002; Stash & Hannum, 2001). Parents’ and grandparents’ social status and literacy were found to be strongly related to children’s school attendance in Nepal (Jamison & Lockheed, 1987).

Among the factors of SES, parental education has been found to be most significantly associated with children’s learning achievement (Chevalier & Lanot, 2002; Fuchs & Woessmann, 2004; Guncer & Kose, 1993; Parcel & Menaghan, 1994; Willms & Somers, 2001; Yayan & Berberoglu, 2004). Using the Third International Mathematics and Science Study (TIMSS) data from Turkey, Yayan and Berberoglu (2004) estimated the significant relationship between parental education and mathematics learning achievement of eighth grade students in Turkey. Fuchs and Woessmann (2004, p. 13) used the PISA data and concluded that the "effects of parental education is larger in reading than math and science, with the maximum performance difference between students whose parents did not complete primary education and students whose parents have university degree 34.3 average point in reading, 26.9 in math and 26.5 in science". Prior to this, results of PISA in 2000 mentioned that students whose mothers had completed upper secondary education achieved higher levels of learning in reading than other students in all participating countries (OECD, 2000).

Similarly, Johnston and Thompson (2006, p. 15) analyzed the PISA data and found that "students with the higher SES, as measured by parental level of education, number of books at a student's home, had a educational benefit over students with the lowest SES". However, the effect of fathers' and mothers' level of education on their children's academic achievement was found different. A research conducted by Engin-Demir (2009) in Turkey estimated the higher effect of father's level of education than mother's level of education in explaining variances in academic achievement. In most of the cases, mothers' level of education was estimated stronger than fathers' level of education on their children's academic achievement. This is because generally mother spends more time and helps their children's study more than father.

Similarly, Hungi and Thuku (2010) in Kenya used the data of the SACMEQ II project and concluded that socio-economic factors are more important to predict school outcomes. They mentioned that "pupils from homes with better quality houses, many possessions, and more educated parents were estimated to achieve better in mathematics and readings than pupils from homes with low quality houses, few or no possessions, and less educated parents" (p. 36). Similarly, Dincer and Uysal (2010, p. 596) in Turkey concluded that "students whose fathers are at least high school graduates score 10-14 points higher but mother's education does not have a significant impact on the school performance of children".

In addition to the parental education, several studies demonstrated that household income is related with the student learning achievement (Hanushek, 1992). However, other studies such as Ganzach (2000) and Chevalier and Lanot (2002) did not find the association between fathers' and mothers' level of education and job status, and student achievement. However, Lee and Lockheed (1990) in Nigeria found the positive relationship between schools with a higher proportion of parents with professional jobs and their students' average scores of mathematics learning achievement.

In addition to parental education, occupation, and income, researchers have examined how family structure and size influence learning achievement of children. Several studies indicated that large number of children in the family is negatively related with children's school outcomes because resource are divided (Blake, 1989; Downey, 2001; Patrinos & Psacharopoulos, 1995). It is obvious that parent can provide fewer resources when number of children increases in a family. According to Coleman (1991), under such condition all forms of family capital -financial, human and social -are spread among the children. Various studies' findings approve these claims that families in larger number of children have less conducive home environment and lower levels of verbal facility (Parcel & Menaghan, 1994) as well as higher rates of behavior problems (Downey, 2001). Studies by Blake (1989) and Steelman and Powell (1991) in United States found a negative effect of number of family members and learning achievement of children. The negative effects of family size and learning achievement of children were simulated not only in the United States but also in some other developing countries including Thailand (Knodel & Wongsith, 1991) and Philippines (Montgomery & Lloyd, 1997).

Even though several studies established the negative relationship between family size and the learning achievement of children, it is not consistently observed. Shi Anh, Kondel, Lam, and Friedman (1998) in Vietnam mentioned that the negative relationship between the number of family members and school attainment disappeared when controls for socio-economic status were added. Similarly, in Kenya, Buchmann (2000) didn't find any effects of the number of family members on children's probability of school attainment. Not only the negative effect, some studies reported the positive effect of number of children to education. Studies by Gomes (1984) in Kenya and Chernichovsky and Meesook (1985) in Botswana found the positive relationship of number of children to school enrolment and attainment. These findings indicate that the effects of family size are not consistent across societies.

It is not only the number of family members that influences the learning achievement of children. The family structure is also associated with the learning achievement of children. However, most of the studies were concentrated in the United States and other industrialized countries. A study by Seltzer (1994) in the United States mentioned that children with a single parent are more prone to school drop-out and lower learning achievement. Interestingly, in some African contexts, family headed by female member has found related with greater educational opportunities for children. For example, a study conducted by Fuller and Liang (1999) in South Africa mentioned that the absence of father decreases the risk of girls' dropping out from school. Lloyd and Blanc (1996) analyzed the effects of female headship on children's schooling in seven sub-Saharan African countries and found that "children from female-headed households are consistently more likely to be enrolled in school and to have completed grade four than children in households headed by men" (p. 270). It is because female household heads are more likely to invest resources, including time, money and emotional support, in facilitating the education of children living in their household.

2.3.2 Student Characteristics and Learning Achievement

In general, students bring their personality and self-esteem to their studies (Bandura, 1988). Research results have indicated that student characteristics such as gender, ethnicity, motivation, involvement in household chores, time spent on study, school absenteeism, class repetition, and pre-primary-education experiences have a association on learning achievement. Other student characteristics such as students' perception on teacher support and their expectations have also been found positive relationship to learning achievement of children (Verkuyten & Thijs, 2002). Similarly, many studies have investigated the relationship between learning achievement and children's motivation to study. Academic motivation refers to the cognitive, psychomotor and affective psychological processes that influence students' learning (Slavin, 1997), guide and sustain study behavior (Schunk, 1990), contributing to foster students' engagement in academic activities. Motivated learners are more likely to use higher cognitive processes to learn, absorb, and retain information and try to improve their performance even if they face failure.

Gender is a variable frequently used to explain the variations in learning achievement. By using SACMEQ data, Nguyen, Margaret, and Gillis (2005) in Botswana and Kulpoo (1998) in Mauritius mentioned that generally girls perform better than boys but variation appears according to the school's average level of academic performance and subject if other factors are held constant. Similarly, Engin-Demir (2009) in Turkey estimated higher scores of girls than those of boys, which is consistent with the findings of Farkas, Sheehan, and Grobe (1990) and Veenstra and Kuyper (2004). However, Berberog (2004) and Woßmann (2003) found lower scores of girls than those of boys in mathematics and science scores though a UNESCO report on Zimbabwe in 1994 didn't find any significant gender differences in learning achievement for reading subjects.

In addition to gender, several studies have found that the ethnicity of students is associated with learning achievement. Generally, children from marginalized ethnic groups or minority groups tend to have less parental education, fewer materials, and a less favorable environment at home, which might lead to low performance in school. A study by McEwan and Trowbridge (2007) in Guatemala found large gaps in learning achievement between indigenous and non-indigenous children. They recorded the gap from .8 to 1 standard deviation in Spanish and approximately half of that in mathematics. Similarly, Hungi (2008, p. 158) in Vietnam reported that “pupils who belonged to the Vietnamese ethnic majority group (Kinh) were likely to achieve better in mathematics (-5.24, 1.79) and reading (-7.47, 1.93) than pupils who belonged to other Vietnamese ethnic groups”.

Grade repetition is another characteristic that negatively affects students’ self-esteem and academic motivation and is associated with long-term problems such as poor academic performance, behavioral problems, and dropping out of school. There might be several reasons for grade repetition, such as poverty, the high opportunity cost of schooling, and the low quality of schools in developing countries (Lockheed et al. 1986). Research by Hungi and Thuku (2010) using the data of SECMEQ in Kenya found a negative relationship between grade repetition and learning achievement in mathematics and reading subjects.

Analyzing the data collected as a part of major survey that sought to examine the quality of education offered in Vietnam, Hungi (2008, p. 159) found the similar result for 2010 and mentioned that “students who had never repeated a grade were estimated to achieve better in mathematics (-10.89, 0.80) and reading (-13.69, 0.95) when compared to students who had repeated a grade one or more times”. Using the data of the Unit of Education Quality Measurement (UMCE) evaluation project of 1998 and 1999, Marshall (2003) in Honduras reported that the first time grade repetition as well as repeating previous grade is associated with lower marginal achievement in the UMCE exam.

It is easy to understand that regular attendance of school is crucial for learning, as it affects academic success (Gray & Beresford, 2008; Gray & Partington, 2003). Several studies have demonstrated that school absenteeism is negatively associated with the learning achievement. There are multiple reasons for school absenteeism. Children who are excessively absent from school might have the risks for various negative reasons and social problems (Dube & Orpinas, 2009). However, the reasons might be different according to the context and socio-economic background of family. Children from poor families are more likely to provide support to their parents in household activities, particularly in developing countries, which might be a possible reason for school absenteeism. Hungi (2008, p. 159) in Vietnam found that "pupils who were never or rarely absent from school were estimated to achieve better in mathematics (-2.58, 0.20) and reading (-2.33, 0.22) when compared to pupils who were frequently absent from school", and the similar result was found by Hungi and Thuku (2010) in Kenya. It is obvious that pupils who are frequently absent from school receive fewer hours of instruction and therefore are highly likely to have a lower score compared to the rest of their classmates who go regularly and receive more hours of instruction.

Similarly, involvement in household work or economic activities is also associated with children's learning achievement. Patrinos and Psacharopoulos (1995), Jensen and Nielsen (1997), Psacharopoulos (1997), Ravallion and Wodon (2000), and Ray and Lancaster (2003) are the part of a large literature that provides evidence on the trade-off between children's work and schooling. However, most studies focuses on the impact of children's labor participation rate rather than hours worked by children, on child schooling. This is because collecting data on child labor hours is more difficult to obtain than that on child labor participation rate.

Children work in a variety of settings, not only as wage workers but also as domestic/informal workers. The implications of involvement of children in works differ according to the context. Children's involvement in economic activities or household chores may reduce their study hours. However, it is not clear, theoretically and empirically, to what extent the child work actually leads to the reduction of human capital development, especially when children are engaged in household chores. Using the Human Resource Development Survey Data of Tanzaniya in 1993, Akabayashi and Psacharopoulos (1999) investigated the relationship between children's involvement in work and learning achievement. They found that factors that tend to increase children's working hours generally tend to decrease their hours of study with a negative correlation to their reading and mathematics skills. Likewise, Heady (2003) in Ghana reported that involvement in work outside the household has a substantial effect on learning achievement.

Using the data of Statistical Information and Monitoring Programme of Child Labour (SIMPOC), Ray and Lancaster (2003) conducted a research on the involvement in household chores and its effect on the school attendance and learning achievement of children of the 12-14 years age group in seven countries: Belize, Cambodia, Namibia, Panama, Philippines, Portugal and Sri Lanka. They found a negative impact of hours spent at work on learning achievement but with marginal impact. However, in the case of Sri Lanka, involvement in work approximately 12-15 hours a week was found positively related to child's schooling and to his/her study time.

Several researchers have pointed out that the experience of pre-primary education has a positive impact on learning achievement and low level of class repetition and dropping out. A study by Save the Children in 2003 in the Siraha district in Nepal found that students with pre-school experience had a 26% higher rate of promotion from grade 1 to grade 2 than children who had not attended pre-school (UNESCO, 2003). Students having prescribed textbook and reference materials also perform better than their counterparts with fewer materials (Veenstra & Kuyper, 2004).

Similarly, students' efforts in their studies, particularly the time spent on homework, improve their learning achievement (Keith et al., 1986) and it is a means of communication between parents, children and schools. Postlethwaite and Wiley (1992) conducted a study in 23 countries, and found higher score in science where students spent more time on homework. The time spent on homework is associated with student's motivation to achieve (Stenberg, Lamborn, Dornbush, & Darling, 1992). However, a study conducted by Engin-Demir (2009) in Turkey did not find the significant relationship of "homework completion" to children's learning achievement, which contradicts the findings of Postlethwaite and Wiley (1992), Keith et al. (1986), Simmons and Alexander (1978) and Cooper (1989).

2.3.3 Parental Involvement and Learning Achievement

Expanding parental involvement in schooling and their children's learning has been viewed as an important strategy to advance the effectiveness and improve the quality of education (Chrispeels, 1996; Scheerens & Bosker, 1997). Strengthening the relationship between school and parents is critical because in the context of broader autonomy of schools, parents can play an important role for the management of school and providing support for their children's study at home. However, the research on parental involvement shows considerable variation to exist in the level of involvement and this variation largely depends on the socio-economic position and ethnic background of parents (Boethel, 2003). Several studies found a positive association between parental involvement and cognitive and social development of children, however, which aspect of development remains unclear (Driessen, Smit, & Sleegers, 2005).

A recent research by Vogels (2002) in Dutch showed parental involvement to be an important strategy to improve learning achievement of children, although the parental involvement in the primary education is much greater than in the secondary education. He categorized four types of parents; partners, participants, delegators, and invisible parents. The first two types of parents, who have middle to high socio-economic backgrounds, are closely involved in their children's schooling. The delegators and invisible parents from a low socio-economic position participate less both in various activities organized by schools and their children's learning at home.

Comparable differences in involving active versus passive parents are evident in related literature. A qualitative study in Cyprus by Phtiaka (1994) distinguished three types of parents- strongly involved parents, an intermediate group and a fringe group. The parents in the first group are primarily highly educated and actively involved in school activities and their children's learning at home. The second group of parents is well educated. These parents make contact with schools when they need some feedback and information about their children. The third group of parents consists of mostly poorly educated parents who have considerable difficulties communicating with school and feel powerless in relation to the school. These three groups of parents show a clear variation in parental involvement related to the socio-economic position and ethnicity of parents.

The characteristics of parents such as level of parental support, parental level of education and home environment are found to be positively associated with children's schooling. Using the data of a large-scale Dutch primary education cohort study by Driessen et al. (2005), which contained information on more than 500 schools and 12,000 students and their parents, parental involvement was examined and considerable parental involvement was found, but a direct effect could not be demonstrated. There are two kinds of parental involvement –school-initiated parental involvement and parent-initiated involvement. Most studies have focused on parental involvement from the perspective of school, and only a limited number of studies have looked at parental involvement from the perspective of parents.

Whatever the parental socio-economic background and educational status, it is clear that parents are the first teachers in a child's life, and it can be initiated with the verbal stimulation and supportive behavior by parents (Macbeth, 1994). Parents provide opportunities to their children to explore, express and imagine (Center for Educational Research and Social Development [CERCOD], 2005). Children learn by observing the behaviors of parents and siblings, and they try to relate it to their learning. It means that parents provide vital support for children's learning while continuing to serve as role models at home. Parents support their children's schooling by monitoring whether children do homework at home and complete it before they go to school. Parents' support to their children's learning at home is important because love, respect, and other emotional support are crucial aspects of learning and personality development.

Parents' involvement in their children's education fosters a positive attitude towards school, increased homework completion, reduced absenteeism, lower levels of dropping out, and enhanced learning achievement (Astone & McLanahan, 1991; Epstein, 1987; Fehrmann et al., 1987; Keith et al., 1986; Stevenson & Baker, 1987). Children attend schools regularly when their parents encourage them to and monitor their activities and progress because parental involvement creates a good home environment for the higher attainment in school (Epstein, 1986). However, parents with lower SES are less involved in their children's education than parents with higher SES (Sui-Chu & Willms, 1996).

Several researches in developed countries, such as Grau, Weinstein, and Walberg (1983) in the United States, Iverson and Walberg (1982) in Australia, show that parental support powerfully influences what children learn in and outside of the school. Macbeth

(1994), in his review of the parental dimension of schools, mentions that "most of the children's education happens outside of the school, especially at home, and if parents are the co-educators of the child, then it seems logical to make the two elements of school learning and home learning compatible, and for teachers to use home learning as a resource" (p. 303).

Parental involvement is not a new practice in Nepal. The education Act 2001 ensures the representation of majority of parents in School Management Committee (SMC). They are generally involved in school management activities. However, a study conducted by Center for Educational Research and Social Development (CERSOD) in 2005 highlighted that the involvement in their children's study is less than in school management activities. About 68% of students mentioned unfavorable home environment and they are involved more in household activities than their study. It shows that despite the important role of parental involvement in improving their children's learning, a majority of parents are still not fully aware of their roles in creating and supporting an encouraging learning environment for their children.

2.3.4 School Characteristics and Learning Achievement

Schools are where teaching and learning activities take place. It is generally assumed that schools do better if more resources are provided; however, evidences regarding the relationship between school characteristics and learning achievement of student are inconsistent. Researchers suggested that increased school resources do not guarantee the improvement in children's learning achievement (Hakkinen, Kirjavainen, & Uusitalo, 2003; Hanushek, 1997; Hanushek & Luque, 2003), however, other researches such as Lockheed and Verspoor (1991) and Card and Krueger (1996) found a significant relationship between school characteristics and student outcomes.

Hanushek (2003) argued that the traditional approach of simply providing resources is frequently insufficient and that differences in educational quality between schools are not due to differences in expenditures, class size, and other commonly measured attributes of teachers. He further mentioned that the relationship between input and output indicated that national policies on tend to be very in efficient all around the world. However, conducting a research in low income countries, Heyneman and Loxley (1983), Fuller and Clark (1994), and Heyneman (2002) highlighted the importance of schools resources such as school facilities, teacher-student ratio, teaching learning materials, teacher experience and qualifications in achieving better student learning. Similarly, other researchers such as Parcel and Dufur (2001), and Willms and Somers (2001) also found the positive significant effect of school characteristics on students' learning achievement. However, Bacolod and Tobias (2006) in the Philippines estimated only six percent of variances in children's learning achievement.

Similarly, Fuller (1986) viewed instructional time spent on particular subject, assignment of homework, feedback from teachers, time on task and active role of students in the classroom are the major conditions related to the quality of education. However, Scheerens (2004) put emphasis on the process of education where educational inputs are used effectively. He further mentioned that quality is not just the result of collision between subject and object but it is the cause of subjects and objects. Not only the processes of teaching and learning are important, teacher's subject knowledge and qualification, teacher-student ratio, school resources and its location have been found to influence students' learning achievement (World Bank, 2004).

Similarly, Dalin (1994) mentioned in-service teacher training, adoption of locally-related and relevant teaching materials and curriculum, regular support and supervision by the local communities, and motivated school leadership are the necessary conditions for the success of every school. Verspoor (1989) suggested that teachers' knowledge of subject matters, their experience with materials and high expectations for students' performance, pedagogical processes, teaching practices, and classroom organization as well as students' available time and time on task in the classroom are the factors associated with the quality of education. However, Chapman and Adams (2002) mentioned that quality inputs were important, but without effective processes, it would be hard to achieve improved outputs.

Among various school characteristics, the teacher-student ratio has been a widely examined variable, however, findings are inconsistent. Hanushek (1997) claimed that class size was not important, but Woessmann (2003) claimed that smaller class size was beneficial for low performing students in mathematics and science in 39 countries in 1994/1995, whereas Lindhal (2005) found that the minority and economically disadvantaged children benefited from smaller class sizes in Sweden. The findings that small class size was beneficial for low performing and minority and disadvantaged children were consistent with the results of Angrist and Lavy (1999) in Israel and (Krueger, 2003) in the United States. However, Hoxby (2000) found that class size did not significantly influence students' learning achievement in the United States. Kingdon (1999) did not find a significant relationship but found that class size was negatively associated with numeracy skills and positively related to reading skills in India.

The quality of education depends upon various school factors, some of them are the availability of school facilities, teaching and learning materials, and textbooks. Heyneman (1980) mentioned that students in developing countries perform much lower than students from developed countries because of poor school facilities. A research by Mwamwenda and Mwamwenda (1989) in Botswana found that the performance of students who belonged to schools with sufficient classrooms was significantly better than that of students who belonged to schools with insufficient classrooms for mathematics and social studies.

Teachers are the people who directly interact with students in classrooms, and their characteristics such as levels of education, years of experiences, status of training, job satisfaction and motivation are frequently examined variables to illustrate the relationship to students' learning achievement. It is generally agreed that if teachers are motivated, they can defy the other external effects such as the socio-economic status of students and so on. Teacher training is one of the important strategies frequently used to improve children's learning achievement, but there is little evidence for the effects of teacher training on student learning achievement. In a meta-analysis of 93 studies, Kennedy (1998) found that only 12 studies showed positive effects of teacher training on student learning achievement. Wiley and Yoon (1995) and Choen and Hill (2000) are the other researchers who found a positive effect of teacher training on students learning achievement.

Not only the characteristics of teachers and school facilities are associated with the learning achievement of children, studies have also highlighted the role of school management. Traditionally most governments used to keep their education systems under their control. However, budgetary shortages encouraged many governments to re-examine the role of private sector in education. A study conducted by Psacharopoulos (1987) in Colombia and Tanzania found that, while controlling for student ability and socio-economic status, private school students outperform their public school counterparts. Similarly, Govinda and Varghese (1993) in India and Williams and Carpenter (1991) in Australia concluded that private school students outperform their public school counterparts even after controlling for students' characteristics and family background.

In the above sections, I explained the factors that are associated to students' learning achievement. I particularly mentioned how the studies by earlier scholars suggest the effects of the family characteristics, student characteristics, parental involvement, and school characteristics on students learning achievement. Since this dissertation analyzes the learning of mathematics, the section below explains assessment practices, particularly focusing on areas of mathematics learning (arithmetic, algebra, data management, and geometry) which is considered as content domain, and cognitive domains (knowledge, comprehension, application, and problem solving) which specify the domains or thinking process to be assessed while students engage with mathematical content.

2.4 Assessment of Mathematics Learning Achievement

Assessing the learning achievements of students is not a new practice. Earlier efforts to assess learning achievement in mathematics began in late the 1950s under the auspices of UNESCO, with implementation by the International Association for the Evaluation of Education Achievement (IEA) project, aiming to measure learning achievement and identify determinants of achievement in different participating countries (Postlethwaite, 2004). This produced a large body of knowledge with regard to students' learning achievement in mathematics in different countries. Until the late 1980s, results of cross-countries studies were shared mainly with researchers and educators, but after 1990, many governments, particularly in developing countries, were interested in them because of the belief that the improvement of learning achievement of students is for national economic development. Moreover, there was growing public concern that government expenditures allocated to education needed to bring about higher levels of learning achievement (Ross, Paviot, & Jurgnes-genevois, 2006).

Similarly, the World Conference on Education in Jometian, Thailand in 1990, mentioned in its fourth article that the focus of basic education should be "…on actual learning acquisition and outcomes rather than exclusively upon enrolment, continued participation in organized programs and completion of certification requirements" (UNESCO, 1990, p. 5). Furthermore, the Dakar World Education Forum in Senegal in 2000 emphasized that "to achieve EFA by 2015 would require, in addition to school participation in education, all nations to improve all aspects of quality of education and ensure excellence so that recognized and measurable learning outcomes are achieved by all" (UNESCO, 2000, p. 8).

Since then, policy makers and researchers have been interested in knowing whether students acquire appropriate knowledge, skills, behaviors and attitudes as a result of their exposure to schooling. International assessments, such as the Third International Mathematics and Science Studies (TIMSS) organized by the International Association for the Evaluation of Education Achievement (IEA), the Program for International Student Assessment (PISA) organized by the Organization for Economic and Co-operation and Development (OECD), and the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SECMEQ), with14 African countries participating, are attempting to assess mathematical learning achievement. However, most previous studies have assessed narrow mathematical performance and reported quantitative performance differences (differences in mean scores) rather than qualitative performance differences (mathematical understanding) (Cai, 1995). Just knowing the difference in overall score of tests is not enough, because it does not give the information on areas of mathematics learning (arithmetic, algebra, data management, and geometry), and development of mathematical thinking process (knowledge, comprehension, application, and problem solving). It is important to know these aspects of mathematics learning because policymakers and curriculum developers will be informed strong and weak areas of students which will support to develop educational policies to improve the quality of mathematics learning.

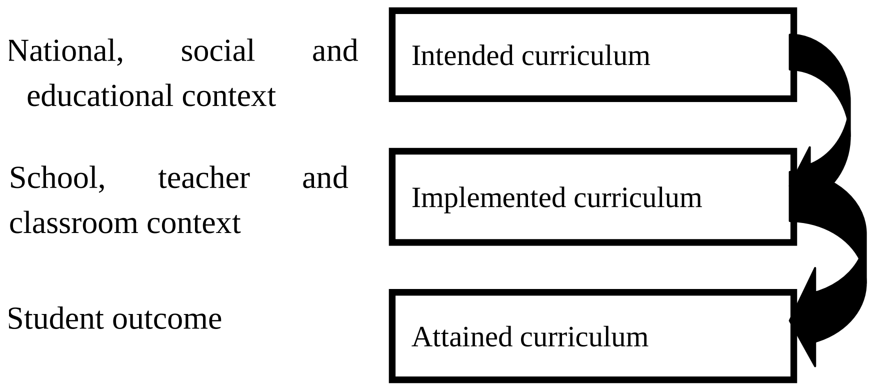
Generally, there are three types of practices to assess learning achievement: public examinations, national assessments and cross-national assessments. Public examination is a popular practice to determine whether an individual student possesses certain knowledge and skills at the end of an academic year. Public examination of students' learning outcomes is used to make decisions about educational certification and job selection. National assessment is a relatively new concept which can provide quantitative as well as qualitative information about learning achievement. Kellaghan (2004, p. 6) defined "national assessment as an exercise designed to describe the level of achievements, not of individual students, but also the whole education system or a clearly defined part of it" and Murphy, Greaney, Lockheed, and Rojas (1996, p. 2) explained it as a "systematic and regular measure of learning achievement". The purpose of national assessment is not primarily concerned with the individual student performance; rather, its purpose is to find out what all students know and do not know.

Cross-national assessment also shares common features with national assessment, but according to Postlethwaite (1988), cross-national comparative studies are generally designed to meet four objectives: identify what is happening in different countries that might help improve educational systems and outcomes; describe similarities and differences in educational phenomena between educational systems and interpret why these exist; estimate the relative effects of variables that are thought to be determinants of educational outcomes (both within and between systems of education); and identify general principles concerning educational effects (p. xx). These four objectives have been implemented while designing cross-countries studies, especially in the designs of the International Association for the Evaluation of Education Achievement (IEA) research.

Similarly, (Cai, 1995, p. 4) mentioned that "cross-national studies provide opportunities to identify effective ways of teaching and learning mathematics in a wider cultural context". Examining the outcomes of education in different cultures helps policy makers to understand how subject matter is taught and is learned and performed by students in different cultures and provides the framework to assess students' learning achievement and curriculum provision (Husen, 1967). Cross-country assessments give some indication of where the students of a country stand relative to students in other countries. They also show the extent to which the treatment of common curriculum areas differs across countries, and, in particular, the extent to which the approach in a given country may be idiosyncratic.

According to the TIMSS assessment framework for 2011 (p. 10) (Figure 2.2), three types of curriculums- intended curriculum, implemented curriculum, and attained curriculum -are to be assessed. The intended curriculum describes what the national and social context intends for students to learn, while implemented curriculum focuses on what is actually taught in classrooms and the characteristics of teaching. Finally, attained curriculum focuses on what students have learned against the intended and implemented curriculum. This dissertation only focuses on attained curriculum because one of the purposes is to assess the level of content and cognitive domain of learning mathematics among eighth grade students in Nepal.

Figure 2.2 Framework for Assessment of Learning Achievement



Source: Trends in International Mathematics and Science Studies, 2011, p. 10

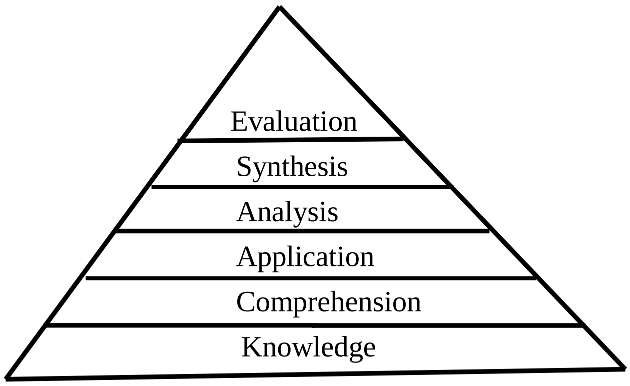
2.5 Assessment of Content and Cognitive Domains of Mathematics Learning

Traditionally, competencies of mathematics were measured by the aggregate scores of performance-test score of students, but not much investigation has been done regarding the capacities of students to answer respective questions in the test. But contemporary views emphasize the cognitive process in respect to how people mentally represent and process information (Anderson, 1985; Simon, 1989). This emphasizes the importance of thinking, reasoning, conceptual understanding, problem solving, and communication (Cai, 1995). Cognitive research revealed that “learning is not simply a matter of the accretion of subject matter concepts and procedures; it consists rather of organizing and restructuring of this information to enable skillful procedures and processes of problems representation and solution" (Glaser, Lesgold, & Lajoie, 1985). According to Glaser et al. (1985), there are different levels of knowledge organization and different degrees of cognitive processes and procedural skills involved in different stages of learning. Examining the contemporary views could explain similarities and differences in mathematics performance of students, help to know their current status of developmental of mathematical thinking and reasoning, and provide diagnostic and decision-making information to resolve learning difficulties.

In order to ensure alignment with the changed view of mathematics, the approaches of assessing the learning outcomes has also changed. Generally, assessing learning outcomes is undertaken in two dimensions –the content dimension and the cognitive dimension. First, the content dimension includes the areas of mathematics or subject matters to be assessed, such as arithmetic, algebra, statistics, and geometry, which gives information about performance according to areas of mathematics and helps teachers to know which area/s they should focus on more to effectively support students to achieve better.

Second, the cognitive dimension focuses on thinking and reasoning processes. Learning does not happen as an event. It is a process which progresses continuously. An influential work by Benjamin Bloom in 1956 developed a system of categories of learning behavior known as “Bloom’s taxonomy” to assist in the design and assessment of educational outcomes. He categorized the three domains of learning -cognitive, affective and psychomotor. According to Bloom’s taxonomy, the cognitive domain focuses on knowledge and development of intellectual skills, while the affective domain focuses on changing attitudes, feelings, and emotions, and the psychomotor domain focuses on changing behavior or skills of learners. Within each domain, there are multiple levels of learning that progress from basic to complex or deeper levels of learning. I explain the cognitive domain of learning because one of the objectives of this dissertation is to analyze the mathematics learning of eighth grade students in Nepal. Cognitive domain involves the development of mental skills and the acquisition of knowledge. It includes the recollection or recognition of specific facts, procedural patterns and concepts that assist to develop the intellectual abilities and skills. There are six categories arranged from the simplest behavior to the most complex. That is, the first one must be mastered before the next one can take place (Figure 2.3).

Figure 2.3 Stages of Cognitive Learning



Source: Benjamin & Krathwohl, 1956, author edited

Knowledge is the first step, which is defined as the remembering of previously learned information. This involves the recall or recognition of facts and procedures. *Comprehension* focuses on the ability to understand the meaning of given information. This cognitive skill goes one step beyond the first category which is to recall or recognize facts and procedures. *Application* refers to the ability to use learned knowledge in the new situations. The cognitive skills of *application* requires a higher level of understanding than those under *comprehension*. *Analysis*, *synthesis* and *evaluation* are the higher levels of learning, which focus on interpretation, creative thinking and assessing the effectiveness. Cognitive skills at these levels require a higher intellectual capacities than the comprehension and application because it requires an understanding of both the content and structural form of the material.

2.6 Chapter Summary

There are three sections in Chapter 2. The first section explains the concept of quality of education. Quality of education is a notion rather than operational concept, which implies that it cannot be captured by single definition or approach. The understanding of the quality of education differs according to the viewpoints of people and their academic traditions. The existing notion of quality of education can be categorized into two traditions: the progressive/humanist, and the economic view of education. The progressive/humanist tradition emphasizes acquisition of knowledge by students as the center of the quality of education, while economic view of education emphasizes education as an investment for the acquisition of knowledge and skills which will increase earnings or provide long-term benefits for individuals.

Highlighting the importance of quality of education, the second section explained determining factors for the quality of education. Empirical evidences indicate that education is the fundamental factor for peoples' economic and social development (Barro, 1996; Krueger & Lindhahl, 2001). According to the human capital theory, the investment in education leads to the formation of human capital, and is an important factor for economic growth of a country. The skills and productive knowledge imparted through education increases the productivity of people, and thereby their earnings. Education is itself a basic need which supports to fulfill other basic necessities such as food and shelter which help to improve the quality of life.

Hence, providing access to education for all people has significant implications for the development of individuals and societies, but evidences indicated that expansion of educational opportunity has not markedly reduced income inequalities, underdevelopment and poverty, possibly because of the poor quality of education (Vegas & Petrow, 2008). Since long time educationists and researchers have tried to answer the questions as follows: What constitutes the quality of education? What are the determinants of education quality? However, no consensus has been made and the quest for answers still continues.

School is a formal institution that educates children and youth, and learning is a product of it, but the role of family, communities, and peers are also highly recognized. However, there is a debate on the relative effects of home and school related factors on students' learning outcomes from education at school. The debate on the importance of family and school factors on students' learning achievement was initiated by the findings of Coleman et al. (1966) in the United States. They examined the aggregate effect of school quality on academic achievement after controlling the students' socio-economic status. The conclusion was that the amount of variance in learning achievement accounted by socio-economic status of student is larger than the impact of all aspects of school quality. Since then, many researchers have tried to reexamine the effect of home, and school factors on students' learning achievement.

In addition to family socio-economic and school factors, students' learning achievement is also found influenced by their own characteristics. This includes gender, ethnicity, school absenteeism, involvement in household chores, homework completion (Keith et al., 1986; Konu & Rimpela, 2002; Veenstra & Kuyper, 2004). Similarly, parental involvement in their children's study to support and provide opportunities to explore and express ideas were found to be vital for learning achievement (Astone & McLanahan, 1991; Barnard, 2004 ; Fehrmann et al., 1987; Iverson & Walberg, 1982). Although several studies have highlighted the importance of various factors that are associated with the learning achievement of children, most of them appear to focus on four factors: family characteristics, student characteristics, parental involvement, and school characteristics which is presented in Figure 2.1 as the conceptual framework for this study.

The final section of Chapter 2, explains assessment practices, particularly assessment of mathematics learning. Traditionally, competencies on attained curriculum were measured by the aggregate test scores of students, but contemporary view emphasizes on cognitive process which focuses on the development of knowledge and thinking processes. Generally, assessment of attainted curriculum is assessed in two domains- content domain, and cognitive domain. Content domain focuses on the areas of mathematics or subject matter (arithmetic, algebra, data management, and geometry) that students are expected to learn by the end of the academic year, while cognitive domain focuses on the development of mental skills and the acquisition of knowledge in the process of learning.

As I have presented the conceptual framework in Chapter 2 (Figure 2.1), Chapter 5 examines the effect of family characteristics, student characteristics, parental involvement, and school characteristics on eighth students' mathematics learning achievement in Nepal. Similarly, according to the conceptual framework (Figure 2.2), Chapter 6 analyzes mathematics learning particularly focusing on areas of mathematics knowledge (content domain) and the mental and cognitive skills applied in the process of learning (cognitive domain). However, before presenting the research findings, Chapter 4 provides the background information, especially educational development in Nepal. The following Chapter 3 explains the methodology that this study has adopted to analyze the data.

Chapter 3 Methodology

3.1 Introduction

Chapter 3 explains the methodology that this study adopted for data analysis. It explains the development of data collection instruments, sampling, procedures of data collection, and analytical approaches. There are three sections in Chapter 3. The first section explains the sampling strategy, including the descriptions of samples. The second section explains the development of instruments for data collection. It explains four types of data collection instruments -mathematics test design by the author, survey questionnaires for students, and survey questionnaires for head teachers and mathematics teachers. The final section explains the analytical approaches. It particularly explains the multiple regression analysis and principle component analysis (PCA). Multiple regression analysis is used to examine the factors affecting learning achievement in mathematics, while PCA is used to examine the relationships between mathematical items.

3.2 Sampling

This study is quantitative in its data analysis because the purposes are to estimate the relationship between a dependent variable (mathematics test scores) and independent variables (family characteristics, student characteristics, parental involvement, and school characteristics), and to assess the mathematics learning achievement for eighth grade students in Nepal. The survey of this study was carried out from May 2011 to July 2011 in nine districts covering three geographical zones -mountain, hill and lowland (Tarai). The selection of country has significance because Nepal has not participated in any international assessments so far, and none of the studies have examined the determining factors for learning achievement in mathematics focusing on the Nepalese cases.

A multi-stage random stratified sampling method was used to select the samples. Initially, two stages –geographical zones and districts –were identified. Based on the proportion of students from three zones –mountain, hill and lowland (Tarai) – nine districts were selected: one mountain district, four hill districts and four lowland (Tarai) districts. Altogether, the sample consisted of 21 secondary schools with 762 eighth grade students (400 girls). Schools within the districts were purposefully selected, taking into account characteristics such as public, private, rural, urban and so on. To ensure the representation of schools from all five regions of the country, three schools were selected from the far western region, seven schools from the mid-western region, two schools from the western region, seven schools from the central region and two schools from the eastern region. Different types of school (public or private) and schools located in rural and urban areas were also included because a current debate in Nepal concerns the extent to which differences in learning achievement are related to school characteristics. Out of the total 21 sample schools, four schools are privately managed and ten schools are from urban areas. Urban areas in the context of Nepal also includes the district headquarter. One head teacher and one mathematics teacher from each school participated in the study. The description of the sample is presented in Table 3.1.

Table 3.1 Description of Samples

Location	Districts	Schools		Location		Student	Mathematics teacher	Head teacher
		Public	Private	Urban	Rural			
Mountain	1	1			1	34	1	1
Hill	4	8	2	5	4	328	10	10
Lowland (Tarai)	4	8	2	6	5	400	10	10
Total	9	17	4	11	10	762	21	21

Source: Survey conducted by the author

3.3 Data Collection Instruments Used for the Study

Four types of instruments -mathematics test, questionnaires for students, questionnaires for head teachers, and questionnaires for mathematics teacher- were developed to collect the data for this dissertation. The mathematics test was designed and conducted with eighth grade students in Nepal to assess the level of learning, while student survey questionnaires were developed to collect the data on students' family characteristics, their own characteristics, and their perception of parental involvement in their study. Similarly, survey questionnaires for head teachers and teachers were distributed to collect the data on school and mathematics teachers' personal and professional characteristics. The details of each instrument are explained below.

3.3.1 Mathematics Test

There were two purposes for designing the mathematics test for this study. The first purpose was to measure the overall learning outcomes in mathematics of eighth grade students in Nepal. The second purpose was to assess students' capacity to answer questions in different areas of mathematics learning such as arithmetic, algebra, data management, and geometry which is regarded as content domain of learning, and cognitive skills students can use in the process of solving problems which is regarded as cognitive domain of learning. The mathematics test was designed in line with the national curriculum. Altogether, 20 mathematical test items were included in the test, with the maximum marks of 50. Mathematics test items were categorized in three types of questions: objective questions, short questions and long questions. The objective questions are related to mathematical facts where students need to recall mathematical knowledge. The short questions measured the students' ability to apply knowledge and conceptual understanding of mathematics. The long questions measured the students' ability to solve mathematical problems within relatively complex contexts which require students to follow multiple steps.

The weightage of each type of question was assigned according to the teaching hours weighted in national curriculum. Objective questions were assigned one mark each, short questions were assigned two marks each, and long questions were assigned four marks each. The mathematics test was conducted with grade 8 students at the end of academic year to ensure the completion of teaching and learning of the curriculum designated for this grade of education. Similarly, the marking scheme was developed in order to maintain the consistency for correcting the answer sheet. The copy of marking scheme is included in Appendix 5. The detailed explanation of the mathematics test is included in Chapter 4 and a copy of the test used for this study is included in Appendix 4.

3.3.2 Survey Questionnaires for Students

The student survey questionnaires consisted of three sections. The first section included the information of family characteristics such as number of family members, number of siblings, father's and mother's level of education, occupation, income, traveling time to school, number of books at home, and presence of certain items at home (radio, television, telephone, bicycle, computers, cooking gas, and motorbike). The second section focused on the personal characteristics of students such as gender, number of days absent from school, grade repetition since admission to school, homework completion, number of hours spent studying at home, number of hours spent on household chores, preschool experience, perception of mathematics teachers' teaching and learning, and academic motivation. The final section related to students' perception of their parents' involvement in their education. It included the information about parental support for their studies, particularly homework, parental encouragement, parental monitoring of their children's studies, and parental relationship with school. To ensure the consistency of the student survey questionnaires, pilot testing was conducted in one of the public secondary schools in the Bardiya district in the mid-western region of Nepal, which was not included in the study sample. The schools were selected by their characteristics such as combination of students' of socio-economic background, school types, and location.

3.3.3 Survey Questionnaires for Head Teachers and Mathematics Teachers

Questionnaires were also administered to head teachers and mathematics teachers. The survey questionnaire for head teachers was designed to get data on schools' physical conditions and human resources management. The head teachers' survey questionnaires mainly included data such as location of the school (rural/urban), types of school (public/private), number of teaching staff, number of students in total and in grade eight, condition of the school facilities, and school days open in a year. Furthermore, it focused on the head teachers' personal and professional characteristics such as age, teaching experience (years), academic qualifications, status of training (teachers' training and management training). Similarly, the survey questionnaires were distributed to mathematics teachers to get personal and professional data, which included age, sex, teaching experience, training status, academic qualifications and their perceptions about the relationships with the head teacher and the community.

3.4 Analytical Approaches

Three types of approaches were used to analyze the data for this study. First, multiple regression analysis was used to answer the first and second research questions, which intend to investigate the relationship between the dependent variable (mathematics score) and the explanatory variables (family characteristics, student characteristics, parental involvement and school characteristics). The justification for adopting the multiple regression analysis is that the nature of the dependent variable (marks in mathematics) of this study is a continuous type of variable, and when a dependent variable is continuous, a standard practice is to assume a linear functional relationship with the explanatory variables (Muijs, 2004) which is represented by the following equation.

$$Y_i = (b_0 + b_1X_1 + b_2X_2 + \ldots\ldots\ldots + b_nX_n) + e_i$$

Y_i is the outcome variable, b_0 is the coefficient of the regression model, b_1 is the coefficient of the first predictor (X_1), b_2 is the coefficient of the second predictor (X_2), b_n is the coefficient of the n-th predictor and e_i is the difference between the predicted and observed value of Y for the *i* th participant.

There are three techniques to enter independent variables into the regression equation. They are simultaneous, stepwise, and hierarchical regression method. The simultaneous and stepwise techniques are suitable for prediction, while the hierarchical regression is generally used for the explanatory studies (Ma, 1997). The simultaneous entry approach was used to enter the variables in the regression model because the goal of the study was predictive rather than explanatory (Cohen & Cohen, 1983).

There were some qualitative or categorical variables which assigned numbers to qualitative information for the sake of quantitative analysis. One of coding methods to turn qualitative information into quantitative variable is a dummy coding. A dummy variable takes the value 0 or 1 to indicate the absence or presence of some categorical effect. Some of the variables, such as fathers' and mothers' occupation and income, were not included in the regression model because the high degree of multi-collinearity among them. Generally, in developing countries, if the parents have a high level of education, it is likely that he or she will have an occupation, which means that they earn income. The education level of the parents can explain the other two variables.

While conducting the multiple regression analysis, a casual priority of independent variables in explaining the dependent variable is specified. (Cohen & Cohen, 1983). The priorities of entering the independent variables were determined based on the conceptual framework that was discussed in the literature review section. Their causal priority of set of independent variables is determined as follows:

- Family characteristics are related with student characteristics such as the time spent on household chores, the time spent studying, homework completion, preschool experience and academic motivation.
- Family characteristics and student characteristics are related with parental involvement in children's schooling.
- Family characteristics, student characteristics, and parental involvement are related with school characteristics.

To predict the relationship between dependent variables (mathematics test score) and a set of independent variables, four types of separate and combined models were developed. The models suggested how students' learning outcomes are affected by the combination of factors such as family, student's own characteristics, school characteristics and parental involvement.

Second, the weighted mean was calculated to assess the content and cognitive domains of mathematics learning. The weighted mean was used this way because different mathematical items had different means. For example, within the arithmetic content domains, the mean for whole number is 65 and the mean of profit and loss is 12. After assessing the level of content and cognitive domains, one-way analysis of variances (abbreviated as one-way ANOVA) was calculated to examine the differences in content and cognitive domains of mathematics learning achievement by gender, the ethnic background of student, types of school and location of school. Finally, I used principal component analysis (PCA) which is a multivariate technique in which observations are described by several interrelated variables. In other words I used PCA to examine how the mathematics test items are interrelated with each others. PCA is a mathematical procedure that transforms a number of (possibly) correlated variables into a smaller number of uncorrelated variables. Before conducting the PCA, I examined the Pearson's correlation analysis to examine strength of relationships between mathematics test items included in this study (Table 6.7).

3.5 Chapter Summary

I conducted multiple regression analysis to examine the factors affecting mathematics learning achievement of eighth grade students in Nepal. I particularly examined the relationship between aggregate scores of mathematics test as the dependent variable and family characteristics, student characteristics, parental involvement, and school characteristics as independent variables which is explained in Chapter 5. Similarly, I calculated weighted mean, one-way ANOVA, and PCA in Chapter 6. I used weighted mean to examine the average score of content and cognitive domains of mathematics learning, while one-way ANOVA and PCA were used to examine the differences in these domains by gender, ethnicity, types of school and location of school, and to identify the relationship among distribution patterns of students' marks for respective questions of the mathematics test for this study. However, before presenting the data analysis and research findings, the following Chapter 4 provides the background information of this study particularly educational development in Nepal.

Chapter 4 Educational Development and Policies to Improve the Quality of Education in Nepal

4.1 Introduction

This chapter provides a brief introduction to the socio-economic context and status of educational development in Nepal. There are two sections in this chapter. The first section provides an introduction to the Nepalese socio-economic context, which includes culture and tradition, geography and the current development status of the country. The second section explains the educational development of the country, which includes the quantitative and qualitative expansion of educational development in the country. Educational development after 1990 is presented because after the commitment made to the goals of Education for All in 1990, Nepal has made remarkable progress, particularly with school participation of all levels of education. The final section explains the current educational policies to improve the quality of education in Nepal.

4.2 Socio-Economic Context of Country

Nepal is a small landlocked country located in the south Asia, sandwiched between the Republic of India in the east, west and south and the People's Republic of China in the north. It has a total land area of 147,181 square kilometers. The country has a total population of 26.6 million that consists of 92 different language groups, 125 caste/ethnic groups, and 10 religious groups (Central Bereau of Statistics [CBS], 2011). The official language is Nepali, which is spoken as a first language by 44.6% of people, followed by Maithili with 11.7%, Bhojpuri with 6%, and Tharu with 5.8%. There are ten religious groups reported in the 2011census. The majority in Nepalese people, more than 81%, are Hindus, followed by 9 percent Buddhists, 4.4 percent Muslims, and 3 percent Kirants (an indigenous religion).

Nepali society has deep roots with the Hindu caste system, with a hierarchy of different groups of people within the system since ancient times. Caste-based exclusion and discrimination are not only historical facts but also are constantly reinvented in the present day through social institutions and relationships.

Geographically, the country is divided into three distinct ecological regions. The mountain region, at an altitude between 4,877 and 8,848 meters, comprises 35% of the land area; the hills, at an altitude between 610 to 4876 meters, comprises 42% of the land area; and the lowland (Tarai) region, which is an extension of the Gangetic Plains, lies below an elevation of 610 meters and comprises 23% of the land area. For administrative purposes, there are 5 development regions, 14 zones, and 75 districts. Each district consists of a number of Village Development Committees (VDCs) and municipalities, which are the lowest elected bodies for the governance of the people within their defined area.

The present reality is that poverty is pervasive in Nepal. The Nepal Living Standards Survey (NLSS), conducted by CBS in 2011 estimated that 25% of the total population is below the poverty line. Moreover, there is an enormous disparity in rural-urban poverty, at 35% in rural areas compared to 10% in urban areas, and it is more unequal between social groups and region. Despite some progress in poverty reduction in recent years, Nepal remains one of the poorest countries in the world, with human development index (HDI) of 0.463 and ranked 157th out of 187 countries in the year 2012 (UNDP, 2013). Agriculture makes a contribution of about 35% to the gross domestic product (GDP), and about 80% of the total population derives their livelihood from this sector. In recent years, besides agriculture and other national income such as remittance has become one of the major income sources for the country. The income from remittances has helped large numbers of people to come out of poverty and improve their standards of living.

Nearly 80% of the total population lives in rural areas. Life expectancy at birth is estimated to be 68 years (UNDP, 2013). According to the (CBS, 2011), the literacy among Nepalese over six years of age has increased from 54.1% in 2001 to 65.9% in the 2011 census. Disparities exist between gender, urban and rural areas and development regions. Male literacy is 75.1% compared to female literacy at 57.4%. Literacy is substantially higher in urban areas (77%) than in rural areas (57%). Similarly, the Western development region has the highest literacy with 66%, and the lowest rate of literacy is in the Central region with 57%. There are marked differences in literacy rates between consumption quintiles. While the literacy rate of the richest consumption quintile in the population 6 years and above is 79.3% (male 90.1% and female 70%), it is only 45.3% (male 55.8% and female 37.2%) in the poorest consumption quintile (CBS, 2011). It shows that more women are illiterate than men, displaying extreme gender disparity and inequality in education. With little time left to reduce illiteracy by 50%, as set out in Dakar, Senegal for the Education for All goals, it seems highly unlikely that women and the poorest will achieve universal literacy by 2015.

After the restoration of democracy in 1990, Nepalese people had high expectations for the development of their society and improvement of their daily life. However, even basic demands such as universal primary education and literacy for all that constitute a basic human right have not been fulfilled, particularly in rural areas. Building upon the frustration of the people, Nepal Communist Party (Maoist) organized people from rural and remote areas and launched a revolution against the government of Nepal with the aim of overthrowing the Nepalese monarchy and establishing a People's Republic. Ten long years of armed conflict ended with the 12-point Comprehensive Peace Accord (CPA) in 2006 between the government and the Nepal Communist Party (Maoist), which transformed the country from a constitutional monarchy to a democratic republic. In 2009 Constituent Assembly (CA) election was conducted for 240 direct members and 361 proportional members. However, after 4 years of extensive work, the new constitution could not be drafted and another election for Constituent Assembly was conducted in November 2013.

4.3 Educational Development in Nepal

Nepal does not have a long educational development history. The history of modern schooling began about 150 years ago, with the establishment of the first school in 1853 (Ministry of Education [MOE], 2003). Traditional schools were mainly focused on Hindu and Buddhist religion and the aim was to prepare priests. A century ago the Rana regime established the western-style of education in the country, which served only the interests of the rulers, politicians, merchants, and the richer section of the society, not the mass of people. After the end of the Rana regime, a democratic government was established in 1950, which lasted only until 1961, but brought fundamental changes in the educational scenario and the expansion of school facilities in the country.

Since then a number of initiatives were undertaken to expand educational opportunities in Nepal. The creation of the Nepal National Education Planning Commission in 1953 was the beginning of the systematic development of education in the country. The commission recommended the universalization of the primary education. Similarly, the National Education System Plan (NESP) in 1973 was another important milestone which focused on the development of the primary education sub-sector and emphasized the role of the government in planning, management, and financing. It recommended the free primary education. This plan made significant achievements in terms of the expansion of primary schooling opportunities and uniform curriculum and textbooks for a comprehensive school education from grades one to ten, however, the role of local people in school affairs was discouraged.

To expand the educational opportunities to people, using the external resources of the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Development Programme (UNDP) and the United Nations International Children's Emergency Fund (UNICEF) for the first time in the educational history of Nepal in 1980, the government initiated an innovative project called the Education for Rural Development Project (ERDP), popularly known as the SETI project. The main thrust of the program was to develop primary education as a vehicle for rural development (MOE, 1999). With the successful experience of the SETI project, the Primary Education Project (PEP) was implemented in 6 districts in 1984 with the assistance of the World Bank (WB) and the UNICEF. Consequently, the number of schools increased, contributing to greater numbers of children attending and completing primary school and making the transition to the secondary education.

With the people's popular movement in 1990, once again the democratic government was restored, which adopted liberal education policies, opening the door for the involvement of the private sector in education. Furthermore, participating in the World Education Forum in 1990, Nepal made a firm commitment on Education for All to provide the quality basic education for all people. Thus, with the technical support of the United Nations Development Programme (UNDP), the government developed the Basic and Primary Education (BPEP) Master Plan (1991-2002) in 1991, which presented a broad picture of the primary education in Nepal and provided a good framework for its future development. It also provided impetus for both the government and the international agencies to work together in this effort.

Lesson learned from the past experiences, the Ministry of Education (MOE) implemented the new program called Basic and Primary Education Project BPEP I (1992-1997) with the financial support of the World Bank (WB), DANIDA, the Japan International Co-operation Agency (JICA) and UNICEF. The main focuses were improving the access to, and the quality and management of primary schools throughout the country. The second phase of Basic and Primary Education Program II (1999-2004) was implemented as a basket funding modality with the assistance of Denmark, Finland, Norway, the European Union (EU), and the World Bank (WB) as a core investment program (CIP), and JICA and United Nations International Children's Emergency Fund (UNICEF) as a Non-Core Investment Program.

Ten years after the EFA commitment made in 2001, the government developed a long-term EFA National Plan of Action (EFA, NPA, 2001-2015), which provided a broader framework for the educational development of Nepal. Within the overall framework of EFA NPA, an Education for All Program (EFAP, 2004-2009) was implemented with the financial assistance of the governments of Denmark, Finland, Norway, the United Kingdom (UK), the Asian Development Bank (ADB) and the World Bank as pool donors and JICA, UNICEF and United Nations Educational, Scientific and Cultural Organization (UNESCO) as non-pool donors, which targeted the achievement of the six goals of EFA.

Currently, to respond to the public demand for educational quality and opportunity, the School Sector Reform Plan (SSRP, 2009-2015) is in the fifth year of its implementation, and aims to restructure school system. Grade 1 to 8 is considered basic education and Grade 9 to 12 is secondary education. A national level school leaving certificate (SLC) examination is carried out at the end of grade 10, and the higher secondary education examinations are conducted for grade 11 and 12. The higher education consists of a bachelor's degree of three to four years and a master's degree of two years programs. The Doctor of Philosophy (Ph.D.) is regarded as the highest degree offered by relevant universities. The structure of education system is presented in Table 4.1.

Table 4.1 Structure of Education System in Nepal

Age	Grade	Previous School System	Current School
16	12	Higher Secondary Education (Grade 11-12)	Secondary Education (Grade 9-12)
15	11		
14	10	Secondary Education (Grade 9-10)	
13	9		
12	8	Lower Secondary (Grade 6-8)	Basic Education (Grade 1-8)
11	7		
10	6		
9	5	Primary Education (Grade 1-5)	
8	4		
7	3		
6	2		
5	1		
4	Pre-primary Education/Early Childhood Development		Pre-primary Education

Source: World Bank, 2009, p. 28

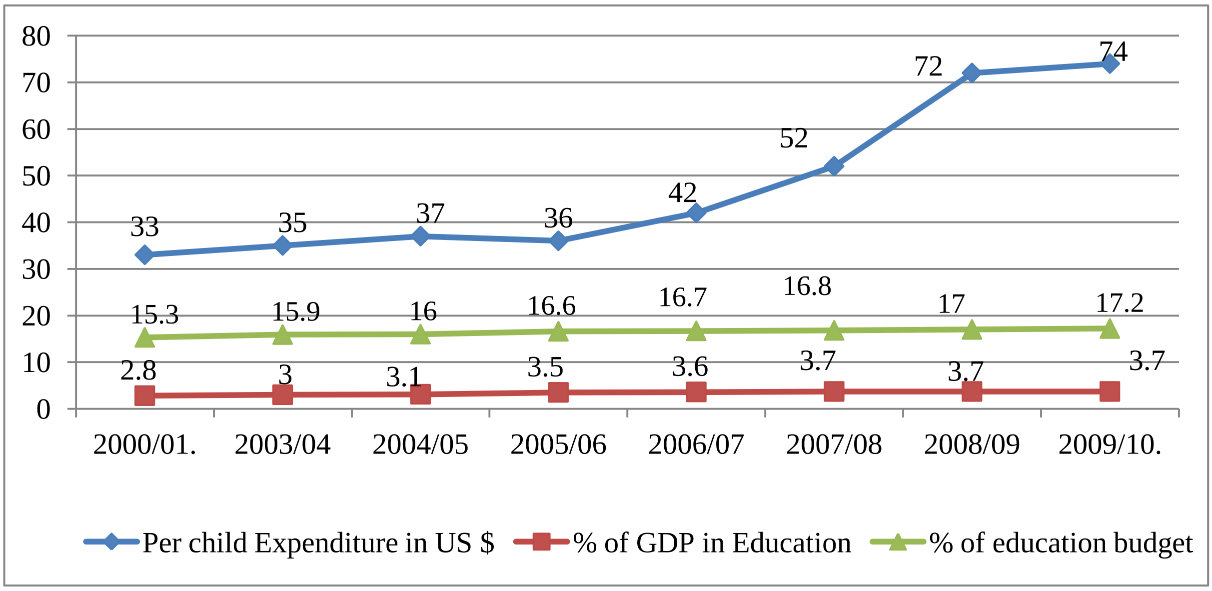
The relevant age groups are 3-4 years for pre-primary/Early Childhood Education and Development (ECED), 5-9 years for primary education, 10-12 years for upper primary education/basic education and 13-16 years for secondary education.

The Ministry of Education (MOE) is the apex body for formulating education policies and overall management of the education system in Nepal. The Department of Education (DOE) is responsible for planning, budgeting, and monitoring school education. The Curriculum Development Center (CDC), the Non Formal Education Center (NFEC), and the National Center for Educational Development (NCED) are the specialized agencies supporting the DOE at the central level and are responsible for the development of curriculum, non-formal education, and teacher training respectively. There are five Regional Education Directorates (REDs) responsible for monitoring the educational programs within their respective regions. The District Education Offices (DEOs) are responsible for implementing the educational programs and managing the school system at the district level. Below the district level, the Resource Center (RC) is responsible to provide academic and technical support to schools.

4.3.1 Quantitative Expansion of School Education in Nepal

Education is a key sector in which Nepal has made remarkable progress over the past 50 years. The rapid progress can be seen particularly after 1990 with the establishment of democratic government that made a pledge in Dakar, Senegal in 2001 to achieve Education for All (EFA) goals. The government of Nepal prioritized education as a vehicle to reduce poverty and improve the livelihood of people. To universalize the quality basic education for all, resources in the education sector increased and various programs such as BPEP I, BPEP II, EFA program, SESP, a school construction program, the Teacher Education Project (TEP) and the Community School Support Programme (CSSP) were implemented. Figure 4.1 shows that per-child expenditure for school education in 2000 was $33 US, while in 2009 it increased to $74 US. The national budget for the education sector was 15.3% in 2000, which increased to 17.2% in 2009. Similarly, the allocation of percentage of GDP to the education sector was 2.8% in 2000, increasing to 3.7% in 2009, which shows the commitment of the government to provide the quality basic education for all.

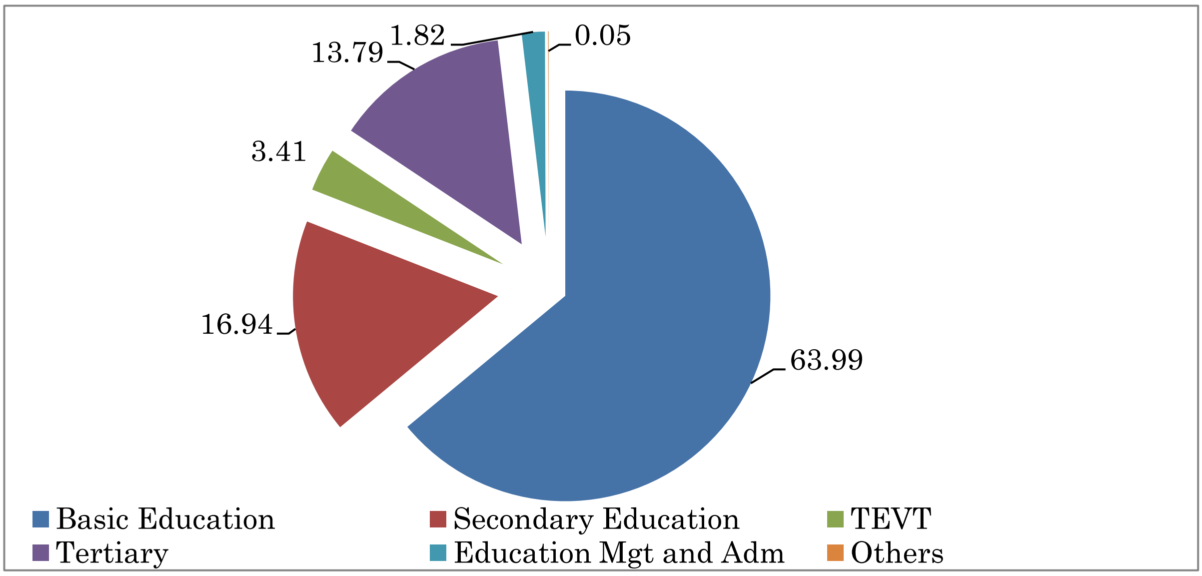
Figure 4.1 Education Financing in Nepal



Source: Ministry of Finance, (2009), Nepal, author edited

Figure 4.2 below shows the allocation of national budget to education by subsectors. It indicates that the government has given a high priority to school education, as over 80% of the national budget to education goes to this sector, followed by 14% for higher education and 3.4 % for Technical Education and Vocational Training (TEVT).

Figure 4.2 Percentage of National Education Budget by Sub-Sector in 2009



Source: Ministry of Finance, 2009, p. 163, author edited

Financing education by sub-sector shows an increased investment in school education, especially in basic education (grade 1-8), with a substantial impact on the impressive growth in school enrollment and the reduction of the gender gap in both primary and secondary education. The experiences of the last two decades illustrate that increasing the financing of education can go a long way towards achieving the Education for All goals. Table 4.2 shows the expansion of school education in different years.

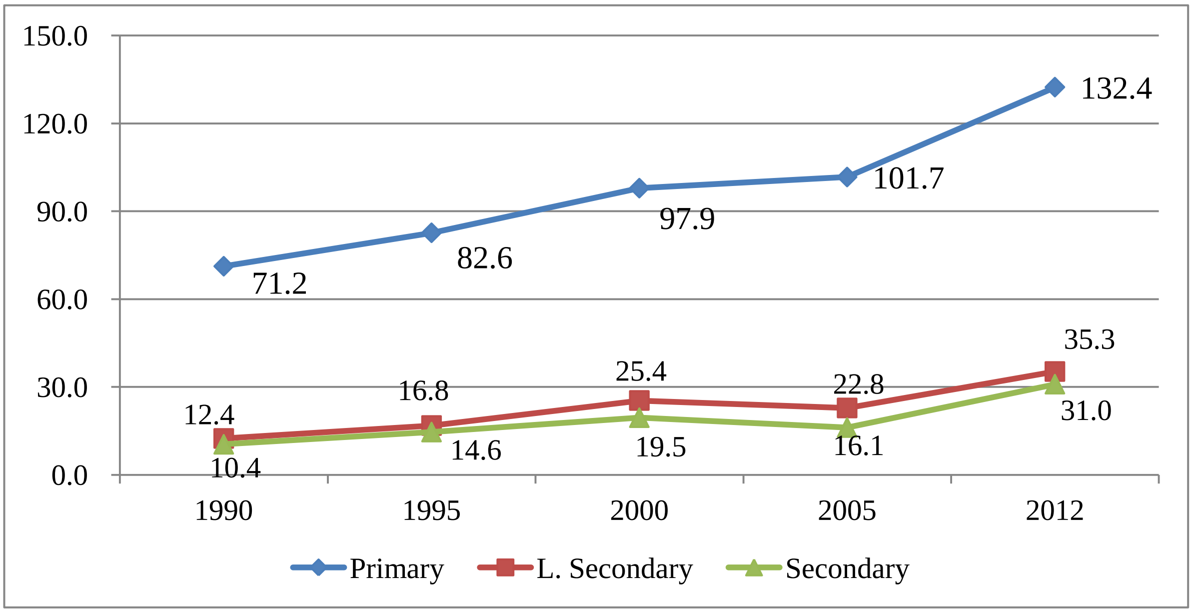
Table 4.2 Expansion of Schools in Various Years

Level	1951	1990	1995	2000	2005	2012
Early Childhood Development		NA	3852	4038	4069	34174
Primary (grade 1-5)	351	17842	21473	25927	27525	34782
Lower Secondary (grade 6-8)	schools	3977	5041	7289	8471	14447
Secondary (grade 9-10)		1828	2654	4350	5039	8416

Source: Consortium for Research on Educational Access, Transitions and Equity, 2006, p. 5 and Department of Education, 2012, p. 15, author edited

Early Childhood Development (ECD), which is regarded instrumental for the social, emotional, intellectual, and physical development of children, was introduced after 1995. It also helps to improve the internal efficiency of school education. There are three types of pre-primary classes: school-based ECD centers, community-based ECD centers, and privately managed ECD centers. Table 4.2 indicates a steady increase in numbers of pre-primary classes. Currently, there are more than thirty four thousand pre-primary classes, and almost 56% of children enroll for grade one with ECD experience. Furthermore, it shows that in 1951 there were altogether 351 schools, whereas in 2012 there were more than thirty four thousand primary schools, fourteen thousand lower secondary schools, and eight thousand secondary schools. Out of total schools, 15% of schools in the primary level are privately managed, followed by 13% in the lower secondary and 11% in the secondary. Figure 4.3 shows the number of teachers in various years for school education in Nepal.

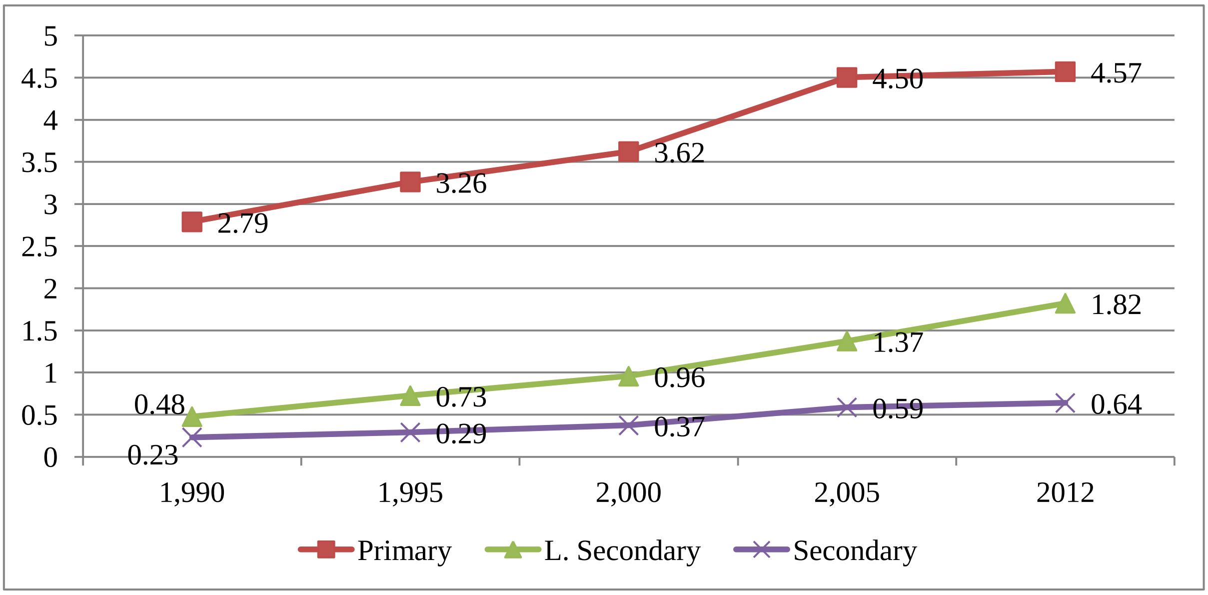
Figure 4.3 Number of Teachers at Primary, Lower Secondary and Secondary Level of Education in Various Years (in thousands)



Source: Consortium for Research on Educational Access Transitions and Equity, 2006, p. 9 and Department of Education, 2012, p. 35, author edited

It shows that there were less than one hundred thousand teachers at all levels of school education in 1990, which increased two times by 2012. Currently, around two hundred thousand teachers are providing education at all levels of school education in Nepal. According to (DOE, 2012), 21% of primary teachers are untrained, whereas in the lower secondary education 42% and in the secondary 16% teachers are untrained. Because of the expansion of school facilities, the number of students increased dramatically, which can be seen in the Figure 4.4.

Figure 4.4 Number of Students in Various Years (in millions)

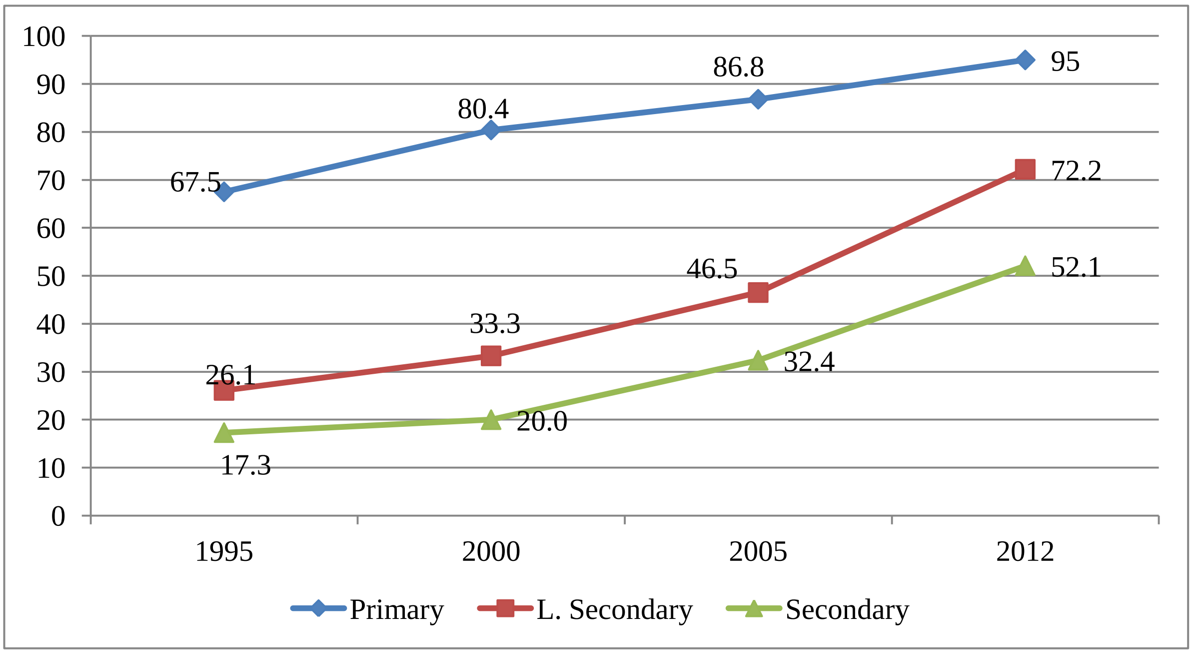


Source: Consortium for Research on Educational Access Transitions and Equity, 2006, p. 6 and Department of Education, 2012, p. 19, author edited

Figure 4.4 shows the numbers of students at primary, lower secondary and secondary levels of education in different years. It indicates that currently there are seven million children receiving education through the network of thirty four thousand schools in Nepal. Despite the significant increase in the number of schools, concerns are raised about the equitable distribution of schools in different areas. Primary schools are more crowded than lower secondary and secondary schools. According to Flash Report 2012, the average school-student ratio for the basic education is 186, however; it depends on the location of schools, namely the geographical zones (mountain, hill and lowland). The average teacher -student ratio for the primary level was 29:1, whereas in the lower secondary level, it was 44:1, which again it depends on the geographical zones. Lowland (Tarai) had the highest teacher-student ratio of 44:1 for the primary level and 61:1 for the lower secondary level. Similarly, the average of teacher-student ratio for the secondary level was 31:1.

Because of the noteworthy progress in the expansion of schools, access to school education has enormously improved and gender inequality fell. However, thousands of children, particularly those disadvantaged due to a variety of disabilities, caste and ethnicity, income, remoteness, and so on, are still out of school. Among those out of school, some may enter late, while many may never enroll. Among those who are in schools, more than 10% will drop out, while others who continue throughout the cycle and complete school education may lack competencies required for the job markets. The net enrolment ratio, which measures the percentage of participation of children belonging to the official age in a given level of education, is presented in Figure 4.5.

Figure 4.5 Net Enrolment Ratio (NER) of Primary, Lower Secondary and Secondary Level of Education in Various Years



Source: Consortium for Research on Educational Access Transitions and Equity, 2006, p. 7 and Department of Education, 2012, p. 31, author edited

Figure 4.5 indicates that the net enrolment ratio of primary level in 1995 was 67.5%, which increased to 95% in 2012. However, 5% children who are out of school comprise a disproportionally large share of children from the historically, geographically, economically and socially deprived and marginalized communities. Similarly, in lower secondary education age group, 28% of children are out of school, while at the secondary level, 45% children are out of school, raising serious concerns about the equitable development of comprehensive school education. Those children who are out of school, most of them are from middle and low ethnic background. Low ethnic children have highly deprived status causing extreme low self-esteem and social exclusion (untouchability). The low ethnicity student occupied of 20.3% in primary enrolment in 2012. Similarly, middle ethnic are (Janjati groups) who have their own language, tradition and culture. These groups occupied 35.4% in primary enrolment in 2012 (DOE, 2012). The classification of middle and low ethnicity by caste is included in Appendix 6. Generally, children from these categories belong to poor households enter school late as they generally live far away, their health and nutritional condition is worse and their parents are less aware of the significance of education for improved livelihood and enhanced quality of life for their children.

4.3.2 Qualitative Expansion of School Education in Nepal

Despite the rapid expansion of school education, the efficiency of school, which is generally measured in terms of promotion, repetition and drop-out rate, is a great challenge for the educational development in Nepal. The term “efficiency” indicates the relationship between input and output. A system is considered efficient if it produces maximum outputs from given inputs. Table 4.3 shows the promotion, repetition and drop-out, and survival rate of primary, lower secondary, and secondary education in 2012.

Table 4.3 Promotion, Repetition and Drop-Out Rate of Primary, Lower Secondary and Secondary Levels of Education in 2012

Categories	Primary	Lower secondary	Secondary
Promotion	84.2	88.7	89.8
Repetition	10.6	5.2	3.6
Drop-out	5.2	6.1	6.5
Survival rate	77	62	-

Source: Department of Education, 2012, p. 32, author edited

Table 4.3 shows that the promotion rate for primary, lower secondary and secondary level is 84%, 89% and 90% respectively. It means that at the primary level 16% of children could not be promoted to the next level. The situation of grade one is the most serious, as 30% of children could not pass from grade one to grade two, implying that they either repeated or dropped out (DOE, 2012). Even if the promotion rate of the secondary level is around 90%, only 41% of students could pass the school leaving certificate examination, which cause a serious debate about the efficiency and relevance of school education in Nepal. It is clear that the increasing school participation doesn’t mean that children acquire basic knowledge, skills, and behaviors which are necessary to function effectively in the world and society.

The quality of education, which is measured by the average test score in examinations, particularly in core subjects, has not improved despite the increased resources and implementation of various innovative programs. Table 4.4 presents the average learning achievement in different subjects during various years.

Table 4.4 Average Learning Achievement in Various Subjects

Year	Grade	Mathematics	Nepali	Social Studies	Science	English
BPEP-1998	5	26.6	52.4	35.9	-	-
PEDP-1998	5	33.7	40.6	39.5	-	-
BPEP-1997	4	28.0	47.0	42.0	-	-
EDSC-1997	3	43.8	45.7	50.4	-	-
EDSC-1999	5	27.3	51.5	41.8	-	-
EDSC-2001	3	47.0	44.5	63.6	-	-
CERSOD 2001	5	30.1	45.3	34.4	-	-
EDSC- 2003	5	33.3	55.8	61.1	-	-
CERID 1999	6	44.4	56.4	-	39.6	43.6
CERID 1999	8	28.9	75.3	-	29.6	34.3
EDSC- 2008	8	31.7	44.4	53.4	48.8	36.6

Source: Education Development Service Center, 2008, p. 8

Table 4.4 indicates that Nepalese students are achieving relatively higher scores in Nepali and Social Studies than in Mathematics, English, and Science. Studies of eighth grade students by the Research Center for Educational Innovation and Development (CERID) in 1999 and the Educational Development Service Center (EDSC) in 2008 indicated little improvement in learning achievement in core subjects. This indicates that the learning achievement of eighth grade students in 1999 in mathematics was 28.9 out of possible 100 marks, which increased to 31.7 on average in 2008, demonstrating a marginal improvement of only two percentage points after a decade. Similarly, with little improvement in learning achievement, the average scores in Science and English were 48.8 and 36.6 respectively. The above figures with reference to average scores indicate the underperformance of the school education system in Nepal, demanding greater urgency and serious policy concern to ensuring improved quality of education.

4.4 Educational Policies in Nepal

The MOE through its various organizations and institutes works to enhance the sector-wide coherence of education policies with an explicit focus on cross-cutting issues such as improving universal access and participation, the quality and relevance of schooling and learning, and reaching marginalized populations. Education policies and strategies are reflected in the legal provision and education plans and programs of the education sector. The Constitution of 1990 and the Education Act (2001) included the right of every child to free primary education with the choice of learning in his or her mother tongue. Similarly, the Interim Constitution of 2007 ensures the right to get free education up to secondary level.

Based on the human rights approach to education and in accordance with the principles and provisions of the EFA National Plan of Action (2001-2015), the School Sector Reform Program (SSRP) (2009-2015) aims to achieve three key objectives: (i) ensuring access and equity in school education; (ii) enhancing the quality and relevance of education; and (iii) improving efficiency and institutional capacity. The Education Act (2001) and the Education Regulation (2002) underpin provisions for pre-primary education in collaboration with local bodies (VDCs and municipalities), free primary education with provision of free textbooks to all children, and scholarships to girls and children with disabilities. Moreover, it also includes scholarships and free secondary education to all, especially disadvantaged children. Improved curriculum and textbooks, increased qualification and training for teachers, the provision of female teachers, adequate and suitable physical facilities, pure drinking water, separate toilets for girls, and empowerment of school management committees are some of the key reform measures to ensure the quality school education for all eligible children in the country.

4.5 Chapter Summary

This chapter provides the background information of this study. The first section provides the brief introduction of socio-economic context of country, while the second section explains the current status of educational development of Nepal. After the commitment to the achievement of EFA in 1990, resources in education increased (Figure 3.1) and various programs were implemented. By these initiatives, remarkable progress was seen in improving school participation at all levels of school education (Figure 3.5) of Nepal. However, despite the substantial progress in expanding educational opportunities, quality of education which is generally measured by higher levels of learning outcomes in examinations is still low (Table 3.4), and inequality between students exist. So, the following Chapter 5 examines the factors affecting mathematics learning achievement of eighth grade students in Nepal, while Chapter 6 assesses the content domains of mathematics learning achievement such as arithmetic, algebra, data management, and geometry, and cognitive domains (knowledge, comprehension, application, and problem solving).

Chapter 5 Factors Determining Mathematics Learning Achievement of Eighth Grade Students in Nepal

5. 1 Introduction

The objective of this chapter is to examine the factors that are associated with the learning achievement in mathematics of eighth grade students in Nepal. It examines the effect of four set of factors on learning mathematics -family characteristics, student characteristics, parental involvement, and school characteristics. More specifically, it focuses on three issues: determining the various factors that influenced learning achievement in mathematics; identifying the factors that primarily affected academic achievement; and determining to what extent the differences in mathematics learning achievement are associated with family characteristics, student characteristics, parental involvement and school characteristics. This study is innovative in terms of examining four set of factors simultaneously and novel in the context of Nepal because no studies have examined the factors that determine the quality of education, particularly learning achievement in mathematics of eighth grade students.

5.2 Data Analysis

Three types of data analysis are used in this chapter. First, the distribution of mathematics scores by gender (Table 5.1) and the cumulative percentage of scores (Figure 5.1) are presented to explain the general pattern of mathematics scores of eighth grade students. Second, mean and standard deviation are calculated to examine the variances in learning achievement in mathematics between students such as gender, location, types of school and geographical zones (Table 5.2). Third, the multiple regression analysis is conducted to determine the factors for learning achievement in mathematics. Four separate and combined models are developed to examine the effect of the set of variables described above (Table 5.4).

5.2.1 Distribution of the Mathematics Test Scores

Distribution of the mathematics scores is categorized into four groups. It is based on the examination system in Nepal, where out of the 50 possible marks, less than 16 is considered as a disqualified or a fail, 16 and above and less than 24 is considered the third division, 24 and above and less than 30 is considered the second division, and 30 and above is considered the first division. Table 5.1 below presents the distribution of mathematics scores by gender. It indicates that out of the total sample of this study, 73% of students scored less than 16 marks in mathematics, which is considered disqualified or a fail and which shows the poor quality of education in Nepal. However, there are gender differences in learning achievement in mathematics. 78% of the 400 girls and 67 of the 362 boys scored less than 16 marks and were considered disqualified. Similarly, 17% of students scored between 16 and above and less than 24 (third division), 5.6% of students scored 24 and above and less than 30 (second division) and 5% of students scored above 30 (first division).

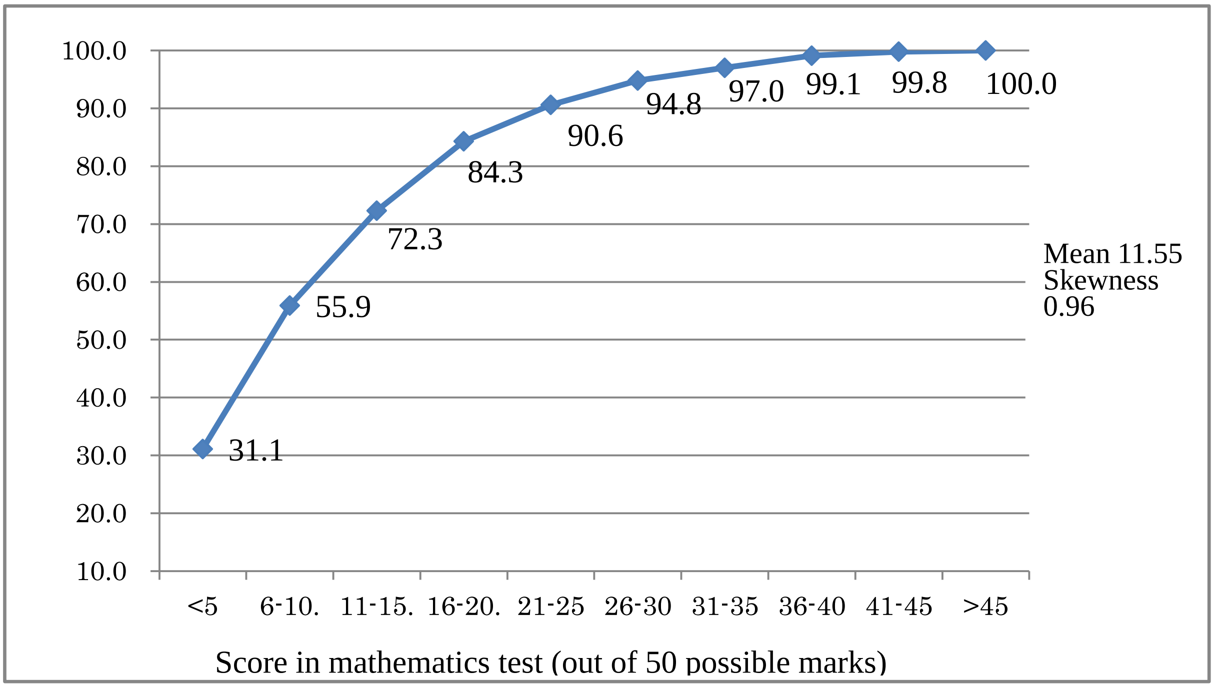
Table 5.1 Distribution of Scores in Mathematics Test by Gender

Descriptions	Gender		Total	% Girls	% Boys
	Girls	Boys			
Less than 16 (fail)	312	241	553 (73%)	77.9	66.6
16 and above and less than 24 (Third division)	61	66	127 (17%)	15.3	18.2
24 and above and less than 30 (Second division)	15	28	43 (5.6%)	3.8	7.7
Above 30 (first division)	12	27	39 (5.1%)	3	7.5
Total	400	362	762		

Source: Mathematics test conducted by the author

Figure 5.1 below illustrates the cumulative distribution of scores of mathematics test of eighth grade students in Nepal. The average score was 11.55 out of the 50 possible marks with the skewness of 0.96, indicating that the majority of students positively skewed in the low left end.

Figure 5.1 Distribution of Scores in Mathematics Test (Cumulative Percentage)



Source: Mathematics test conducted by the author

Figure 5.1 explains that 31.3% of sample students scored less than 5 out of the possible 50 marks. It further indicates that the majority of sample students (72.3%) scored between 11 and 15 marks, which is considered disqualified for the purpose of promotion into the next grade. Only 9.4% of sample students scored more than half of the possible 50 marks, which is a policy concern for educational development in Nepal. However, there were differences in the mathematics achievement between the groups of students, such as gender, ethnicity, types of school, and location of school.

5.2.2 Differences in Learning Achievement in Mathematics between Groups of Students

Table 5.2 presents the mean and standard deviation and one-way ANOVA. The Mean and standard deviation is calculated to examine the average learning achievement, while one way ANOVA is calculated to examine the differences between students such as gender, location (rural and urban), geographical zones (mountain, hill and lowland), types of school (public and private) and the ethnicity of students. It shows that the average learning achievement in mathematics of eighth grade students in Nepal is 11.55 out of possible total 50 marks with the standard deviation of 9.28; however, there are differences in mathematics performance based on gender, ethnic group, types of school and location.

Table 5.2 Mean and Standard deviation of Mathematics Learning Achievement by Gender, Ethnicity, Types of School and School Location

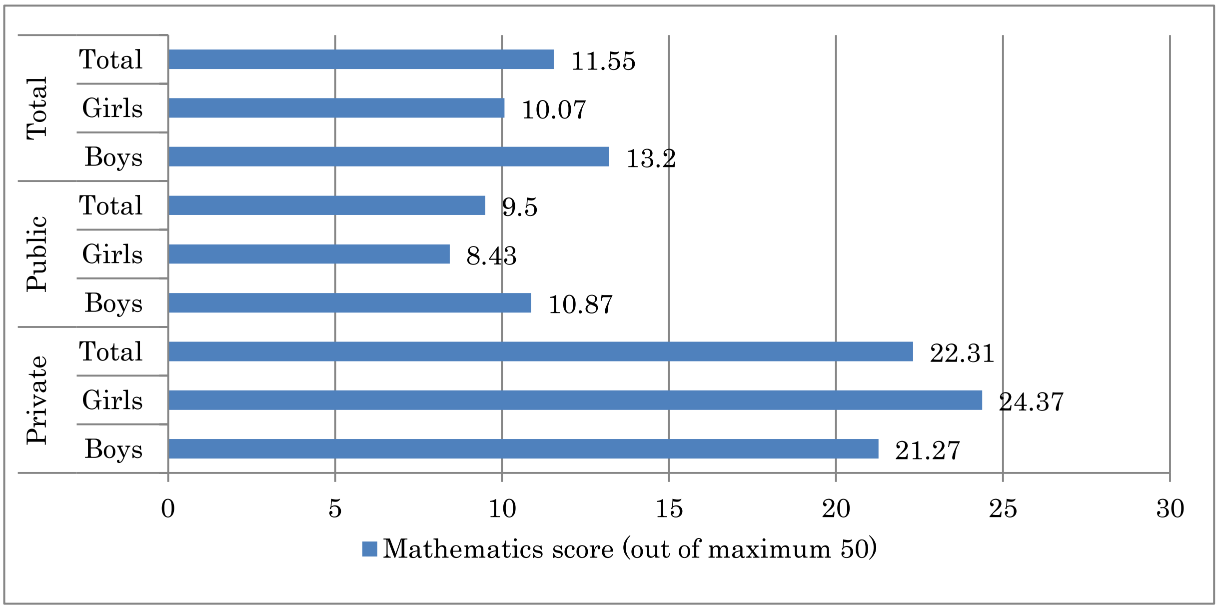
Categories		Mean	Standard Deviation	T statistics	Significance
Gender	Girls	10.08	8.53	6.08	000
	Boys	13.13	9.74		
Ethnicity	High ethnicity	15.54	10.27	41.73	000
	Middle ethnicity	9.60	8.15		
	Low ethnicity	8.28	5.70		
Type of school	Private	22.31	10.29	31.38	000
	Public	9.47	7.44		
School location	Urban	13.27	9.88	17.98	000
	Rural	9.52	8.01		
Ecological zones	Mountain	5.32	5.13	8.81	000
	Hill	11.42	7.54		
	Lowland (Tarai)	12.15	10.50		
Mean		11.55	9.28		

Source: Mathematics test conducted by the author

Boys were found to perform higher (M = 13.13, SD = 9.74) than girls (M = 10.08, SD = 8.53), which is statistically significantly different ($t = 6.08$, $p<0.01$). Students from the high ethnicity were found to perform higher than middle ethnic students, and middle ethnic students performed higher than the low ethnic students, with a mean learning achievement of 15.54, 9.60 and 8.28 respectively, which is significantly different ($t = 41.73$, $p<0.01$). The classification of middle and low ethnicity by caste is included in Appendix 6. Urban students were found to score higher than rural students, with average scores of 13.27 and 9.52, which is statistically significant ($t=17.98$, $p<0.01$). Similarly, students from lowland (Tarai) were found to perform better than those from hill areas. Students from hill areas were found to perform better than those from mountain areas, with average scores of 10.50, 7.54 and 5.13 respectively.

Differences in the quality of education between public and private school is a matter of policy debate and concern for all the stakeholders in Nepal. This study found a large gap in learning achievement in mathematics between private and public school. Figure 5.2 below presents the average learning achievement in mathematics by type of schools.

Figure 5.2 Average Learning Achievements in Mathematics by Type of School



Source: Mathematics test conducted by the author

It shows that the average learning achievement in mathematics for public school is 9.5, while that for private school is more than two times higher, with an average of 22.31. However, the interesting result is that boys perform better in general, but in private schools, girls perform better than boys, with an average learning achievement of 24.37 and 21.27 respectively. Table 5.2 and Figure 5.1 indicate that the learning achievement in mathematics of eighth grade students is low and there are significant differences between students.

5.2.3 Multiple Regression Analysis

A multiple regression analysis was used to predict the relationship between the dependent variable of mathematics score and the set of independent variables such as family characteristics, student characteristics, parental involvement, and school characteristics. Family characteristics consisted of number of family members, father's level of education, mother's level of education, travel time to school, number of books at home and presence of certain items at home such as bicycle, a radio, a television, a CD player, water taps, gas stove, bio gas, motorbike, and computer. Travel time to school was also included because in Nepal students in different zones have different commuting time to school that might influence learning achievement.

Student characteristics are gender, ethnicity, absenteeism, grade repetition, homework completion, time spent on studying, time spent on household chores, preschool experience, perception of mathematics teacher, and academic motivation of student. Parental involvement includes children's perception of parental involvement in their schooling, which primarily consisted of parental support for homework, students' perception of parental support, and parental monitoring. School characteristics which consisted of school type, school location, teacher training, the number of operating days in the academic year, teacher-student ratios, and school facilities (a library, separate rooms for the head teacher and teachers, a playground, drinking water, toilets, electricity, and telephones). Variables examined in this study are presented in Table 5.3.

To predict the relationship between the dependent variable of mathematics score and a set of independent variables, 4 models were developed. The models suggest how academic achievement is affected when family, student, school characteristics and parental involvement variables are combined.

Model 1 Learning achievement in mathematics and family characteristics

$LEARACHIVij = \beta_0+(\beta_1 NUMFAMij+\beta_2 EDUFATHij + \beta_3 EDUMOTHij + \beta_4\ TRVLTIMESCHij +\beta_5\ ADDBOOKHOMij +\beta_6\ MATERLHOMEij)$

The first model explains the relationship of outcome variable (mathematics scores) and the family characteristics variables. Six variables are examined for the characteristics of family background, where *NUMFAM* = Number of family members, *EDUFATH*= Father's level of education, *EDUMOTH* = Mother's level of education, *TRVLTIMESCH* = Travel time to school, *ADDBOOKHOM* = Additional books at home, *MATERLHOME* = Materials at home.

Model 2 Learning achievement in mathematics, family characteristics and student characteristics

$\mathrm{LEARACHIV}_{ij} = \beta_0+(\beta_1 NUMFAM_{ij}+\beta_2 EDUFATH_{ij}+\beta_3 EDUMOTH_{ij} + \beta_4\ TRVLTIMESCH_{ij} +\beta_5 ADDBOOKHOM_{ij}+\beta_6 MATERLHOME_{ij})+(\beta_7 GENDER_{ij}+\beta_8 ETHNSTU_{ij}+\beta_9 REREP_{ij}+\beta_{10} ABSNT_{ij}+\beta_{11} HOMEWORK_{ij}+\beta_{12} STUTIMHOM_{ij}+\beta_{13} STUPERTEACH_{ij}+\beta_{14} HOUSWORK_{ij}+\beta_{15}\ EXPECD_{ij} + \beta_{16} STUMOTIVA_{ij}\ )$

The second model is the combination of a set of family characteristics variables and a set of student characteristics variables. Student characteristics include *GENDER* =Sex of child, *ETHNSTU* = Ethnicity, *GREREP* = Number of grade repetitions since school admission, *ABSENT* = Number of days absent during the past month, *HOMEWORK* = Completion of homework, *STUTIMHOM* = Number of hours spent studying, *STUPERTEACH* = student perception of teacher, *HOUSWORK* = Number of hours spent on daily household chores, *EXPECD* = Preschool experience and *STUMOTIVA* = Student motivation to study.

Model 3 Learning achievement in mathematics and family characteristics and student characteristics and parental involvement

$$\mathrm{LEARACHIV}_{ij} = \beta_0+(\beta_1 NUMFAM_{ij} +\beta_2 EDUFATH_{ij} + \beta_3 EDUMOTH_{ij} + \beta_4\, TRVLTIMESCH_{ij} +\beta_5 ADDBOOKHOM_{ij}+\beta_6 MATERLHOME_{ij})+(\beta_7 GENDER_{ij}+\beta_8 ETHNSTU_{ij}+\beta_9 GREREP_{ij}+\beta_{10}\, ABSNT_{ij} +\beta_{11} HOMEWORK_{ij}+ \beta_{12} STUTIMHOM_{ij} + \beta_{13} STUPERTEACH_{ij} + \beta_{14} HOUSWORK_{ij} +\beta_{15} EXPECD_{ij}+\beta_{16} STUMOTIVA_{ij})+(\beta_{17} PARSUPHOM_{ij}+\beta_{18} PARENCOURG_{ij}+\beta_{19} PAREMONI_{ij})$$

In the third model, a set of parental involvement variables is included with family and student characteristics variables. The variables included in the model III are *PARSUPHOM* = Parental support of homework, *PARENCOURG* = Parental encouragement for studying, *PAREMONI* = Parental monitoring of studying.

Model 4 Learning achievement in mathematics and family characteristics, student characteristics, parental involvement and school characteristics)

$$\mathrm{LEARACHIV}_{ij} =\beta_0+(\beta_1 NUMFAM_{ij}+\beta_2 EDUFATH_{ij}+\beta_3 EDUMOTH_{ij}+\beta_4\, TRVLTIMESCH_{ij} +\beta_5\, ADDBOOKHOM_{ij}+\beta_6 MATERLHOME_{ij}) + (\beta_7\, GENDER_{ij}+\beta_8\, ETHNSTU_{ij} +\beta_9\, GREREP_{ij}+\beta_{10}\, ABSNT_{ij} +\beta_{11} HOMEWORK_{ij}+ \beta_{12} STUTIMHOM_{ij} + \beta_{13} STUPERTEACH_{ij} + \beta_{14} HOUSWORK_{ij} +\beta_{15} EXPECD_{ij}+\beta_{16} STUMOTIVA_{ij})+(\beta_{17} PARSUPHOM_{ij}+\beta_{18} PARENCOURG_{ij}+\beta_{19} PAREMONI_{ij})+(\beta_{20} TYPSCH_{ij} + \beta_{21}\, LOCSCH_{ij} + \beta_{22} GEOLOCSCH_{ij} + \beta_{23} TEACTRIN_{ij} + \beta_{24} INSERVTRIN_{ij} + \beta_{25} TEACHDAYS_{ij} + \beta_{26} STR_{ij} +\beta_{27}\, PHYFACIL_{ij})$$

The fourth model is the combination of a set of school characteristics variables with a set of family characteristics variables, a set of student characteristics variables, and a set of parental involvement variables. Where LEARACHIV is the outcome variable, learning achievement of children j of school *i*, β_0 is the intercept of the regression model and β_1, β_2, β_3 and β_4 are the slope of the set of explanatory variables - family characteristics, student characteristics, parental involvement and school characteristics of child *j* of school *i*, respectively. The set of variables included as school characteristics are *TYPSCH* = Type of school, *LOCSCH* = School location, *GEOLOCSCH* = Geographical location of school, *TEACTRIN* = Teacher training, *INSERVTRIN* = In-service teacher training, *TEACHDAYS* = Number of school days in the academic year, *STR* = Student-teacher ratio and *PHYFACIL*= School facilities.

Before conducting the data analysis, to ensure the reliability and internal consistency of the instrument (student survey questionnaires), Cronbach's alpha was checked, in which the reliability of the overall student survey questionnaires was 0.72, which is acceptable for research purposes (Muijs, 2004). However, the reliability of different categories such as family characteristics, student characteristics, and parental involvement had different findings. The Cronbach alpha for parental involvement questionnaires was found higher with 0.86, followed by student characteristics (0.76) and family characteristics (0.73). Similarly, the Cronbach alpha of the questionnaires related to school characteristics (questionnaires of head teachers and mathematics teachers) was 0.70.

Furthermore, I checked the correlation analysis between the variables to avoid a problem of multicollinearity, where zero order correlation coefficient among the variables which explain direction of relationship and its strength (Muijs, 2004), were found to be less than .50. The correlation coefficient of variables examined in the model is included in Appendix 7. Similarly, I checked the value of variance inflation factors (VIF) and tolerance statistics. The value of VIF was between 1.15 and 1.62 and tolerance statistics were all above .3 which suggest that the final model is free from multicollinearity (Field, 2009). The Durbin-Watson statistic was also between one and three (1.27), suggesting that the errors are independent. Furthermore, I checked the standardized residuals where five cases were found to have standardized residuals more than .3, however none of the cases had cook's distance greater than one which suggest that there is no undue influence on the regression model (Field, 2009). Furthermore, I checked the standardized scatterplots residuals to examine the normality, linearity and homoscedasticity of the variables. It was found the straight line relationship with the dependent variable.

5.3 Factors Determining Students' Mathematics Learning Achievement

The variables used to examine the effects of family characteristics, student characteristics, parental involvement and school characteristics on learning achievement in mathematics is presented in Table 5.3 The variables were selected according to their importance in the context of Nepal and the theoretical framework presented in Chapter 2. The variables are categorized into four sets. The set of family characteristics includes the variables- number of family member, father's and mother's level of education, additional books at home, travelling time to school and available materials at home. The set of student characteristics variables include- gender, ethnicity of student, days of school absenteeism, number of times of grade repetition since the admission of school, experience of ECD, homework completion, involvement in household chores and student motivation. The set of parental involvement variables consisted of the three variables- parental support on homework, parental encouragement and parental monitoring. Finally, school characteristics includes the variables- types of school, location, teacher training, teacher-student ratio, school opening days in a year and school physical facilities. The definition of variables and descriptive statistics (percentage, mean and standard deviation) are presented in Table 5.3 and the standardized regression coefficient of each set of independent variables is presented in Table 5.4.

Table 5.3 Variable Definitions and Descriptive Statistics (N=762)

Variables	Definitions	Percent	Mean	SD
LEARACHIV	Children's mathematics test score		11.55	9.28
NUMFAM	Number of family members in the household		6.23	2.05
EDUFATH	Father's education, 1 = secondary and above, 0= otherwise	43.4		
EDUMOTH	Mother's education, 1 = secondary and above, 0= otherwise	24.8		
TRVLTIMESCH	Traveling time to school		19.34	11.14
ADDBOOKHOM	Number of books at home, 1= 1-5 books, 2= 6-10 books, 3= more than 10 books, 4= no books		2.74	1.17
MATERLHOM[a]	Presence of certain items at the home, available =1, not available = 0		5.05	2.46
GENDER	Child sex, 1 = Male, 0= Female	47.5		
ETHNSTU	Child ethnicity, 1= High caste, 2= middle caste and 3 = low caste			
GREREP	Number of grade repetitions since school admission		1.39	.62
ABSNT	Number of days absent during the past month		2.83	2.66
HOMWORK	Complete homework, 1= never do, 2= sometimes do, 3= everyday		2.71	.56
STUTIMHOM	Number of hours spent studying		2.68	.85
STUPERTEACH	Student perception of teacher, 1= difficult, 2= easy, 3 = very easy		1.97	.71
HOUSWORK	Number of hours spent on daily household chores		2.34	.75
EXPECD	Preschool experience, 1= yes, 0= otherwise	43		
STUMOTIVA	Student motivation to study, 1= strongly disagree to 5 = strongly agree		3.88	1.12
PARSUPHOM	Parental support of homework, 1= yes, 0= otherwise	41		
PARENCOURG	Parental encouragement for studying, 1= strongly disagree- 5= strongly agree		4.08	1.08
PAREMONIT	Parental monitoring of studying, 1= strongly disagree-5= strongly agree		3.59	1.27
TYPSCH	Type of school, 1= public, 0= Private	84		
LOCSCH	School location, urban = 1, 0= rural	53.5		
GEOLOCSCH	Geographical location of school, lowland =1, hill = 2 and mountain = 3			
TEACTRIN	Teacher training, 1= Untrained, 2= partially trained, 3= Trained		2.42	.77
INSERVTRIN	In-service teacher training, yes = 1, otherwise= 0	32.4		
TEACHDAYS	Number of school days in the academic year		181.7	4.3
STR	Student-teacher ratio in a particular grade		60.5	10.9
PHYFACIL[b]	School facilities, available = 1, not available = 0		7.80	2.34

Source: Survey conducted to students, head teachers and mathematic teachers by the author

Note: a Bicycle, radio, television, CD player, water tap, gas stove, bio gas, motorbike, computer

b. Library, separate room for head teacher and teacher, playground, drinking water, toilets, electricity, telephone

Table 5.4 Standardized regression coefficients for family background, student characteristics, parental involvement, and school characteristics

Variables	Model I		Model II		Model III		Model IV	
	β	t	*β*	t	*β*	t	*β*	t
NUMFAM	-.118***	-3.750	-.059**	-2.126	-.056**	-2.027	-.032	-1.24
EDUFATH	.170***	4.647	.067**	2.043	.034	1.032	.001	.032
EDUMOTH	.220***	5.916	.163***	4.975	.139***	4.289	.069**	2.17
TRVLTIMESCH	-.048	-1.527	-.061**	-2.191	-.058**	-2.116	-.067*	-2.63
ADDBOOKHOM	.240***	7.224	.133***	4.492	.122***	4.180	.106***	3.97
MATERLHOM	.090**	2.516	.040	1.271	.031	.989	.018	.59
GENDER			.083**	3.044	.072**	2.666	.063*	2.47
ETHNSTU			-.096***	-3.377	-.095***	-3.418	-.076**	-2.94
GREREP			-.050*	-1.755	-.042**	-1.497	-.047*	-1.81
ABSNT			-.185***	-6.514	-.169***	-6.037	-.153***	-5.97
HOMWORK			.126***	4.492	.099***	3.539	.067*	2.56
STUTIMHOM			.036	1.300	.023	.840	.006	.243
STUPERTEACH			.153***	5.252	.126***	4.327	.090***	3.31
HOUSWORK			-.061**	-2.106	-.056**	-1.973	-.022	-.82
EXPECD			.086**	3.098	.052*	1.843	.037	1.39
STUMOTIVA			.135***	4.645	.102***	3.268	.068*	2.38
PARSUPHOM					.131***	3.991	.145***	4.80
PARENCOURG					.072**	2.040	.058*	1.79
PAREMONIT					.083**	3.092	.049**	1.98
TYPSCH							-.120**	-2.77
LOCSCH							.169***	5.08
GEOLOCSCH							-.152***	-4.93
TEACTRIN							.130***	3.65
INSERVTRIN							.077**	2.80
TEACHDAYS							.119***	3.72
STR							-.102**	-2.45
PHYFACIL							.089**	2.33
Multiple R		**55.2**		**70.0**		**71.6**		**77.5**
R^2		**30.5**		**49.0**		**51.3**		**60.1**
Adjusted R^2		**29.9**		**47.9**		**50.0**		**58.6**
Variance		**29.9**		**18.0**		**2.1**		**8.6**

Source: Survey conducted to students, head teachers and mathematics teacher by the author

Note: N = 762, *p <0.10, **p<0.05 and ***p<0.01

5.3.1 Family Characteristics and Mathematics Learning Achievement

As shown in Model I of Table 5.4, the set of family characteristics variables showed significant relationships to children's learning achievement in mathematics (R^2 = .305, adjusted R^2 = .299; F(6,756) = 1.36; p<0.01). The result indicated that family characteristics accounted for 29.9 % of the variances in children's learning achievement in mathematics. The correlation coefficient for the set of family characteristics was 55.2. It further suggested that children from households with less family members, father's and mother's education at the secondary level or above, and more books and more possessions at home were likely to outperform their counterparts.

Family characteristics as measured by parents' level of education were found to be significantly related to the mathematics learning achievement of children. Among the sample students of this study, nearly 44% of fathers have completed the secondary school or higher level of education, whereas only 24% of mothers have completed the secondary school or higher level of education. However, it varies according to the type and location of schools. Almost 81% of mothers of students from private schools have completed the secondary school or a higher level of education, whereas with students from public schools, only 14.4% of mothers have completed the secondary school or a higher level of education. Similarly, 89.5% of fathers of students from private schools have completed the secondary school or a higher level of education, whereas only 34.8% of fathers of students from public schools have completed the secondary school or a higher level of education.

Model I (Table 5.4) indicated that students whose father and mother have the secondary school or a higher level of education were found to perform higher than students whose parents have less than the secondary level of education. However, the effect of fathers' and mothers' level of education is estimated different. The effect of mother's education level was greater than the effect of father's education level, although fewer mothers (24%) had completed the secondary education compared to fathers (44%). In Nepal, mothers are less likely to be employed than fathers, regardless of their level of education, which might provide mothers with more opportunities to spend time on their children's schooling. Mothers who are more educated are also likely to have the higher SES, which would benefit their children. Furthermore, the higher effect of mothers' level of education on their children's learning outcomes is because of their ownership of household resources, particularly land. This finding is consistent with the findings of other studies in respect to the effects of family socio-economic status on children's educational outcomes (Fuchs & Woessmann, 2004; Guncer & Kose, 1993; McEwan & Marshall, 2004; Schiller et al., 2002; Willms & Somers, 2001; Woessmann, 2003). The result indicated that an increase of one standard deviation in mother's education level increased the child's academic achievement by .220 ($p<0.01$). Correspondingly, an increase of one standard deviation in the father's level of education increased the children's academic achievement by .170 ($p<0.01$), other things being held constant.

There was a negative relationship between family size and students' mathematics learning achievement. Students in this study had a minimum of two and a maximum of 15 members in their family, and the average family size was 6.23 members. However, the National Living Standard Survey (NLSS) 2011 reported that the average family size in Nepalese households was 4.9. Family size varies according to the location and type of school. Students from private schools have an average of 4.89 family members, whereas students from public schools have an average of 6.49 family members. More than 75% of students in this study were found to have four to seven family members. Students with smaller family size (three to five family members) outperformed children in larger family size (-.118, $p<0.01$). The effect of family size diminished for private school students compared to public school students and was greater for students in rural schools compared to urban schools. The possible reason for the reduced effect of family size for private and urban schools is that parents have higher levels of education and more materials and books at home than the parents with children in public and rural schools.

The resource dilution theory (Heer, 1985), which explains the effect of family structure, claims that children benefit less from available resources in larger families. Children in smaller families have greater access to resources and intellectual contexts that provide academic motivation (Blake, 1989), such as economic resources (Olneck & Bills, 1979), and parental aspirations and parental support (Behrman & Taubman, 1886). However, Buchmann and Hannum (2001) found that the number of siblings did not affect parents' focus on children's schooling in developing countries.

Nepal is a diverse country in terms of geography. Students living in the mountain and hill areas must spend more time travelling to school than students in lowland (Tarai) areas. According to NLSS 2011, 88.8% of households are within a 30 minute walk of an Early Childhood Development Center (ECDC), whereas for the primary, secondary and higher secondary, it is 94.7%, 71.7% and 56.7% respectively. The average travelling time to school for students in this study was 19 minutes. There was a negative relationship between traveling time to school and children's learning achievement in mathematics. However, the relationship was not statistically significant. When this measure was combined with other family characteristics measures in model IV, the model was significant and consistent with findings of Hungi (2008) in Vietnam.

The finding that the number of books at home was significantly related to learning achievement confirmed the finding reported in the sociological literature, which documented that the number of books at home is a proxy for family educational SES. Out of the total sample students, 35.6% of students do not have any kinds of book at home, which shows the not meaningful culture of reading practice at home. However, it varies according to type and location of school. Private school students have more books at home than students from public schools. The analysis shows that 93% of students from private schools have additional books at home, whereas in public schools, 59% of students have additional books at home. Similarly, differences in availability of books at home relate to geographical zones in Nepal. Students from the mountain region have fewer books (61%) than students from lowland (Tarai) areas (41%) and students from hilly areas (27%). The result showed that increasing the availability of books by 1 standard deviation increased students' academic achievement by .240 standard deviations. Regardless of the type of school, students from homes with more than ten books outperformed students from homes with fewer than ten books or students in homes without any books.

The presence of certain items at home –e.g., radio, bicycle, water tap, cassette player, television, telephone, gas stove, computer and motorbike –reflected family SES and was significantly related to students' mathematics learning achievement. More than 60% students lived in homes with radio, bicycle, water tap, television, and telephone. However, only 25% of the students lived in homes with computers and motorbikes. Students in urban schools and private schools were more likely to have a computer at home than students in rural schools or public schools. For the various possessions identified in this study, family ownership of radio, bicycle and computer was significantly related to mathematics performance. Among the possessions included in this study, the availability of computer at home was found to be significantly related (.214, p<0.01) to mathematics learning achievement compared to availability of other items. This finding is consistent with the finding that facilities available at home were positively related to student achievement in Jordan (Al-Nhar, 1999).

5.3.2 Student Characteristics and Mathematics Learning Achievement

In Model II (Table 5.4), student characteristics variables were combined to the set of family characteristics variables. The result found a significant relationship with mathematics learning achievement (R^2 = .490, adjusted R^2 = .479; F(10,752) = 2.38; p<0.01). Student characteristics explained for 18% of the variance in mathematics achievement, with a correlation coefficient of .70. Standardized coefficients for the Model II indicated that absenteeism, homework completion, students' perception of their mathematics teacher, time spent on household chores, preschool experience, academic motivation and gender –but not time spent studying at home –were significantly related to mathematics learning achievement.

Among the student characteristics gender is a frequently examined factor for learning achievement of children. The result found that gender was significantly related to mathematics learning achievement (0.83, p<0.05). Overall, boys outperformed girls, with a mean difference of -3.05 (Table 5.2). However, for students in private schools, girls (mean score = 24.37) outperformed boys (mean score = 21.27). There might be several reasons for the better performance of boys than girls. However, the available data of this study shows that boys have high socio-economic status (SES) than girls measured by completion of fathers' and mothers' level of education, additional books at home, and materials at home.

The data shows that boys have less family members than girls, with an average of 6.00 persons and 6.44 persons respectively. Furthermore, 45% of boys' fathers have completed the secondary and above levels of education, while 42% of girls' fathers have completed the secondary and above levels of education. Similarly, 23% of girls' mothers have completed above the secondary level of education in comparison to 27% of boys mothers. Other possible reasons for high mathematics achievement of boys than girls might be the availability of more books at home. The data shows that 68% of boys have additional books at home, while 60% of girls have additional books. Furthermore, in household chores girls are involved more than boys and get less support from their parents, particularly for doing homework, than boys.

One of the interesting findings of this study is that in private school, girls outperformed boys in mathematics. The data shows that mothers of girls have more education than mothers of boys. It shows that 12% of girls in private schools have mothers with less than secondary education, while 25% of boys in private schools have mothers with less than the secondary education. Similarly, fathers of girls have higher education levels than fathers of boys. Furthermore, girls have low levels of class repetition and low absenteeism and do more homework, and more girls have the experience of early childhood care and development than boys.

This result is consistent with findings of Farkas et al. (1990) that girls in the United States outperformed boys in 12 subjects with a median difference of -4.5 points. But in Vietnam, Hungi (2008) found that boys outperformed girls in mathematics (-3.91, 0.59), while girls outperformed boys in reading (8.51, 0.63). Fuchs and Woessmann (2004) obtained similar results using the PISA data. Sammons' longitudinal analysis of student achievement over the course of 9 years (1995) found that girls in the United Kingdom outperformed boys in reading and mathematics. However, Veenstra and Kuyper (2004) found that in the Netherlands student characteristics accounted for more variance than family characteristics and that boys outperformed girls in mathematics but not in language skills.

Nepal is a diverse country in terms of culture, language, and ethnicity. The 2011 National Census reported more than 103 castes and ethnicities and 90 languages, and inequality based on caste and ethnicity can be seen in school participation and learning achievement. This study examined the effect of ethnic background on learning achievement in mathematics and a negative relationship was found between ethnicity and learning achievement in mathematics. It is estimated (Table 5.2) that boys with high ethnic backgrounds outperformed children with middle and low ethnic backgrounds to a statistically significant level (-0.96, $p<0.05$). Interestingly, girls with middle and low ethnic backgrounds outperformed boys. However, different effects of ethnicity have been estimated between schools. Private schools showed less effect of ethnic background than public schools. The possible reason is that students who enroll in private schools tend to have higher socio-economic status (SES) (landholdings, location of house) even if parents are not well educated. This finding is consistent with Jamison and Lockheed (1987) that land ownership, literacy level, caste membership and district of residence were strongly related to children's school attendance in Nepal.

Despite the improvements in school participation at all levels, grade repetition and school absenteeism are major issues for educational development in Nepal. Poor quality of education is one of the major reasons for grade repetition, because if the children could not achieve a minimum level of learning in each subject, she/he cannot be promoted to the next grade. To minimize grade repetition, targeted interventions such as teacher training, grants to school, and school improvement plans have been used for a long time. However, nine percent of children still repeat the eighth grade (DOE, 2010).

The degree of grade repetition depends on type and location of school. Students from private schools have less experience of grade repetition than students from public schools. The data of this study shows that 31% of the sample students have experienced grade repetition at least once since their admission to school. 37% of public school students had repeated a grade, compared to 6% of private school students. Similarly, there was less grade repetition in the favored ethnic groups (20%) compared to the middle (30%) and marginalized (35%) ethnic backgrounds, and students in urban areas have less experience of grade repetition than students in rural areas.

The result showed that grade repetition was negatively related to children's mathematics learning achievement (Table 5.4, model II). Children who repeated a grade one or more times had scores that decreased by -.050 standard deviations compared to children who never repeated a grade. This finding is consistent with finding of Hungi (2008) in Vietnam and Marshal (2003) in Honduras, who found that repeating a grade more than once was associated with poorer academic outcomes.

It is obvious that students who regularly attend school receive more hours of instruction than students who are absent. This study estimated a negative relationship between school absenteeism and learning achievement in mathematics. The degree of school absenteeism was found to be different according to type of school, location (rural/urban), geographical zones (mountain, hill and lowland) and ethnicity of students. The data of this study shows that 32% of the private school students reported absenteeism, compared to 53% of public school students. Similarly, 74% of students from mountain districts reported that they were absent from school, compared to 48% of students from hill and lowland (Tarai) areas. Students with favored ethnic background experience less school absenteeism than students with middle and marginalized ethnic backgrounds. The data shows that 31% of students from favored ethnic backgrounds experienced school absenteeism, while 54% of students from middle and 65% of students from marginalized ethnic backgrounds have experienced school absenteeism. The result showed that decreasing school absenteeism by one standard deviation increased students' academic achievement by -.185 standard deviations (-6.819, $p<0.01$). One of the reasons that was often mentioned by head teachers and teachers for school absenteeism, particularly in Nepal, was children's involvement in household chores.

Homework, which is an important point of contact between parents, children and schools, is one of the factors frequently examined in relation to school outcomes. This study found a significant relationship between homework completion and mathematics learning achievement among eighth grade students in Nepal. Descriptive statistics show that 90% of private school students do homework every day, compared to 70% of public school student; none of the private school children reported that they never do homework. It is estimated that increasing student time on homework by 1 standard deviation increased academic achievement by .126 standard deviations (model II, Table 5.4). However, this study contrasted with findings of Engin-Demir (2009) in Turkey and Keith et al. (1986) in the United States, although it supports Cooper (1989), who found that students who did homework scored two-thirds of a standard deviation higher than those who did not.

Expanding early childhood education and development (ECED) programs for all children is a policy priority designed to enhance children's overall development and establish a foundation for school success in Nepal. More than 50% of the sample students of this study mentioned that they have experienced of early childhood education and development. Seventy percent of private school students had preschool experience, compared to 40% of public school students. This study estimated a positive significant, relationship between preschool experience and academic achievement (.086, $p<0.01$), which was consistent with the Save the Children (2003) finding that students with preschool experience were 26% more likely to be promoted from grade 1 to grade 2 than children without preschool experience in Nepal (UNESCO, 2003, p. 182).

Other student characteristics that were examined were students' perception of their mathematics teachers, academic motivation and involvement in household chores. In the analysis, students who perceived that it was easy to understand their teacher's instruction had mathematics scores that were .153 standard deviations higher ($p<0.01$). Student motivation also plays an important role in learning (Schunk, 1990) because it encourages students to engage in learning activities. The result found a significant relationship between student motivation and outcomes (.135, $p<0.01$). However, the number of hours spent on studying was not significantly related to academic achievement, which contrasts with the finding of Engin-Demir (2009) in Turkey.

Children often carry out household chores in Nepal. Increased involvement in household chores was associated with fewer opportunities to study. In the result, increasing children's involvement in household chores by one standard deviation decreased academic achievement by -0.6 standard deviations ($p<0.05$), which is consistent with the finding of Akabayashi and Psacharopoulos (1999) in Tanzania. Children who spent only one hour on daily household chores scored 3.53 points higher on average than children who spent two or more hours per day. Private school students reported less time spent on household chores (mean = 1.77 hours per day), compared to public school students (mean = 2.45 hours per day). Involvement in household chores significantly affected mathematics learning achievement for public school students but not private school students.

5.3.3 Parental Involvement and Mathematics Learning Achievement

The third model, the set of parental involvement variables were added to the model that included the sets of variables for family and student characteristics. The set of family characteristics, student characteristics and parental involvement variables were significantly related to mathematics learning achievement (R^2 = .513, adjusted R^2 = .50; F(3,759) = 2.39; $p<0.01$). The correlation coefficient for model III was .71.6 and accounted for 2.1% of variances in children's mathematics learning achievement. Parental involvement in homework, support and monitoring of their children's study are significantly related to learning achievement in mathematics.

Parents are considered to be children's first teachers and children's academic performance is better when parents are involved in children's schooling. However, measures of parental involvement in children's education vary across studies, and differences are associated with SES and ethnic background (Boethel, 2003). The model III which incorporated parental involvement as well as family and student characteristics, explained for 50% of the variance in students' mathematics learning. However, parental involvement only accounted for 2.1% of the variance in mathematics learning achievement (Table 5.4).

The result found a significant relationship between parental involvement in homework and children's mathematics performance (1.31, $p<0.01$). Mothers were found to help with their children's studies, particularly in homework, more than fathers. However, huge differences in parental support were found between private and public schools. 72% of students from private schools reported that they get help from their parents in their studies, while it is 35% in the case of public schools.

Many studies that have investigated the effects of parental involvement in children's homework have found conflicting results. Some studies have found an association (Cooper, 1989; Fehrmann et al., 1987), and others have not (Engin-Demir, 2009; Epstein, 1986). Hoover-Dempsey, Otto, Bassler, and Burow (1995) suggested that parental involvement entails a multi-dimensional set of tasks that parents often felt ill-prepared for due to limited knowledge and demands on their time and energy. Result showed that children who strongly agreed that their parents encouraged them to study obtained scores that were 6.37 points higher on average than children who strongly disagreed. The parental encouragement was found significantly related with mathematics learning achievement (0.72, $p<0.05$). In addition to encouragement to children's to study, parents might also monitor their children's efforts by asking questions and observing their activities. The result found that parental monitoring was positively related to children's academic outcomes (0.83, $p<0.05$).

5.3.4 School Characteristics and Mathematics Learning Achievement

Schools are formal institutions, where teaching and learning practices happen, and most of the resources are invested assuming that they will produce quality education. However, this assumption came into doubt after the influential findings by Coleman et al. (1966) in the United States, who estimated that more effects are home-related rather than school factors. However, Heyneman and Loxley (1983) highlighted the importance of school factors, particularly in developing countries. This study examined the set of school characteristics represented by the variables of type of school (public or private), school location (rural or urban), geographical location (mountain, hill, lowland), teacher training, in-service teacher training, number of school days, teacher-student ratios and school facilities and found that significantly related to students' mathematics performance.

The model IV (Table 5.4), which is the combination of school characteristics variables with family characteristics, student characteristics and parental involvement variables was independently and linearly related to students' mathematics performance (R^2 = .601, adjusted R^2 = .586; $F(8,754) = 5.93$; $p<0.01$). The correlation coefficient for the model IV was .775, which explained for 8.6% of the variance in students' academic outcomes. It is important to note that some of the student characteristics variables such as absenteeism, grade repetition and homework completion, are closely related to school characteristics because they reflect the quality of the school that the student attends, which might be a possible reason for the low variance of school characteristics.

There were substantial differences in mathematics learning achievement associated with school characteristics in Nepal. Traditionally, governments have preferred to retain the control over the educational process to maintain the quality of public education. However, budgetary shortfalls and increasing student enrolments have led many governments to re-examine the role of the private sector in education (Kingdon, 1996). After the democracy was restored in 1990, government of Nepal introduced liberal policies that emphasized the role of the private sector, and currently 11% of students are enrolled in more than five thousand private schools which are mainly in urban areas. According to NLSS III 2011, 71.9% of students attend public schools, while 26.8% attend private schools and 1.2% attend other schools. The increasing access to private schools has raised a public dissatisfaction due to differences in cost and quality of education between private and public schools. The results presented in Table 5.2 revealed that private school students scored two times higher (mean = 22.31 points) than public school students did (mean = 9.47 points). This difference was significant (-.120, $p <0.01$).

This study found that students from private schools have higher SES measured by parental education, availability of books and other materials. Similarly, students from private schools were found to have the low levels of absenteeism and more homework completion, which might be reasons for why they perform better than public school students. Private schools were found to run more days in an academic year than public schools. There might be several other reasons highlighted by literature, such as the management strategy of schools, the motivation of teachers and principals, close monitoring from the school head, and better relationship with parents. However, this study does not examine these factors.

Another possible reason might be the competitive nature of schools as they face pressure to maximize a performance while using resources efficiently (Woessmann, 2003). This finding is consistent with Psacharopoulos (1987) and Govinda and Varghese (1993), who found that children in private schools in countries as diverse as the UK, Tanzania, Australia, India, and Colombia performed better than their public school counterparts, even after controlling for student and family characteristics.

Scarcity of resources in developing countries often leads to poorer academic performance due to dilapidated schools, insufficient numbers of teachers, and crowded classes. However, this situation can be mitigated by effective instructional processes and improvement in equipment and instructional materials rather than smaller class size (Fuchs & Woessmann, 2004). In Nepal, after the progress made in improving access to all levels of education, classes are crowded. However, even this relates to type of school, location of school, and level of school education. The Educational Management Information System (EMIS) shows that primary grades are more crowded than the lower secondary and the lower secondary grades have more students than the secondary level. The average teacher-student ratio for the sample schools in this study is 1:61. However, private schools were found to have fewer students and maintain the teacher-student ratio at 1:43, which is close to the national standard. Public schools were found to be much more crowded, with a teacher-student ratio of 1:64. Similarly, wide variance in the teacher-student ratio was not found between the geographical zones. The average teacher-student ratio for lowland (Tarai) and hill areas was 1:60, while for mountain areas it was 1:64. For urban and rural areas, the teacher-student ratio was 55:1 and 67:1 respectively.

This study found teacher-student ratio negatively related with mathematics learning achievement (-.102 <0.05), indicating that children in smaller classes outperformed children in larger classes. In Nepal, schools lack instructional materials, and larger class sizes might affect student learning due to less interaction between students and teachers, a noisier and more disruptive class environment, and teachers' inability to carry out activities or focus on students' individual needs. This result contradicts the finding of Hanushek (1997) but is consistent with the finding of Woessmann (2003), where class size significantly associated to the poor performance of students in mathematics and science on the TIMSS in 39 participating countries in 1994/1995. Kingdon (1999) found that smaller class size was negatively associated with the acquisition of numeracy skills but positively associated with reading skills in India. Similarly, Lindhal (2005) found that larger class size was detrimental for minority and economically disadvantaged children in Sweden.

Although findings have not been consistent, teacher training is a widely used intervention to improve instructional practices. The result of this study found a positive association between teacher training and students' academic achievement (0.77, p<0.05). Children taught by trained teachers were likely to score ten points higher than children taught by partially trained or untrained teachers. This result is consistent with Biniakunu (1982) findings in the Democratic Republic of Congo (1982). However, Craig, Kraft, and Plessis

(1998) found that teacher training did not necessarily improve educational quality. An academic year that includes a greater number of school days provides more opportunities for learning to occur in the classroom. In Nepal, the Education Act and government regulation requires a minimum of 220 school days in an academic year. This study found that schools run less than the required minimum school days in an academic year. Schools were found to run for 175 to 193 days. However, it varied according to type of school and location of school. The result (model IV) suggests that the number of school days in an academic year was significantly related to mathematics learning achievement (0.119, $p<0.01$).

5.4 Conclusion

By using the multiple regression analysis, I examined the factors associated with learning achievement in mathematics of eighth grade students in Nepal. I developed the four regression models to examine four sets of factors that would affect learning achievement.

The first multiple regression model examined the effect of family characteristics variables. The first model (Table 5.4) shows that family characteristics variables are significantly related to the learning achievement in mathematics (R^2 = .305, adjusted R^2 = 29.9; F (6756) = 1.36; $p<0.01$). Standardized coefficients for the model I indicated that the number of family members, father's and mother's education, the number of books in the home and the presence of certain household items –but not travel time to school –were significantly related to the learning achievement in mathematics.

In the second model (model II) in which, student characteristics variables were combined to family characteristics, result found a significant relationship with the learning achievement in mathematics (R^2 = .490, adjusted R^2 = .479; F(10,752) = 2.38; $p<0.01$). Student characteristics accounted for 18% of the variance in the learning achievement in mathematics, with a correlation coefficient of .70. Standardized coefficients for model II indicated that school absenteeism, homework completion, students' perception of their mathematics teacher, time spent on household chores, preschool experience, academic motivation and gender are significantly related to the learning achievement in mathematics, but time spent studying at home does not significantly relate to learning achievement in mathematics.

In the third model (model III), the set of parental involvement variables was added to the model II. The result showed that family characteristics, student characteristics and parental involvement were significantly related to learning achievement in mathematics (R^2 = .513, adjusted R^2 = .50; F(3759) = 2.39; p<0.01). The correlation coefficient for the model III was .71.6 and the parental involvement accounted for 2.1% of the variance in learning achievement in mathematics. Parental homework involvement, support and monitoring were significantly related to learning achievement in mathematics.

In the fourth model (model IV), school characteristics variables were combined with family characteristics, student characteristics and parental involvement variables. The result showed the significant relationship to learning achievement in mathematics (R^2 = .601, adjusted R^2 = .586; F(8754) = 5.93; p<0.01). The correlation coefficient for model IV was .775, and school characteristics variables were accounted for 8.6% of the variance in students' mathematics learning achievement. It is important to note that some of the student characteristics variables included in model II such as school absenteeism, grade repetition, and homework completion, are closely related to school characteristics because they reflect the quality of school that students attend, which might be a possible reason for the low variance of school characteristics. The type of school (public and private), school location (rural or urban), geographical location (mountain, hill, and lowland), pre- and in-service teacher training, number of school days, teacher-student ratios and school facilities were significantly related to learning achievement in mathematics.

In conclusion, the findings of this chapter shows that average of mathematics learning achievement of eighth grade students in Nepal is 11.55 out of the possible 50 marks with the standard deviation of 9.28. However, there are differences in mathematics learning achievement based on gender, ethnicity, type of school and school location. The analysis of one-way ANOVA (Table 5.2) shows that boys performed higher ($M = 13.2$, $SD = 9.47$) than girls ($M = 10.7$, $SD = 8.53$) which is statistically significantly different ($t = 6.08$, $p<0.01$). Students from the high ethnicity are found to perform higher than middle ethnic students, and middle ethnic students performed higher than the low ethnic students, with a mean learning achievement of 15.54, 9.60 and 8.28 respectively, which is significantly different ($t = 41.73$, $p<0.01$). Similarly, result shows a large gap in mathematics learning achievement between private and public schools. The average mathematics learning achievement for students of public school is 9.50, while mathematics learning achievement for private school students is more than two times higher, with an average of 22.31. Similarly, there are differences in mathematics learning achievement between students from urban and rural, and ecological zones (mountain, hill, and lowland).

Similarly, multiple regression analysis shows that family characteristics accounted for highest level of variance (29.9%) in the learning achievement in mathematics, followed by student characteristics (18.0%), school characteristics (8.6%) and parental involvement (2.1%). Variables such as parental education, particularly mother’s level of education, number of books at home, school absenteeism, parental support for homework, school type and location, teacher training, the number of school days in the academic year, and school facilities were found to be significant factors related to the learning achievement in mathematics.

Chapter 6 An Assessment of Mathematics Learning Achievement of Eighth Grade Students in Nepal

6.1 Introduction

In Chapter 5, this dissertation examined the factors affecting the quality of education, particularly mathematics learning achievement. Since the Chapter 5 indicated the low level of learning achievement in mathematics, it is important to analyze mathematics test particularly focusing on its areas such as arithmetic, algebra, statistics, and geometry, and cognitive and mental skills to solve mathematical questions. Similarly, it is equally important to identify the differential patterns of students' capacities to solve mathematical questions by examining the mutual relationships among cognitive and contents domains. These analyses are essential to improve mathematics learning because it will provide useful information to policy makers, curriculum developers, teachers, and other stakeholders to identify mathematical areas, concepts and topics that need more focus and effort to improve the quality of education, particularly mathematics learning in Nepal.

In this context, Chapter 6 first assesses the content domains of mathematics learning such as arithmetic, algebra, statistics, and geometry. Content domains specify the subject matters of mathematics that students are expected to learn by the end of the academic year (TIMSS, 2011). Similarly, this chapter further assesses the cognitive and mental skills students use in solving test questions according to the domains or thinking process, which, in this study, is considered as cognitive domain of learning. Learning does not happen as an one-time event. It is a process which progresses continuously. First we develop our cognitive and mental skills, develop our attitudes and acquire new physical and cognitive skills to perform certain activities. According to Bloom' taxonomy (1956), there are three types of domains of learning- cognitive, affective, and psychomotor. Cognitive domain involves the development of our mental skills and the acquisition of knowledge, while affective domain involves our feeling, emotions, and attitudes, and the psychomotor domain focuses on changing behavior or skills of learner. Among these three, this dissertation focuses on the cognitive domains of mathematics learning because one of the objectives of this dissertation is to assess how much students attain the curricular contents which they are taught in school and which kind of combination of cognitive skills and content knowledge are crucial for them to achieve better learning.

Within each domain, there are multiple levels of learning that progress from basic to complex or deeper levels of learning. There are six categories within the cognitive domain arranged from the simplest behavior to the most complex. The first level of cognitive domain, as I indicated in Figure 2.3, *Knowledge* is to recall or recognize mathematical facts, concepts and procedures. Generally, it is believed that the more relevant knowledge of mathematics a student is able to recall and the wider range of concepts he or she has understood, the greater chances are to solve mathematical problems. The second level of the cognitive domain, which is named *Comprehension* in Figure 2.3, focuses on students' ability to apply knowledge and conceptual understanding of mathematics to solve problems or answer questions. The third cognitive domain, *Application*, focuses on the application of the knowledge and understanding in a given context. Analysis, synthesis, and evaluation are the higher levels of learning, which focus on interpretation, creative thinking and assessing effectiveness. This dissertation does not include analysis, synthesis, and evaluation separately because eighth grade students' mathematics test does not include the complex stage of learning such as synthesis and evaluation. The problem solving is the highest stage of learning for this study which corresponds to analysis, synthesis, and evaluation. Problem solving goes beyond the solution of routine problems to encompass unfamiliar situations, complex context and multi-step problems.

Second, Chapter 6 examines the differences in areas of mathematics (content domain), and mental and cognitive skills to solve mathematical problems (cognitive domains) by gender, ethnicity, type of school and school location. Furthermore, it examines what are the mathematical knowledge and concepts associated with each other and which mathematical concept or cognitive skills have to be strengthened to improve learning achievement in other areas of mathematics. By examining the differences in content and cognitive domains of mathematics learning by gender, ethnic background, types of school and location reveal the gap between groups of student, while examining the mathematics knowledge and cognitive skills that need to be strengthened, policy makers will benefit to improve the quality of education particularly mathematics learning in Nepal.

For more than five decades, the assessment of students' learning achievement in different subjects has been practiced, particularly in developed countries; however, it is a new phenomenon in the context of Nepal because Nepal has not participated in any international assessments so far. In recent years, Nepal has carried out national assessments to assess the level of learning achievement, particularly in the core subjects of English, mathematics and science in different grades. However, none of them have analyzed the content and cognitive domains of mathematics learning or how the content domains are related to each other. Therefore, the analysis in this chapter has significant implications for improving the quality of education, particularly in mathematics learning in Nepal.

The structure of chapter 6 is as follows. The first section describes the mathematics test design, including its reliability and validity. The second section assesses the content and cognitive domains of learning mathematics for eighth grade students in Nepal. It further examines the differences in content and cognitive domains of learning mathematics by gender, ethnicity, type of school, and location of school. The third section examines the relationship between mathematical items. The final section concludes findings.

6.2 Mathematics Test Design

The mathematics test for eighth grade students was designed for two purposes. The first purpose was to assess the overall learning achievement in mathematics of eighth grade students in Nepal. The second purpose was to assess the content (areas of mathematics such as arithmetic, algebra, geometry, and statistics) and cognitive domains (knowledge, comprehension, application and problem solving). Before designing the test, I analyzed the national curriculum and mathematics textbooks in particular to examine knowledge, skills, and areas of mathematics that eighth grade students are expected to learn. The test was designed in line with the national curriculum for grade eight students in Nepal. Test items were discussed with subject specialists, people in charge of mathematics curriculum development in the Curriculum Development Center (CDC), and teachers who were currently teaching grade eight mathematics to make the test more reliable and consistent.

Twenty mathematics items were included in the test with 50 possible marks. The weight of each item was assigned according to the national curriculum. Out of a total of twenty mathematics questions, four fall into the category of objective questions, nine are short questions and the remaining seven belonged to the category of long questions. The objective questions ask mathematical facts where students need to recall mathematical knowledge. The short questions measured the students' ability to apply knowledge and conceptual understanding of mathematics. The long questions measured the students' ability to solve mathematical problems within relatively complex contexts which require students to follow multiple steps. Different marks were assigned to each type of question. Objective types of mathematics questions were assigned one mark each, short questions were assigned two marks each and long questions were assigned four marks each. As the author will discuss later, each question was designed to cover different content (arithmetic, algebra, geometry, and statistics) and cognitive domains (knowledge, comprehension, application, and problem solving) of learning, so that the test will provide comprehensive picture of the relationship among these domains in a systematic manner.

Ensuring the reliability of the test is essential because it shows the degree to which a test is consistent and stable in measuring what is intended to measure (Field, 2009). The justification is that students should get similar scores even if the test is administrated in two points in time. There are different methods for checking the reliability of tests, but the common practice is to check the value of Cronbach's alpha. The overall Cronbach's alpha of the mathematics test designed for this study was found to be .846, which indicate good enough level of internal consistency among categories for an ability test like this one. The value of Cronbach's alpha between 0.6 and 0.7 is also considered acceptable because it is mostly determined by the number of items in the scales (Field, 2009). It means that generally, as the number of items in the scale increases, the value of Cronbach's alpha will also increase. Furthermore, the internal consistency of the categories employed for cognitive skills (knowledge, comprehension, application, and problem solving) was also checked, where Cronbach's alpha for two domains of cognitive skills, namely *comprehension* and *application*, were found to be fair, at .677 and .679. However, the internal consistency for the remaining two domains of cognitive skills (*knowledge* and *problem solving*) was found to be relatively low at .622 and .647.

6.3 Content Domains of Mathematics Test Items

Mathematics test items are categorized into four content domains -arithmetic, algebra, geometry, and statistics. Out of twenty mathematics test items, six related to arithmetic, seven to algebra, two to statistics, and five to geometry. According to the weight of teaching hours given in the national curriculum, highest proportion of weight was given to algebra (32%), followed by geometry and arithmetic (28% each), and statistics (12%). The number of mathematics test items within the content domain, and its proportion of weight were assigned according to mathematics national curriculum of grade eight in Nepal. Table 6.1 below illustrates the content domains of mathematics test items included in this study.

Table 6.1 Content Domains of Mathematics

Content	Items	Marks
Arithmetic	6	14
Algebra and functions	7	16
Geometry	5	14
Statistics	2	6
Total	20	50

Source: Mathematics test conducted by the author

Arithmetic

The Arithmetic content domain included six items -whole numbers, ratios, simple interest, significant figures, percentage, and profit and loss. Arithmetic test items mainly measured the knowledge of numbers system and operations.

Algebra

Under the algebra content domain, students were expected to have the knowledge of algebraic expressions, particularly factorization, multiplication and division, use and simplification of algebraic equations, formulas and solving linear equations. Seven algebraic items -algebraic expression (multiplication and division), indices, factorization, highest common factors (HCF) and lowest common multiples (LCM), linear equations, and co-ordinate geometry were included in the test for this study.

Geometry

There are five geometric items- measurements of angle and parallel lines, area of a circle, prisms, and the construction of trapezium included in the test designed for this study. Within the geometric skills students are supposed to be able to construct of two and three dimensional geometric figures, angels, parallel lines, and circles. Furthermore, students are supposed to be competent to measure geometric shapes using measuring instruments.

Statistics

Data and chance content includes knowledge of organizing data and its interpretation. This content domain particularly measures the skills of data organization, representation, and interpretation. Students should be able to calculate the mean and median of given data.

6.4 Cognitive Domains of Mathematics Test Items

As discussed earlier in this paper, according to the taxonomy provided by Bloom (1956), there are six major categories of learning classified within the cognitive domains listed from the simple to the complex stages of learning (Figure 2.3). In this study, the test items were distributed according to these categories as presented in Table 6.2.

The stages of learning as presented in Chapter 2 (Figure 2.3) -analysis, synthesis and evaluation -are not included separately in this study because eighth grade students' mathematics test does not include the complex stage of data processing such as synthesis and evaluation. However, the problem solving of cognitive domain is the highest stage of learning for this study which corresponds to these three stages.

Table 6.2 Cognitive Domains and Types of Mathematics Test Items

Cognitive domains	Number of items			Total marks
	Objective	Short	Long	
Knowledge	4			4
Comprehension		4		8
Application		5	2	18
Problem Solving			5	20
Total	4	9	7	50

Source: Mathematics test conducted by the author

Out of total of twenty mathematics test items, four items were categorized to assess students' skills of *Knowledge* domain, four items to *Comprehension* domain, seven items to *Application* domain, and five items to *Problem solving* domain. The highest proportion of weight was given to the questions classified under the domain of *Problem solving*, followed by *Application*, *Comprehension*, and *Knowledge* respectively. Similarly, four mathematics test items were belonged to category of objective questions, nine are short questions and remaining seven belonged to the category of long questions. The characteristic of each category is explained in mathematics test design section 6.2.

6.5 Methods for Mathematics Test Items Analysis

In the above section, I explained the design of mathematics test with a particular focus on the content and cognitive domains of learning. From here, I explain the techniques used for the mathematics test items analysis. Three types of analysis have been carried out. First, weighted means were calculated to assess the level of content and cognitive domains of learning mathematics. The weighted means were used because some of the score points for respective categories were not made to be the same. Therefore, the means need to be weighted to make them comparable across categories. Second, one-way ANOVA is used to examine the differences in students' mathematics learning for respective content and cognitive domains compared by gender, ethnicity, type of school, and location of school. In Chapter 5, the differences between groups of students were examined for the overall score of mathematics test (Table 5.2). So here in Chapter 6, the differences of learning outcomes were examined according to the areas of mathematics knowledge (arithmetic, algebra, geometry and statistics) and cognitive skills (knowledge, comprehension, application, and problem solving). Finally, I conducted principal component analysis (PCA) to examine how the students' capacity to solve mathematics questions in different domains are mutually related. PCA is a statistical procedure that transforms a number of possibly correlated variables into a smaller number of uncorrelated variables. It is useful to find groups of variables which shares common elements which are not anticipated but significant. Before conducting the PCA, I examined the Pearson's correlation analysis to examine strength of relationships between mathematics test items included in this study (Table 6.7).

6.6 Assessment of Content Domains of Mathematics Learning

Table 6.3 below presents the average of mathematical knowledge according to content domains (arithmetic, algebra, statistics and geometry). Among the four content domains, students performed higher in statistics, with an average of .41, while in geometry students performed lower, with an average of .17. Similarly, the averages of the arithmetic and algebra content domains are .34 and .32 respectively.

Table 6. 3 Average Mathematics Learning Achievement according to Content Domains

Content domain of mathematics	Topics of mathematics	Average	Standard deviation
	Ratio	.65	0.47
	Simple interest	.33	0.46
	Significant figures	.36	0.48
	Percentage	.24	0.42
	Whole Numbers	.35	0.47
	Profit and loss	.12	0.32
Arithmetic		.34	0.26
	Indices	.70	0.43
	Coordinate	.31	0.45
	Multiplication and division	.46	0.50
	Factorization	.32	0.47
	Linear equation	.06	0.24
	Rational expressions	.33	0.48
	HCF/LCM	.10	0.37
Algebra		.32	.27
	Statistics (median)	.28	0.48
	Statistics (mean)	.53	0.32
Statistics		.41	.36
	Angle and parallel lines	.14	0.47
	Length of line	.36	0.50
	Measurement (circle)	.17	0.31
	Construction	.14	0.34
	Measurement (prism)	.04	0.20
Geometry		.17	.23

Source: Mathematics test conducted by the author

Six mathematics topics-ratio, simple interest, significant figures, percentage, whole number, and profit and loss -were examined within the arithmetic content domain, where students performed the lowest in profit and loss with an average of .12. It shows that having a low level of knowledge of percentage is one of the reasons for low performance in profit and loss. It is estimated that students who are able to answer the questions about percentage are likely (60%) to answer the questions on profit and loss.

Among arithmetic questions, students' performance was higher in the area of ratio, with an average of .65, and in algebra, the area of indices with an average of .70. The higher performance in these two topics is because these questions were designed to require *Knowledge* skill, which is to recall mathematical knowledge and the easiest stage of cognitive skills as shown in Figure 2.3. Similarly, students were found to perform poorly particularly in the content domain of geometry with an average of .17. There might be several reasons for the particularly poor performance in geometry which this chapter is going to investigate. This study also shows that students have a low level of correct marks for the measurement of circles, triangles, and areas.

Within the content domain of algebra, students were found to perform poorly in Highest Common Factor (HCF) and Lowest Common Multiple (LCM), with an average of .10, and in linear equation with an average of .06. The relationship between HCF/LCM, and geometric items, particularly measurement, is not clear. However, as will be discussed later, according to the author's principle component analysis (PCA) (Table 6.8), the algebraic topic of HCF/LCM and geometric topics, particularly measurement, are related to each other. It suggests that if the knowledge of geometric measurement is improved, the algebraic knowledge of HCF/ LCM will also likely improve. Even though still not satisfactory, in general, students performed higher in the content domain of statistics with an average of .41.

6.7 Assessment of Cognitive Domains of Mathematics Learning

Mathematics test items are categorized into four cognitive domains of learning, i.e. *knowledge*, *comprehension*, a*pplication*, and *problem solving*. Table 6.4 below presents the means of cognitive domains. It also describes the contents of mathematical knowledge within each cognitive domain.

Table 6.4 Average Mathematics Learning Achievement according to Cognitive Domains

Cognitive Domains	Mathematical knowledge to be covered	Mean
Knowledge	Find ratio, intercept, write formula of principle, and indices	0.50
Comprehension	Significant number, percentage, find median of data, simplify algebraic equation, and find slope	0.35
Application	Finding the area of triangle, circle, prism, and construction of trapezium	0.17
Problem solving	Simplifying algebraic equations , profit and loss, HCF and LCM, and finding the mean of data	0.29

Note: (1= 100%)
Source: Mathematics test conducted by the author

Table 6.4 shows that students performed higher in the cognitive domain of *Knowledge* with an average of .50. The *Knowledge* domain require students to recall knowledge and is the first stage of learning. For the questions classified in this *Knowledge* domain, 50% of students could find the ratio, write the formulae of percentage and find the indices. At the second stage of cognitive stage, *Comprehension* of the mathematical concepts, students were found to perform with average of .35. It means that 35% of sampled eighth grade students could solve the mathematics items of significant figures, percentage, algebraic multiplication and division and finding the median of data.

The cognitive domain, for which students were found to perform at a lower level was *Application* domain, although theoretically the *Problem solving* is considered to be a higher order of learning than the *Application* cognitive domains. Table 6.4 indicates that only 17% of eighth grade students were able to find the area of a triangle and a circle, construct a trapezium, and find the surface of a triangular prism. The result shows that (Table 6.7) algebraic item HCF/LCM is the highly correlated with the geometric items which require skills categorized as *Application* domain. It indicates that if students are able to solve the algebraic questions about HCF/LCM, they are likely to answer questions related to other questions which require *Application* skills.

The result (Table 6.4) shows that only 50% of eighth grade students were able to recall the mathematical knowledge, while 35% of students could apply the knowledge and conceptual understanding of mathematics to solve the problems. Similarly, 17% of Nepalese students were able to apply the knowledge of mathematics, while 29% of students were able to deal with complex or unfamiliar situations of mathematics.

6.8 Differential Attainment among Content Domains Compared by Gender, Ethnicity, Type of school, and Location of School

In Chapter 5 (Table 5.2), I calculated the overall mathematics learning achievement, and examined the differences of scores by gender, ethnicity, types of school, and location of school. The result showed a significant gap in mathematics learning achievement between these categories of students. However, it did not explain the differences of performance among areas of knowledge (arithmetic, algebra, statistics, and geometry) considered as content domain, and required cognitive skills to answer test questions which is considered as cognitive domain. The Table 6.5 below shows the differences of attainment in areas of mathematics learning (arithmetic, algebra, statistics, and geometry) by gender, ethnic background of student, type of school, and location of school.

Table 6.5 Average Mathematics Learning Achievement in Content Domains by Gender, Ethnicity, Types of School and Location of School

Categories	Arithmetic			Algebra			Statistics			Geometry		
	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.
Gender												
Female	0.23	32.08	.000	0.26	14.58	.000	0.42	4.07	0.39	0.15	2.01	0.156
Male	0.34			0.33			0.48			0.18		
Types of school												
Private	0.54	153.5	.000	0.54	176.6	.000	0.34	45.8	0.11	0.37	143	.000
Public	0.23			0.25			0.24			0.12		
Location of school												
Urban	0.32	18.9	.000	0.34	36.09	.000	0.5	16.8	.000	0.19	12.8	.000
Rural	0.24			0.24			0.39			0.13		
Ecological zones												
Lowland	0.26	4.99	.007	0.30	6.00	0.94	0.53	21.7	.000	0.2	11.2	.000
Hill	0.31		.336	0.30		.002	0.39		0.12	0.12		0.99
Mountain	0.19			0.15			0.18			0.11		
Ethnicity												
High ethnicity	0.4	44.59	.000	0.38	28.18	.000	0.52	6.46	.000	0.22	16.0	.000
Middle	0.21		0.324	0.25		0.16	0.42		0.75	0.14		0.26
Low ethnicity	.26			0.19			0.38			.752		

Source: Mathematics test conducted by the author

Table 6.5 shows the average mathematics learning by its content domain (arithmetic, algebra, statistics, and geometry). It shows that boys perform higher than girls in arithmetic and algebra content domain of mathematics with mean difference of 0.11 and 0.7 respectively, which is statistically significant ($p<0.01$). However, in statistics and geometry, the gender difference did not appear. As a large gap was found in overall mathematics scores between private and public schools (Chapter 5, Table 5.2), similarly, a significant difference was found between these categories of schools in most of contents domains, except for statistics (Table 6.5). The average score of students from private school in arithmetic, algebra, and geometry are 0.54, 0.54 0.37 respectively, while for students form public school, they are 0.23, 0.25 and 0.12 respectively. Similarly, students from urban schools perform higher than those from rural schools in all four areas of mathematics. Similarly, students from lowland (Tarai) areas perform better in arithmetic, statistics and geometry, which was statistically significant at 1% level. However, no significant differences were found in algebra. Furthermore, students from high ethnic background perform better than students from other ethnic backgrounds, but no statistically significant differences were found between students from middle and low ethnic backgrounds.

6.9 Differential Attainment among Cognitive Domains Compared by Gender, Ethnicity, Type of School and Location of School

I analyzed the differences in attainment of areas of mathematics learning (arithmetic, algebra, statistics, and geometry) by gender, ethnicity, type of school, and location of school in the above section. It showed the significant differences in areas of mathematics between students. Table 6.6.below presents the differences in attainment of cognitive domain (*Knowledge*, *Comprehension*, *Application*, and *Problem solving*) between students.

Table 6.6 Average Mathematics Learning Achievement in Cognitive Domains by Gender, Ethnicity, Types of School and Location

Categories	Knowledge			Comprehension			Application			Problem solving		
	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.	Mean	F	Sig.
Gender												
Girl	.446	28.60	.000	.308	23.87	.000	.126	13.25	.000	.261	10.14	.002
Boys	.559			.428			.178			.320		
Types of school												
Private	.762	131.7	.000	.713	185.4	.000	.357	194.6	.000	.509	123.3	.000
Public	.450			.298			.111			.247		
Location												
Urban	.527	7.40	.007	.421	24.15	0.00	.174	12.61	.000	.345	43.80	.000
Rural	.468			.300			.123			.225		
Eco-logical zones												
Lowland (Tarai)	.460	21.64	.000	.344	3.91	.074	.183	11.51	.000	.317	10.02	.000
Hill	.569		0.12	.400		.394	.117		.797	.271		.411
Mountain	.294			.265			.094			.129		
Ethnicity of student												
High ethnicity	.619	36.88	.000	.513	40.60	.000	.214	23.14	.000	.364	19.59	.000
Middle ethnicity	.428		.330	.286		.880	.123		.140	.258		.125
Low ethnicity	.513			.307			.071			.189		

Source: Mathematics test conducted by the author

Table 6.6 shows the average test scores classified by the cognitive domain assigned to respective questions (*knowledge, comprehension, application, and problem solving*). It shows that boys perform higher in all four cognitive domains of mathematics, which is statistically significant at a level of 1%. Similarly, students from private schools and urban schools are performing better than students from public and rural schools, which is statistically significant

($p<0.01$). Furthermore, differences in cognitive domains of mathematics learning are associated with ethnicity of student. Students of high ethnic background perform higher in all cognitive domains of mathematics learning which is statistically significant ($p<0.01$). However, no significant differences are found between middle and low ethnic students in all categories of cognitive domains of mathematics learning. Furthermore, significant difference is found between students of different eco-logical zones. Students from lowland (Tarai) perform higher than students from hill and mountain which is statistically significant at 1% level. However, significant difference does not exist between students from hill and mountain in cognitive domains of mathematics learning.

In conclusion, the results show the significant differences in content domain and cognitive domains of mathematics learning between gender, type of school, and location of school and ethnicity of student. However, there is no significant difference exist between students from middle and low ethnicity, and students from hill and mountain eco-logical zones in all four types of cognitive domains.

6.10 Relationships among Content Domains of Mathematics Test Items

In the above section, I calculated the mean and standard deviations of mathematics learning achievement by content and cognitive domains. Similarly, by using the one way ANOVA, I examined the differences in content and cognitive domains by gender, ethnicity, type of school, and location of school. In this section, I will examine how the mathematics test items are inter-related. I conducted the Pearson's correlation analysis to examine the strength of relationship between mathematics test items. The correlation coefficient (Table 6.7) shows that fairly significant relationship among mathematics test items. It particularly indicated that geometric items such as angle and parallel line, measurement of line, prism, and construction of trapezium are highly correlated with each others. Similarly, the arithmetic items ratio, simple interest and significant figures, and algebraic items- multiplication and division, factorization are found correlated. Furthermore, arithmetic items, percentage, and profit and loss are found strongly related with correlation coefficient of 43.3 which is significant at a level of 1%.

Table 6.7 Correlation Coefficient between Mathematics Test Items

Mathematics items	Ratio	Simple Interest	Perce ntage	Signif icant	Whole number	Profit loss	Indic es	Coor dinate	Multiplic ation and	Factori zation	Linea r	Ratio nal	HCF & LCM	Statist (median	Statist (mean)	Angle parall	Measure (line)	Measure (circle)	Const (trapezi)	Measure (prism)
Ratio	1																			
Simple Interest	.206**	1																		
Percentage	.232**	.221**	1																	
Significant figure	.235**	.151**	.278**	1																
Whole Number	.084*	.171**	.214**	.233**	1															
Profit Loss	.200**	.185**	.433**	.252**	.294**	1														
Indices	.108**	.153**	.220**	.130**	.118**	.155**	1													
Coordinate	.296**	.255**	.323**	.389**	.197**	.266**	.261**	1												
Multiplication	.326**	.238**	.290**	.335**	.255**	.271**	.177**	.372**	1											
Factorization	.286**	.249**	.353**	.316**	.243**	.290**	.133**	.360**	.489**	1										
Linear equation	.129**	.183**	.211**	.124**	.118**	.242**	.074*	.132**	.104**	.149**	1									
Rational expression	.222**	.139**	.184**	.241**	.285**	.220**	.194**	.290**	.322**	.289**	.108**	1								
HCF_LCM	.159**	.082*	.195**	.204**	.230**	.191**	.142**	.248**	.175**	.257**	.090*	.185**	1							
Statistics (Median)	.075*	.090*	.245**	.221**	.241**	.188**	.153**	.207**	.167**	.204**	.097**	.160**	.238**	1						
Statistics (Mean)	.127**	.071	.224**	.142**	.202**	.130**	.082*	.212**	.239**	.164**	.128**	.231**	.197**	.156**	1					
Angle parallel lines	.272**	.217**	.349**	.332**	.277**	.316**	.177**	.353**	.353**	.382**	.122**	.307**	.365**	.296**	.151**	1				
Measurement line	.212**	.186**	.245**	.230**	.274**	.331**	.149**	.260**	.316**	.305**	.183**	.381**	.189**	.178**	.179**	.312**	1			
Measurement circle	.190**	.196**	.333**	.317**	.298**	.304**	.109**	.293**	.271**	.303**	.121**	.247**	.297**	.253**	.186**	.454**	.336**	1		
Const. (trapezium)	.145**	.107**	.176**	.160**	.201**	.125**	.063	.201**	.187**	.198**	.089*	.157**	.238**	.130**	.200**	.279**	.228**	.296**	1	
Measurement prism	.114**	.100**	.270**	.228**	.274**	.339**	.140**	.231**	.154**	.225**	.133**	.205**	.369**	.214**	.145**	.406**	.244**	.409**	.329**	1

Source: Mathematics test conducted by the author

Note: ** and * correlation is significant at the 0.01 and 0.05 levels respectively (2 tailed).

6.11 Principle Component Analysis of Content Domain of Mathematics Test items

The correlation coefficient (Table 6.7) of mathematics test items indicated that they are fairly related with each other. It further showed the clusters of mathematic test items indicating the possible existence of some common underlying denominators. In such as case, it is important to explore smaller components that are inter-related with each others. The principle component analysis (PCA) is a multivariate technique, to explore the existence of smaller components that are correlated with each others. This technique helps to understand the structure of a set of variables by unearthening the underlying variables. It also contribute to reduce the number of variables to a more manageable size by clustering those with similar distributive patterns while retaining as much of the original information as possible. In this analysis, PCA is used to understand the structure of the mathematics test items, or in other words, it is used to understand how content of mathematics are mutually related in developing students' capacities to solve mathematical problems. Table 6.8 shows the results of the principle component analysis with the variances of components.

Table 6.8 Principal Component Analysis between Content Domains of Mathematics Test Items

Components	Initial Eigen Values			Rotation Sums of Squared Loadings		
	Total	percentage of variance	cumulative percentage	Total	Percentage of variance	Cumulative percentage
1	5.416	27.081	27.081	2.629	13.143	13.143
2	1.359	6.796	33.877	2.582	12.910	26.053
3	1.108	5.542	39.419	1.760	8.801	34.854
4	1.031	5.157	44.576	1.630	8.150	43.004
5	1.009	5.044	49.620	1.323	6.616	49.620
6	.937	4.683	54.302			
7	.907	4.537	58.839			
8	.847	4.235	63.074			
9	.795	3.976	67.051			
10	.761	3.805	70.856			
11	.736	3.679	74.534			
12	.702	3.512	78.047			
13	.673	3.364	81.411			
14	.607	3.034	84.445			
15	.591	2.953	87.398			
16	.550	2.748	90.146			
17	.540	2.702	92.848			
18	.506	2.532	95.380			
19	.478	2.392	97.771			
20	.446	2.229	100.00			

Source: Mathematics test conducted by the author

In the principle component analysis, the number of analysis is equal to the numbers of variables being analyzed. This study included twenty mathematics questions, so there are twenty items extracted as initial eigenvalues. However, all of them might not have been important. To determine the importance of factors, I looked at the magnitude of the associated eigenvalues. By default, SPSS uses Kiaser's criteria of retaining factors with eigenvalues greater than 1. Table 6.8 shows the eigenvalues associated with each linear component before extraction, and after rotation. Before extraction, there were twenty components; however, there were only five components which had eigenvalues greater than 1. These five components explained about 50% of total variability for the mathematics test items. The eigenvalues associated with each factor represent the variance explained by that particular linear component. The first factor can be expected to account for a fairly large amount of variance. Table 6.8 shows that the first component explains the 27% of total variance for the test items, whereas the subsequent four factors explain small amounts of variance. The second group of factors explains 6.8% of variance, the third group of factors explain 5.5% of variance, while the fourth and fifth group explain 5.1 and 5% of variance.

The final part of Table 6.8 (second column) shows the eigenvalues of the factors after rotation. Factor rotation has the effect of optimizing the factor structure, and one consequence of rotation is that the relative importance of these five factors is equalized. Before rotation, the first factor accounted for considerably more variance (27%) than the remaining four variables; however, after rotation, it accounts only for 13% of variance, while second, third, fourth and fifth factors explain 12.9%, 8.8%, 8.1%, and 6.6% of variances of mathematics learning respectively. It indicated that the first two factors are equally accountable for the variances (13 %) for mathematics learning of eighth grade students in Nepal.

Table 6.9 below presents the rotated component matrix, which is a matrix of the factor loadings for each variable onto each factor. It shows the factor loading of all the mathematics items included for this study. However, for the purpose of analysis the factor loading above .4 is considered as a cut-off point (Stevens, 1992). It shows that the mathematics test items are clustered in five components, with seven mathematics test items in the first component, five items in the second, three items in the third, three items in the fourth and two items in the fifth. The characteristics of the mathematics test items of each group and their relationships are discussed below.

Table 6.9 Rotated Component Matrix of Mathematics Test Items

Mathematics test items	Components				
	Number system	Geometric skills	Data management	Ratio and percentage	Algebraic expressions
Ratio	.677	.063	.037	.102	-.123
Algebraic (Multiplication and Division)	.667	.075	.347	.049	.076
Factorization	.615	.226	.183	.150	.063
Coordinate	.582	.196	.140	.069	.317
Significant figures	.490	.285	.086	.053	.208
Simple interest	.433	-.018	-.026	.319	.053
Whole number	.406	.315	.120	.205	.175
Measurement (prism)	.019	.735	.076	.208	.085
Measurement (circle)	.251	.620	.148	.189	.037
HCF_LCM	.122	.617	.120	-.060	.182
Angle and parallel line	.311	.583	.085	.111	.169
Construction (trapezium)	.144	.565	.246	-.005	-.259
Statistics (mean)	.057	.101	.671	.028	.032
Statistics (median)	.005	.361	.525	.064	.156
Measurement (line)	.256	.201	.513	.290	-.011
Percentage	.176	.279	.124	.752	.179
Profit and loss	.310	.267	.046	.615	.294
Linear equation	.009	-.008	.149	.486	-.069
Indices	.161	-.037	.094	.076	.748
Rational expressions	.303	.075	.152	.010	.652

Source: Mathematics test conducted by the author

Numbering System: the first component of mathematics test items

There are seven mathematics test items in the first component, where four items belong to arithmetic and the remaining three items belong to algebra content domains. The arithmetic items in first component measure the knowledge of mathematical facts such as calculating a ratio, writing the formula of simple interest, and place value of number, while algebraic items measure the knowledge of simplifying algebraic expressions, particularly multiplication and division. The common characteristic of the mathematics test items in the first component indicates that they are closely related with mathematical knowledge of number system which explains 27% of variances on mathematics test items, however, after rotation, it explains only 13% of variances (Table 6.8).

The first test item in the first component belongs to arithmetic content domain. It is to assess the students' knowledge of ratio. The question in the test was for student to find the ratio of 25 and 55 (Question 1, Appendix 4). This arithmetic question assess the students' knowledge of the number system and is the easiest mathematics question within the content domain of arithmetic. The second question in the first component assesses the knowledge of students on algebraic multiplication and division. The actual question in the test required students to calculate the following: $3x^2 + 5x (x-2) -8x^2 +5$ (Question 8, Appendix 4). The third algebraic question which was clustered in the first component is about co-ordinate geometry. In the actual test, the question in the test required students to find the x- intercept of the line AB in the graph given (Question 4, Appendix 4). Similarly, the fourth question which was clustered in the first component assesses the knowledge of factorization. The actual question was to simplify the following algebraic expressions. $m^2-4m / m^2- 6m$ (Question 7, Appendix 4).

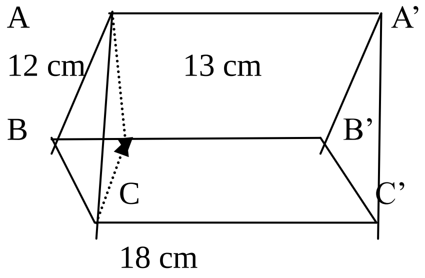
Similarly, the fifth item assesses the knowledge of place value of number by asking students to round off 0.35674 to two significant figures (Question 5, Appendix 4). The sixth test item clustered in first component is to examine students' knowledge about mathematical fact, such as writing the formulae of principal. The question in the test was as follows: if amount (A), rate (R) and time (T) are given, write the formula to calculate the principal (P) (Question 2, Appendix 4). The seventh item in first component belongs to arithmetic item which measure the knowledge of whole number. The question was to simplify $11011_2 + 10011_2 - 1111_2$ (Question 13, Appendix 4).

The common feature shared among questions clustered into the first component is that they are related to the mathematics number system which is the basic requirement for the development of other mathematics skills. It shows (Table 6.8) that before rotation the mathematics items in the first component are accounted for 27% of variances however, after rotation it is accounted for 13% of variances in mathematics learning which suggest that improving the knowledge of number system is important for the improvement of other mathematical concepts.

Geometric Skills: the second component of mathematics test items

There are five mathematics test items clustered in the second component. Four of them belong to the content domain of geometry while the other item belongs to algebra. It shows a high correlation between geometric items, particularly measurement and algebraic factorization (HCF and LCM). The common characteristic of these five items can be explained as geometric skills. It particularly assesses the students' capacity to calculate prism, angles and parallel lines and construction of a trapezium. The second component explains 6.7 % of variances of the total test scores before rotation and 12.9% after rotation.

The first question clustered in the second component examines if students' can calculate the area of a triangular prism, which is the most difficult test item included in this study where only 4% of sample students answered correctly. The question is to find the total surface area of the given triangular prism (Question 20, Appendix 4).

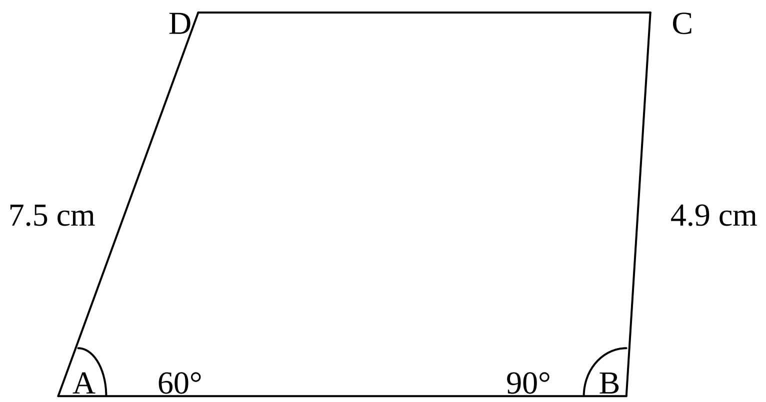


Data analysis shows that less than one percent of students from public schools successfully answered this question, while 14% of students from private schools could. There are three steps to find out the surface of triangular prism. The first step is to calculate the area of triangle and the second step is to find out the area of prism. The third step is to add the area of the triangle and the area of the prism. Analysis shows that most of students who attempted to answer were able to calculate the area of the triangle, but had difficulties calculating the area of the total surface of the prism.

The second test item of the second component examines the skills of measurement. It particularly assesses if students know how to compute the circumference of a circle, whose prerequisite is the knowledge of the formulae of circumferences for circle and value of pi (π). The actual question reads as follows: Find the circumference of a circle with a radius of 14 cm (Question 12, Appendix 4). Analysis showed that students who attempted to find out the circumference of a circle were familiar with the formulae for circumferences but had less knowledge about the value of pi (π).

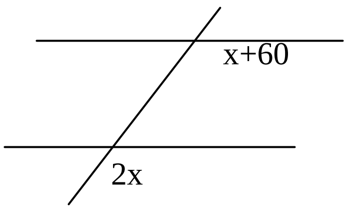
The third item in the second component also gauged skills of measurement. It specifically measured the skill of constructing a trapezium, but only 14% of students successfully constructed it.

The question in the test has read as follows (Question 19, Appendix 4): Construct a trapezium from the given measurement AB= 7.5 cm; BC=4.9cm; $\angle$ BAD = 60; $\angle$ ABC = 90 and AB $//$ CD



Construction of a trapezium requires the skills of drawing angles and lines. The analysis showed that students who attempted to answer but could not do so correctly had a low level of knowledge of constructing angles rather than lines.

The fourth mathematics test item is related to the knowledge of angles and parallel lines. The question was as follows (Question 10, Appendix 4): Find the value of X in the figure.



The fifth test item belongs to the content domain of algebra, which assesses whether students can calculate the highest common factor (HCF) and lowest common multiple (LCM).

The test question was to find the highest common factor (HCF) and lowest common multiple (LCM) of $8x^3 - 27$ and $4x^2$-12x+9 (Question 17, Appendix 4). It was found that students had more difficulties in finding the highest common factor than the lowest common multiple.

The test items in the second component can be represented as geometric skills because out of five items, four items belong to the content domain of geometric. The knowledge of the geometric skills is found to be important for students to improve their overall learning outcomes of mathematics because it accounted for 12.9% of variances (after rotation) of mathematics test items. The correlation analysis (Table 6.7) also shows that mathematics skills, particularly those of geometry, are found highly correlated with other mathematics items. Even though only 17% of sample students successfully answered all the geometric items correctly, the analysis indicates that those students who could answer questions which fell into this second cluster, namely measurement and construction, there is a 60% likelihood that they can answer questions of other content domains correctly.

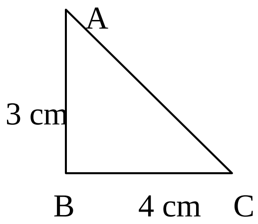
Data Management: the third component of mathematics test items

There are three mathematics test items clustered in the third component; two of them belong to the content domain of statistics and the remaining belongs to geometry. Out of three test items, two statistics items have the highest factor loading. It means that third component can be characterizes as data management which is accounted for 8.8% of variances of overall test scores. The first test item in the third component belongs to the content domain of statistics which require students to calculate the mean. The question was to calculate the mean of given following data (Question 15, Appendix 4).

Marks obtained	10	20	30	40	50	60
No. of students	2	3	5	4	3	3

Similarly, the second test item belongs to statistics, which is to find the median of data. (Question 6, Appendix 4): find the median of the following data. 5, 6, 7, 8, 11, 10, 17, 11, 19, 6. The third item examines the knowledge of measurement of line. For example

Example: Find the length of AC



The third component which consist of three mathematics items are characterized as data management and accounted for 8.8% of variances of mathematics learning of eighth grade students.

<u>Ratio and percentage: the fourth component of mathematics test items</u>

There are three mathematics test items clustered in the fourth component, where two items belong to the content domain of arithmetic and the remaining item belongs to algebra. The first arithmetic item is to calculate the profit and loss, which was the most difficult item within the arithmetic content domain, with only 12% of students (boys 17% and girls 9%) succeeded. The question has read as follows (Question 14, Appendix 4): A shopkeeper marked the price of a radio as Rs. 5000. He sold it allowing a discount of 10% and made of profit Rs. 500. Find the cost of the radio.

The second item on the arithmetic clustered in the fourth group was to assess the knowledge of percentage and 24% of sample students answered correctly. The question has read as follows (Question 5, Appendix 4): How much money should be added to an item which costs Rs. 350 if the tax rate of 10%? As the arithmetic items percentage and profit and loss are clustered in the same component indicates that if students' knowledge of percentage is improved, calculating profit and loss is also likely to improve. This is because both of these mathematics items require the knowledge of percentage. The third item examines the knowledge of algebraic linear equation where only 6% students (8% of boys and 4% of girls) are able to answer correctly. The question has read (Question 9, Appendix 4): Find the slope of line 3y-2x = 3

The characteristic of mathematics test items clustered in the fourth component are those related to the knowledge of ratio and percentage, and explain 8% of the variances in the overall score of the sample students.

Algebraic Expression: the fifth component of mathematics test items

There are two test items clustered in the fifth component. The first item assesses the capacity of students to solve questions to calculate indices. The question included in the test was: what power of x has the value 1? (Question 3, Appendix 4). Similarly, another question in this component was about rational expressions. The question was to simplify the following fractions (Question 16, Appendix 4).

$$\frac{X^{a+b}}{X^{c+b}} \qquad \frac{X^{c+d}}{X^{d+a}}$$

The common characteristic of these two items is represented by the algebraic expression which explains 6% of the variances in overall score of the sample students.

6.12 Conclusion

There are two main objectives of chapter 6. The first objective is to analyze the content areas of mathematics knowledge (content domain) and cognitive skills required to answer questions (cognitive domains), and to examine the differences in the level of students' achievement for respective content and cognitive domains by gender, ethnicity, type of school and location. The second objective is to examine the mutual relationship among mathematics knowledge and skills in different domains, and to identify the areas of knowledge and cognitive skills which are of primary importance for students to achieve further learning. It is important to assess the content and cognitive domains of mathematics learning and to examine the relationships between mathematical test items because it will indicate the areas and concepts that need more focus and effort to improve the quality of education, particularly mathematics education, in Nepal.

The analysis of students' test outcomes according to the content domains (Table 6.3) shows that the performance is generally low. Within the content domains of mathematics, students perform lowest in geometry, with an average of 0.17, followed by arithmetic, algebra and statistics, with averages of 0.29, 0.32 and 0.41 respectively. Similarly, students perform low in the cognitive domain regarding the capacity to *Apply* basic mathematical knowledge to the question in front, with an average of 0.17. The cognitive domain regarding the skills for *Problem solving* is considered to be the highest level of skills according to the Bloom's taxonomy (Figure 2.3). In this cognitive domain, students were found to perform higher than in the domain of the *Applying* skills, with an average of 0.29. In the other cognitive domains, *Knowledge* and *Comprehension*, even if not encouraging, students perform relatively better, with averages of 0.50 and 0.36 respectively.

Similarly, data analysis (Table 6.5 and Table 6.6) shows that there are significant differences in the students' capacity to solve questions for various content and cognitive domains between gender, type of school, and location of school. However, no significant differences are found between students from middle and marginalized ethnic backgrounds, and students from hill and mountain eco-logical zones in content and cognitive domains of mathematics.

Regarding the second objective, the result of principle component analysis (PCA) (Table 6.9) shows the mutual relationship among number system within arithmetic and algebraic items such as multiplication and division. This fact indicates that if the students' ability in the content domain on the number system is improved, the knowledge of algebraic multiplication and division is also likely to be improved. Similarly, geometric skills, particularly measurement and algebraic factorization (HCF and LCM), percentage, and profit and loss are found positively correlated with each other. Although this study does not explain how these knowledge and skills influences each other, however, correlation coefficient (Table 6.7) and PCA (Table 6.9) of mathematics test items show that knowledge of geometric skills, particularly the skills of measurement and knowledge of percentage, are important to improve the knowledge of algebraic factorization and arithmetic knowledge of profit and loss respectively.

Furthermore the result (Table 6.8) shows that mathematics test items are clustered in five different components which have eigenvalue greater than 1. It indicates that the first component, whose constituent items are all about the knowledge on the number system, explain the variance in the test scores of sample population at the highest level (27%) followed by geometric skill (7%), data management (5%), ratio, percentage and proportion (5%), and algebraic expression (5%) respectively. The first component about the number system indicates that improving basic mathematics (number system) skills is the precondition for improving performance in others complicated domains such as geometry, data management, and algebraic expressions.

Chapter 7 Conclusion

7.1 Summary of Findings

There are two main objectives of this dissertation. The first objective is to examine the factors affecting the quality of education, particularly mathematics learning achievement of eighth grade students in Nepal. It specifically examines the effect of family characteristics, student characteristics, parental involvement, and school characteristics on mathematics learning achievement of eighth grade students in Nepal. The second objective is to analyze the mathematics test. It particularly analyzes areas of mathematics learning such as arithmetic, algebra, statistics, and geometry which is known as content domain that students are expected to learn by the end of the academic year. Similarly, it analyzes the knowledge and development of mathematical skills, which is considered as cognitive domain of learning (knowledge, comprehension, application, and problem solving). Furthermore, it examines the knowledge, concepts and skills in mathematics that are associated with each other, and which knowledge and skills need to be developed primarily so that students can build further mathematical learning onto them.

It is of interest to examine the determining factors for learning achievement in mathematics as it informs policy makers and teachers about various factors that influence children’s performance. At the same time, analyzing mathematics test provides useful information to policy makers, curriculum developers, teachers, and other stakeholders to identify areas, concepts and topics of mathematics that need more focus and efforts to improve the quality of education in Nepal. Similarly, policy makers and curriculum developers, including teachers, benefit from knowing what and how mathematical knowledge and concepts are associated with each other and which concept needs focus to improve mathematics learning.

The discussions of the findings of this dissertation are presented in two sections. In the first section, I discussed the findings of the study in relation to the research questions. In the second section, I discuss the implications of the findings of this dissertation for educational development in Nepal.

There are two research questions posited in chapter 1. The first research question that I answered in chapter 5 was w*hat are the factors affecting mathematics learning achievement of eighth grade students in Nepal?*

By using the multiple regression analysis, I examined the effect of family characteristics, student characteristics, parental involvement and school characteristics on eighth grade students' mathematics learning achievement in Nepal. I developed four models. The first model, the set of family characteristics variables, was significantly related to students' learning achievement in mathematics (R^2 = 30.5, adjusted R^2 = 29.9). The standardized coefficient from the model I indicated that numbers of family members, father's and mother's education, numbers of books at home and presence of certain household items were significantly related to students' mathematics learning achievement in Nepal. However, traveling time to school was not found significantly related to mathematics learning achievement.

The effect of the level of mother's education (.220, $p<0.01$) was estimated stronger compared to the father's level of education (.170, $p<0.01$) on their children's learning achievement in mathematics although fewer mothers (24%) have completed secondary education compared to that of fathers (44%). There are two possible reasons for the higher effect of mothers' education level. The first reason is that mothers are less employed than fathers, regardless of their level of education, which provides mothers more opportunities to spend time with their children and on their schooling. Educated mothers are found more supportive to their children's schooling particularly with regard to homework completion. Another specific reason for the higher effect of mother's education is explainable by ownership on household resources, particularly land. It is believed that the distribution of resources is more effective when women participate in decision making about the use of resources.

The findings indicated a negative relationship between family size and students' mathematics learning achievement. Students with smaller families (three to five family members) outperformed children in larger families (-.118, $p<0.01$). It is because children in smaller families have greater access to resources and intellectual contexts that provide academic motivation. The effect of family size diminished for private school students compared to public school students and was greater for students in rural schools compared to students in urban schools. The possible reason for the reduced effect of family size for private and urban schools is that parents have higher levels of education and more materials and books at home than the parents with children in public and rural schools. Similarly, the availability of additional books at home and the possession of certain items e.g., radio, bicycle, water tap, cassette player, television, telephone, gas stove, computer and motorbike, which reflects a family SES is significantly related to students' academic achievement with standardized coefficient of (.240, $p<0.01$) and (.214, $p<0.01$) respectively.

The effect of student characteristics as measured by gender, ethnicity, absenteeism, homework completion, perception of their mathematics teacher, time spent on household chores, and preschool experience were examined in the second model (Table 5.4) and found a significant relationship with mathematics achievement (R^2 = 49.0, adjusted R^2 = 47.9). However, the variable of time spent on studying at home was not significantly related to students' mathematics learning achievement. The finding of this study indicated that gender was significantly related to mathematics achievement (0.83, $p<0.05$). Overall, boys outperformed girls with a mean difference of -3.05 (Table 5.2). However, for students attending private schools, girls (mean score = 24.37) outperformed boys (mean score = 21.27). There might be several reasons for the better performance of boys than girls. However, the available data of this study shows that boys have high socio-economic status (SES) than girls measured by completion of fathers' and mothers' level of education, additional books at home, and possessions at home. Furthermore, in household chores girls are involved more than boys and get less support from their parents, particularly for doing homework, than boys. However, in private schools, girls are found with a higher SES than boys, low level of school absenteeism, and high home work completion.

The findings indicated that ethnic background of student is negatively associated to student' learning achievement in mathematics. It is estimated that boys with high ethnic background outperformed children with middle and low ethnic background, which is statistically significant (-0.96, $p<0.05$). However, the different effect is estimated between types of schools. Private schools have found less effect of ethnic background of students than public schools. The possible reason for less effect of ethnic background of students in private school is that students who enroll at private schools tends to have higher socio-economic status (SES) (land holdings, location of house) even if parents have less education.

Despite significant improvement in school participation at all levels of school education, grade repetition and school absenteeism are still the major concern for educational development of Nepal. This study found negative effect of grade repetition (-.50, $p<0.10$) on students' mathematics learning achievement. Similarly, school absenteeism was found having strong negative (-.185, $p<0.01$) relationship with students' mathematics learning achievement. The average school absenteeism of sample students of this study is 2.83 days in a month. However, the degree of school absenteeism is found different in view of the type of school, location, and ethnicity of students. Similarly, the involvement in household chores is found negatively associated to students' mathematics learning achievement (-.60, $p<0.05$). Private school students are found less involved in household chores (mean = 1.77 hours per day) compared to public school students (mean = 2.45 hours per day). Other variables- home work completion (.126, $p<0.01$) and experience of early childhood development (.086, $p<0.01$) are also found significantly related to mathematics learning of eighth grade students of Nepal.

The effect of parental involvement is widely examined however, measures of parental involvement in children's education vary across studies, and differences are associated with family SES and ethnic background. The findings of this study (Table 5.4, model III) indicated significant relationship between parental involvement in homework and children's school performance (1.31, $p<0.01$). Mothers are found helping their children's study more particularly in homework than fathers. However, huge differences in parental support are found between private and public schools. 72% of students from private schools reported that they got help from their parents on their study while it is 35% in the case of public schools. Similarly, parental support (0.72, $p<0.05$) and monitoring (0.83, $p<0.05$) are also found important for children's better school outcomes.

In addition to the effects of family characteristics, student characteristics, and parental involvement, the variances of children's learning outcomes are also associated with school characteristics because teaching and learning activities occur in school. The fourth model, which includes all these variables are found significantly related to students' mathematics achievement (R^2 = 60.1, adjusted R^2 = 58.6). This dissertation found significant differences in mathematics learning achievement between private (mean score = 22.31) and public schools (mean score = 9.47). The result of this study shows that students from private schools have higher SES measured by (parental education, availability of books and students from private schools were found with low school absenteeism and more homework completion) which might be the reasons for performing better than public school students. Other reasons for better performance of private school students might be management strategy of schools, motivation of teachers and principals and close monitoring from the school head, and better relationship with parents, although, this study does not examine these factors.

Similarly, teacher-student ratio was found negatively associated with students' mathematics learning (-.102, $p<0.05$). It indicates children in smaller classes outperform children in larger classes. The average teacher-student ratio for sample schools of this study is 1:61. However, private schools were found having less students maintaining the teacher-student ratio at 1:43, which is close to the national standard 1:40. Unlike private schools, public schools were found more crowded with the student teacher ratio of 1:64. An analysis of teacher-student ratio shows why private schools perform better than public schools. In private schools with small class size, private school teachers have more time to identify what students actually understood, by asking them questions in class, assisting them in learning, correcting their exercises and offering them more feedback.

Although findings have not been consistent, teacher training is a widely used intervention to improve instructional practices. The result of this study estimated a positive relationship between teacher training and students' learning achievement (0.77, $p<0.05$). An academic year that includes a greater number of school days provides more opportunities for learning to occur in the classroom. In Nepal, the Education Act and government regulation requires a minimum of 220 school days in an academic year. This study found that schools run less than the required minimum school days (i.e. 220) in an academic year. Schools were found running for 175 to 193 days. However, it varies according to type and location of school. The result (model IV) suggests that number of school days in an academic year was significantly related to students' learning achievement (0.119, $p<0.01$).

Furthermore study findings (Table 5.4) indicated that family characteristics accounted for the highest level of variance (29%) in mathematics achievement, followed by student characteristics (18%), school characteristics (8%) and parental involvement (2%). It is important to note that some of individual variables included within student characteristics, such as absenteeism, grade repetition and homework completion, are closely related to school characteristics because they reflect the quality of the school and might be a possible reason for low variance of school characteristics.

After examining the factors affecting quality of education, particularly mathematics learning achievement of eighth grade students in Nepal, I analyzed the mathematics test in Chapter 6. I particularly answered the second research question as posited in Chapter I was, *What are the mathematical knowledge/concepts and skills associated with each other, and which are the knowledge and skills essential to develop further mathematical knowledge onto them and, then, to improve the mathematics learning of eighth grade students in Nepal*?

Before answering the second research question, I analyzed the mathematics test focusing on its content (arithmetic, algebra, statistics, and geometry), and cognitive domain (*knowledge*, *comprehension*, *application*, and *problem solving*) of learning. The findings suggested that students perform lowest in geometry, with an average of 0.17, followed by arithmetic, algebra and statistics, with averages of 0.29, 0.32 and 0.41 respectively.

Similarly, students perform low in cognitive domain regarding the capacity to *applying* basic mathematical knowledge, with the aggregate points of 0.17. The cognitive domain regarding the skills for *Problem solving* is considered to be the highest level of skills according to the Bloom's taxonomy (Figure 2.3). In this cognitive domain, students were found to perform higher than in the domain of the *Applying* skills, with an average of 0.29. In the other cognitive domains, *Knowledge* and *Comprehension*, even if not encouraging, students performed relatively better, with averages of 0.50 and 0.36 respectively.

Furthermore, I examined the differences in content and cognitive domain of mathematics learning between students. Data analysis (Table 6.5 and Table 6.6) shows that there are significant differences in the students' capacity to solve questions for various content and cognitive domains between gender, type of school, and location of school. However, no significant differences are found between students from middle and marginalized ethnic backgrounds, and students from hill and mountain eco-logical zones in content and cognitive domains of mathematics learning.

I used principal component analysis (PCA) to answer the second research question. The result of PCA (Table 6.9) shows the mutual relationship among number system within arithmetic and algebraic items such as multiplication and division. This fact indicates that if the students' ability in the content domain on the number system is improved, the knowledge of algebraic multiplication and division is also likely to be improved. Similarly, geometric skills, particularly measurement and algebraic factorization (HCF and LCM), percentage, and profit and loss are found positively correlated with each other. Although this study does not explain how theses knowledge and skills influences each other, data analysis (correlation coefficient) (Table 6.7) and PCA (Table 6.9) show that knowledge of geometric skills, particularly the skills of measurement and knowledge of percentage, are important to improve the knowledge of algebraic factorization and arithmetic knowledge of profit and loss respectively.

Furthermore the result (Table 6.8) shows that mathematics test items are clustered in five different components which have eigenvalue greater than 1. It indicates that the first component, whose constituent items are all about the knowledge on the number system, explains the variance in the test scores of sample population at the highest level (27%) followed by geometric skill (7%), data management (5%), ratio, percentage and proportion (5%), and algebraic expression (5%) respectively. The first component about the number system indicates that improving basic mathematics (number system) skills is the precondition for improving performance in other complicated domains such as geometry, data management, and algebraic expressions.

7.2 Policy Implications

The finding of this dissertation that family characteristics are responsible for a large proportion (29%) of the variance in students' learning achievement has profound implications for educational development in Nepal, where more than 40% of parents are still illiterate. The study found that children with educated parents and homes with greater material resources exhibited better academic performance. It suggests that educational policies should focus not only on children but also their families and schools. In the short-term, few strategies can be adopted to minimize the effects of family characteristics, but in the long-term much can be done. To provide more opportunities for students from disadvantaged communities, incentives programs such as conditional cash transfer could be introduced. Study findings revealed a significant relationship between parental involvement and school outcomes, which indicates that educational policies should promote the partnership of schools, local communities non-governmental organizations and other social agencies to increase parents' awareness of their role in fostering their children's academic achievement, particularly in disadvantaged communities.

The finding that gender and ethnic background were differentially associated with mathematics performance in Nepal raises another issue. In the current political climate, the issue of equal opportunity in education must be addressed to maintain social equity and harmony. This issue should be investigated further to determine the extent to which teacher training promotes gender sensitivity and schools provide inclusive and gender-friendly as well as gender-balanced curriculum and textbooks. Also, the study found significant differences in mathematics learning achievement between public and private schools, which is a serious concern for policy makers, teachers and parents. It means that the Nepalese government should adopt policies to reduce learning gaps in both type of schools (private and public) they are offering.

The results of this study indicate a strong negative relationship between student absenteeism and mathematics performance. In the context of high absenteeism in both private and public schools and its diverse reasons, further study is needed to thoroughly understand this phenomenon. However, districts and schools with high levels of absenteeism should be identified, and programs that foster school attendance such as day meals, scholarships and conditional cash transfer could be introduced. Grade repetition, which was negatively related to academic outcomes, was related to other issues, and schools that improve educational quality will automatically reduce grade repetition. Student perception of teachers was significantly related to learning outcomes, which suggests that teacher training should focus not only on instructional knowledge and skills but also on attitudes that maintain a positive atmosphere both inside and outside the classroom.

Providing training to teachers is an important policy for better school outcomes but teacher training only may not work properly, because it is strongly related to other teacher development policies, such as teacher licensing, hiring and professional development, which may cause important differences in the qualifications and capacities that teachers bring to their work. The study found a positive relationship between teacher training and academic outcomes. However, due to students' poor and uneven mathematics performance, further investigation is needed to determine the extent to which teachers master training content and incorporate it into classroom practices.

Nationally, the average teacher-student ratio is 44:1 at the basic education level. However, the average teacher-student ratio was 60:1 in the schools participating in the study, which is much higher than the national average, and indicates that human resources in education are not equally distributed. Policies such as teacher redeployment within and between districts should be introduced to distribute existing resources more equitably. Study findings also revealed that the schools' academic year did not provide the minimum number of days required by educational legislation and regulations, which is a serious concern for policy makers, educational administrators and other stakeholders. In this regard, the roles of School Supervisors (SS), Resource Persons (RP), School Management Committees (SMCs) and Parent Teacher Associations need to be re-examined, and further investigation is needed to identify effective monitoring mechanisms.

Another implication of this dissertation belongs to the analysis of mathematics test conducted with eighth grade students. The result indicated that students perform low in geometry content domain of mathematics and indicated the significant differences in mathematics learning between gender, ethnicity of students, type of schools (private and public), and location of school. Other findings of mathematics test analysis (Table 6.8 and

Table 6.9) indicated that mathematics test items are clustered in five components. They are number system, geometric skills, data management, ratio, proportion and percentage, and algebraic expression. The first component number system is accounted for the highest variances (27%) in mathematics learning which suggested that policy makers and teachers should focus on improving basic mathematics skills (number system) for improving performance in other complicated areas of mathematics such as geometric skills, data management, ratio and percentage, and algebraic expressions. The analysis of mathematics test (Table 6.3 and Table 6.4) also indicated that students performed low in higher domain of mathematics learning such as skill and problem solving because many students fail to acquire basic mathematics skills (number system).

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Appendixes

Appendixes 1: Survey Questionnaires for Students

1. Questionnaires for students' family characteristics

District……………………….. Name of School…………………………………………

Sex Boys ☐ Girl ☐

Age…………….years

1. How many members do you have in your family? ☐
2. How many siblings do you have in your Family? ☐
3. What is your position among the siblings?

3.1 ☐ Younger brother 3.2 ☐ Younger sister

3.3 ☐ Older brother 3.2 ☐ Older sister

4. What is the highest level of education that your father has attained?

4.1 ☐ Primary 4.2 ☐ Lower Secondary

4.3 ☐ Secondary 4.4 ☐ Intermediate (IA)

4.5 ☐ Bachelor and above 4.6 ☐ Illiterate

4.7 ☐ I do not have father

5 What is the highest level of education that your mother has attained?

5.1 ☐ Primary completed 5.2 ☐ Lower secondary

5.3 ☐ Secondary 5.4 ☐ Intermediate (IA)

5.5 ☐ Bachelor and above 5.6 ☐ Illiterate

5.7 ☐ I do not have mother

6 What is the occupation of your father?

6.7 ☐ Farmer | 6.2 ☐ Business man
6.3 ☐ Government Employee | 6.4 ☐ Social Worker
6.5 ☐ I do not have father | 6.6 ☐ Others (specify)

7 What is the occupation of your mother?

7.7 ☐ Farmer | 7.2 ☐ Business man
7.3 ☐ Government Employee | 7.4 ☐ Social Worker
7.5 ☐ I do not have father | 7.6 ☐ Others (specify)

8 What is the monthly income of your father?

8.7 ☐ Less than 3 thousands | 8.2 ☐ 3-5 thousands
8.8 ☐ 6-7 thousands | 8.4 ☐ 8-10 thousands
8.5 ☐ Above 10 thousands | 8.6 ☐ I do not have father

9 What is the monthly income of your mother?

9.7 ☐ Less than 3 thousands | 9.2 ☐ 3-5 thousands
9.3 ☐ 6-7 thousands | 9.4 ☐ 8-10 thousands
9.5 ☐ Above 10 thousands | 9.6 ☐ I do not have father

10 How is the structure of your house?

10.1 ☐ Concrete | 10.2 ☐ Semi concrete | 10.3 ☐ Huts

11 How much land do you have your own family?

…………………………………………………………………….

11.1 How owns the land in your family? ☐ Father ☐ Mother

12 Which of the following things can be found in the place (Home) where you stay?

12.1 ☐ Radio | 12.2 ☐ Television
12.3 ☐ Bicycle | 12.4 ☐ Cassette player
12.5 ☐ Refrigerator | 12.6 ☐ Telephone
12.7 ☐ Electricity | 12.8 ☐ Piped water

12.8 ☐ Gas stove 12.9 ☐ News paper

13. How long does it take to go to your school from your house?

13.3 ☐ Less than 10 minutes 13.2 ☐ 10-20 minutes

13.4 ☐ Half an hours 13.4 ☐ More than half an hours

14. What language do you speak in your home?

14.1 ☐ Nepali 14.2 ☐ Tharu

14.3 ☐ Maithali 14.4 ☐ Newari

14.5 ☐ Others (Specify)……………………………

15 Do you have additional books at your home?

15.1 ☐ Yes 15.2 ☐ No

If your answer is positive, could you mention, how many additional books do you have at your home

☐ Less than 5 books ☐ 5-10 books ☐ More than 10 books

2 Questionnaires for Student Characteristics

How many of the following items do you have to work with this term? (Please write the number in the boxes for each item. Please write '0' if you do not have any.)

16.1 ☐ Exercise books 16.2 ☐ Full set of textbooks

16.3 ☐ Additional textbooks 16.4 ☐ Dictionary

16.2 ☐ Bags 16.6 ☐ Table to read and write

16.7 ☐ Geometry tool box 16.8 ☐ Files and folders

16.9 ☐ Calculators 16.10 ☐ Others (specify)

17. How many school days were you absent during last months of school? (Please write the number in the boxes below. Please write '0' if you were not absent.)

☐ days

What was the main reason for your absence?.......................................

18. Have you ever repeated the grade since you are in school?

☐ Yes ☐ No

If your answer is yes, could you mention how many times have you repeated?

18.1 ☐ I have repeated once 18.2 ☐ I have repeated twice

18.3 ☐ I have repeated three times 18.4 ☐ More than three times

Please read each of the sentences below about how you feel about school. Please ticks to show how much you agree or disagree with each sentence. (1= Strongly agree…5 = Strongly disagree)

19.1 I like the weekend when there is no school	1	2	3	4	5
19.2 I look forward to the first day of the school	1	2	3	4	5
19.3 I enjoy at school.	1	2	3	4	5
19.4 Learning at school is exciting.	1	2	3	4	5
19.5 Teachers give too much work at school.	1	2	3	4	5
19.6 School is boring.	1	2	3	4	5
19.7 Teachers and pupils have no fun together.	1	2	3	4	5
19.8 I am usually happy at school.	1	2	3	4	5
19.9 School makes you wise.	1	2	3	4	5
19.10 I like school because I learn.	1	2	3	4	5
19.11 I like school environment.	1	2	3	4	5
19.12 I like school because teachers are friendly.	1	2	3	4	5
19.13 I like school bs I like school environment.	1	2	3	4	5

20. How often your mathematics teacher does give you homework?

☐ Always ☐ Sometimes ☐ Never gives homework

21 How often do you do your mathematics homework? (Please tick only one box.)

☐ I donot do homework ☐ sometimes I do

☐ I always do homework ☐ Teacher does not give homework

22. How often does your math teacher correct your homework? (Please tick only one box.)

☐ Do not get any homework ☐ Corrects most of homework

☐ Never corrects homework ☐ Always corrects homework

☐ Sometimes corrects homework

23. Is it easy to follow your mathematics teacher while he teaches?

☐ Yes ☐ No

24. What kind of characteristics does your mathematics teacher holds?

		Always	Sometimes	Rarely
24.1	Asks questions to all students	☐	☐	☐
24.2	Makes classroom interesting by examples	☐	☐	☐
24.3	Encourage student to learn	☐	☐	☐
24.4	Gives homework	☐	☐	☐
24.5	Corrects homework	☐	☐	☐
24.6	Gives feedback	☐	☐	☐

25. Do you take any kinds of extra classes/tuition for mathematics?

25.1 ☐ Yes 25.2 ☐ No

26. How much time do you spent on your studying outside school (at your home)?

26.1 ☐ One hour 26.2 ☐ Two hours

26.3 ☐ Three hours 26.4 ☐ More than three hours

27. Do you support to your family for household work?

27.1 ☐ Yes 27.2 ☐ No

If you support to your family for household work, could you mention how many hours do you support?

☐ One hour ☐ Two hours

☐ Three hours ☐ More than three hours

28. Do you have experiences of per-primary education?

28.1 ☐ Yes 28.2 ☐ No

3 Questionnaires for parental involvement

29. Is there anyone who helps you in your study after school?

29.1 ☐ Yes 29.2 ☐ No

If your answer for question 29 is positive, please mention who helps on your study after school?

☐ Father ☐ Mother ☐ Others

(specify)……………………………

30. Please read each of the sentences and how do you feel about your parents support. Please ticks to show how much you agree or disagree with each sentence. (1= Strongly agree…5 = Strongly disagree)

Parental encouragement

30.1 My parents encourage me to study	1	2	3	4	5
30.2 My parents ask me about progress of study	1	2	3	4	5
30.3 My parents visit my school frequently	1	2	3	4	5

Parental Support

30.4 My parents provide me learning materials	1	2	3	4	5
30.5 My parents don't care whether I study or not	1	2	3	4	5
30.6 My parents gives me feedback on my study	1	2	3	4	5
30.7 My parents helps me to do my homework	1	2	3	4	5
30.8 My parents don't care about whatever I do	1	2	3	4	5
30.9 My parents give priority for household	1	2	3	4	5
30.10 I think, my parents support on my study	1	2	3	4	5

Parent child relationship

30.11 Parents discuss about my study at home	1	2	3	4	5
30.12 Parents express affection	1	2	3	4	5
30.13 Parents discuss about my study	1	2	3	4	5
30.14 Parents do encourage to know new things	1	2	3	4	5

Appendixes 2: Survey Questionnaires for Mathematics Teachers

Name of school……………………………………………………………

Male ☐ ☐ Female

Age ☐ ☐ Years of experiences

Permanent ☐ ☐ Temporary

1. How long are you in teaching profession?

   …………………….

2. What is the highest level of academic education you have attained? And what is your major subject that you graduated?

   ☐ Academic degree ☐ Major

3. How many years of teacher training have you received altogether? (Please tick only one box.)

   ☐ did not receive any teacher training ☐ have had training of less than 3 months.

   ☐ have had training of less than 6 months ☐ have had a total equivalent of one year

   ☐ have had a total equivalent of two year ☐ have had complete teacher training

4. After having completed your initial teacher training, how many short in-service courses have you attended during the past three years?

   ☐ Number of in-service courses

5. How many classes and hours do you teach once a week?

   ☐ Number of Classes ☐ Hours per week

6. As a mathematic subject teacher, how often do you give homework for students?

   ☐ Every day I give Homework ☐ Sometimes I give homework

   ☐ I rarely give homework ☐ I do not give homework

7. How do you evaluate the learning achievement of children?

- ☐ Test and examinations
- ☐ Oral examination of pupils
- ☐ Observation of pupil participation in class
- ☐ Classroom work for pupils
- ☐ Homework/assignments
- ☐ Project work
- ☐ Others

8. How often do you evaluate the learning achievement of children?

- ☐ Once a month
- ☐ Once a three months
- ☐ Once a six months
- ☐ At the end of session

9. Which of the following items do you have access to in your classroom? (Please tick the appropriate box for each resource.)

		Yes	No
9.1	A classroom library, book corner or book box	☐	☐
9.2	Black board/white board	☐	☐
9.3	Map	☐	☐
9.4	Wall chart	☐	☐
9.5	Chair for teacher	☐	☐
9.1	Book corner	☐	☐
9.1	Teacher's guide (Mathematics)	☐	☐

10. Do you get any kinds of feedback or support to improve your teaching and learning practices by any institutions?

☐ Yes ☐ No

If your answer is yes, could you mention, who provides you feedback or support?

……………………………………………………………………………………..

11. How often do you use the following approaches when teaching Mathematics?

		Never/rarely	Sometimes	often
11.1	Using everyday problems (verbally, written)	☐	☐	☐
11.2	Teaching the whole class as a group	☐	☐	☐
11.3	Teaching individually	☐	☐	☐
11.4	Teaching through question and answer technique	☐	☐	☐
11.5	Using everyday problems (verbally, written)	☐	☐	☐
11.6	Giving positive feedback	☐	☐	☐
11.7	Relating to everyday life situations	☐	☐	☐

12. How often do you usually meet with the parents or guardians of the pupils in your class to discuss pupil performance or related matters?

12.1 ☐ Never ☐ Once a three months

12.3 ☐ Once a year ☐ I do not have such fixed schedule

Appendixes 3: Survey Questionnaires for Head Teachers

Name of school……………………………………………………………

Sex ☐ Male ☐ Female

Age ☐ ☐ Years of experiences

Types of Job ☐ Permanent ☐ Temporary

8. Could you mention total number of children in your school?

☐ Total students ☐ Girls

2. Could you mention how many days your school was opened in last year?.

☐ School days

3. What is the highest level of academic education you have attained?

3.1 ☐ Intermediate 3.2 ☐ Bachelor degree

3.3 ☐ Master degree

4. How many years have you been heading this school as School Head and/or Acting School Head?

☐ Years/months

5. How many years of teacher training have you received altogether?

5.1 ☐ I did not receive any teacher training.

5.2 ☐ I have had short course of less than one-year duration in total.

5.3 ☐ I have had a total equivalent of one year of teacher training.

5.4 ☐ I have had a total equivalent of two years of teacher training.

5.5 ☐ I have had a total equivalent of three years of teacher training.

5.6 ☐ I have had a total equivalent of more than three years of teacher training.

6. Have you received specialized training in school management? If ‘Yes’, please indicate the

total length of the course(s).

6.1 ☐ Yes   6.2 ☐ No

If 'Yes', please indicate the total length of the course(s).

7. How many years have you been heading this school as School Head and/or Acting School Head?

☐ Years/months

8. Do you have the following institutions near by your schools? If yes, please mention how far is it.

			Yes	No	How far
8.1	☐	Health post	☐	☐	☐
8.2	☐	Book shops	☐	☐	☐
8.3	☐	Public road	☐	☐	☐
8.4	☐	Market	☐	☐	☐

9. Which of the following best describes the location of your school? (Please tick only one box.)

9.1 ☐ Isolated

9.1 ☐ Urban

9.1 ☐ In or near a small town

9.1 ☐ In or near a large town or city

10. How many teachers (according to the following categories) are there in your school?

10.1 ☐ Permanent teacher

10.2 ☐ Temporary teacher

10.3 ☐ Female teacher

11. How many times has your school been visited by an school supervisor last year in 2010?

(Please write the number in the boxes below. Please write '0' if there have been no visits.)

☐ Times

12. How many times resource persons have visited your school during last year? (Please tick only one box. If they have visited the school, please write the frequency in the

☐ Times

13. Which of the following does your school have? (Please tick appropriate box for each item.)

	Yes	No
13.1 School library	☐	☐
13.1 Teacher/staff room	☐	☐
13.1 Separate office for school head	☐	☐
13.1Sports area/Play ground	☐	☐
13.1 Piped water/Water tank	☐	☐
13.1 Electricity13.1Telephone	☐	☐
13.1 Compound wall	☐	☐
13.1 Separate toilets for girls	☐	☐

14. What is the general condition of your school buildings? (Please tick only one box.)

14.1 ☐ The school needs complete rebuilding.

14.2 ☐ Some classrooms need major repairs.

14.3 ☐ Most or all classrooms need minor repairs.

14.4 ☐ Some classrooms need minor repairs.

14.5 ☐ In good condition

Appendixes 4: Mathematics Test Items

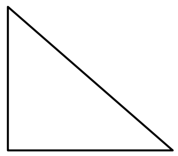
Time: 1 hour   Total Marks 50

(All questions are compulsory)   Group A (4x1 = 4)

1. Find the ratio of 25 and 55.

2. If Amount (A), Rate ® and Times (T) are given write the formula to calculate the principle (P).

3. What power of x has the value 1?



4. Find the x intercept of the line AB in the graph given.

Group B (9x2 = 18)

5. Round of 0.35674 into 2 significant figures

5. How much money should be added to an item which costs Rs. 350 is tax rate is 10%?

6. Find the median of the following data.

5,6,7,8,11,17,11,19,6

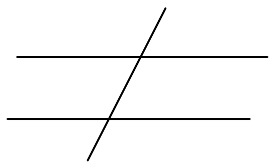
7. Simplify

$$\frac{m^2-4m}{m^2-6m}$$

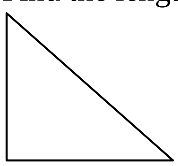
8. Simplify $3x^2+5x(x-2)-8x^2+5$

9. Find the slope of the line $3y-2x = 3$

10. Find the value of x in the figure.



11. Find the length of AC.



12. Find the circumference of the circle with radius 14cm.

Group C (7x4 = 28)

13. Simplify

$11011_2 + 10011_2 - 1111_2$

14. A shopkeeper marked the price of a radio as R. 5000. He sold it allowing a discount of 10% and made of profit rs.500. Find the cost price of the radio.

15. Find the mean from the table given below.

Marks obtained	10	20	30	40	50	60
No of students	2	3	5	4	3	3

16. (Simplify)

$$\frac{X^{a+b}}{X^{c+b}} \quad \frac{X^{c+d}}{X^{d+a}}$$

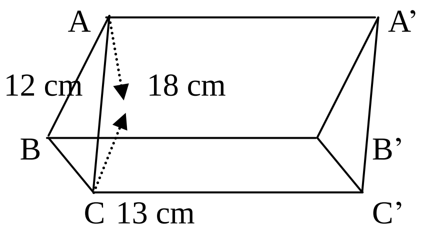
17. Find the Highest Common Factor (HCF) and Lowest Common Factor (LCM)

$8x^2$-27 and $4x^2$-12x+9

19. Construct a trapezium from the measurement given below.

AB = 7.5cm; BC = 4.9 cm; $\angle$ BAD = 60 and $\angle$ ABC = 90

20. Find the total surface area of the given triangular prism.



Appendixes 5: Marking Scheme for Mathematics Test Items

The following are the guidelines for awarding the marks.

1. Give relevant marks for a numerically correct stage or a correct result provided essential steps leading to that stage or result are clearly shown.
2. If a candidate uses a method other than those shown in the scheme, give relevant marks for correct stage of result if the method used is correct.
3. When the data of a question is misread in such a way as not to change the aim or difficulty of the question, follow through the working and give marks as indicated on the scheme. Then deduct marks as punishment for misreading. This is applicable only if the wrong value is used throughout the solution.
4. If units (where necessary) are not given, deduct 1 mark for long questions only.
5. Use of wrong methods or formula scores 0.
6. If no figure is drawn or if the figure drawn is not relevant to the question or if the figure is drawn at the end of proof. The whole question scores 0.
7. If construction is stated but not shown on the figure, the proof scores 0.
8. If a part of working is not shown, check if it can be done mentally: if the omitted working can de done mentally and answer is correct, give relevant marks.
9. If the omitted working cannot be done mentally, deduct relevant marks (i.e. marks allocated for a particular stage or result). But candidate still gets mark (s) for subsequent work.

Marking scheme

Group A

	mark
1. 5/11	1
2. P = 100 X A/100+ TR	1
3. 0	1
4. 3	1

Group B

5. 0.36	2
6. Tax = 35 x 10/100	1
= Rs. 35	1
7. Writing the data in ascending or descending order and formula	1
M = 9	1
8. m(m-4)/m(m-6)	1
m-4/m-6	1
9. $3x^2 + 5x^2 - 10x - 8x^2 + 5$	1
5 (1-2x)	1
10. 3y = 2x + 3	1
Slope = 2/3	1
11. $2x = x + 60^0$ (alternate angels)	1
$= x = 60^0$	1
12. $Ac^2 = 3^2 + 4^2$	1
= 5 cm	1
13. For writing the formula	1

Circumference of circle = 88 cm 1

Group C

14. $11011_2 + 10011_2 - 1111_2$

(i) $101110_2 - 1111_2$ 2

(ii) 11111_2 2

15. (i) SP = Rs. 5000- 10% of Rs. 5000 (1 + 1)

= Rs. 4500

(ii.) CP – SP – G (1 + 1)

= Rs. 4500- Rs 500

= Rs. 4000

16. (i) $x^{a+b} \times x^{-c-b} \times x^{c+d} \times x^{-d-a}$ 1

(ii.) $x^{a+b-c-d+c+d-d-a}$ 1

(iii) X^0 1

(iv) 1 1

17.

Marks obtain (x)	No. of student (f)	fX
10	2	20
20	3	60
30	5	150
40	4	160
50	3	150
60	3	180
	$\sum f = N = 20$	$\sum f = N = 720$

(i) $\sum f = N = 20$ 1

(ii) $\sum fX = 720$ 1

(iii) Mean = $\sum fX/N$ 1

(iv) Mean = 720/20 = 36 1

18. (i) $(2x - 3)(4x^2 + 6x + 9)$ 1

(ii) $4x^2 - 12x + 9$

$4x^2 - 6x - 6x + 9$

(iii) $(2x - 3)(2x - 3)$ 1

(iv.) HCF = $(2x-3)$ 1

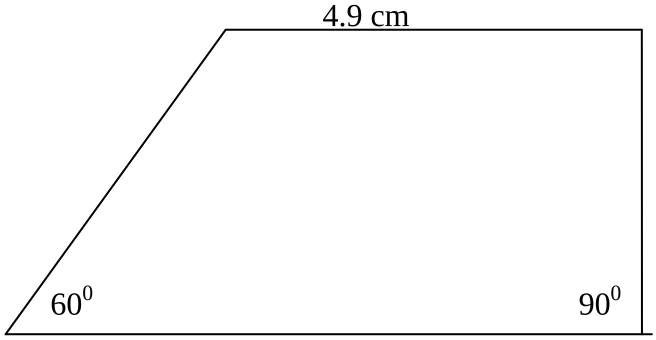
(v) LCM = $(2x - 3)^2 (4x^2 + 6x + 9)$ 1

19. (i) Draw a line AB = 7.5 cm 1

(ii) Construct angels of size 60^0 and 90^0 at A and B 1

(iii) Draw a line BC = 4.9 cm and draw CD parallel to BA 1

(iv.) Hence, trapezium ABCD is the required figure and completing the figure 1



20. (i) Area of the triangle ABC

(ii) 1/2 x 5cm x 12 cm

= $30\ cm^2$ 1

(ii) Area of total surface of the prism

= $2 \times 30cm^2 + 18\ (5cm + 13\ cm + 12\ cm)$ (1 + 1)

(iii) $60\ cm^2 + 540\ cm^2$

= $600\ cm^2$ 1

Appendixes 6: Classification of Ethnicity by Caste

1. Middle ethnicity by caste

Classification	castes
Endangered	Kusunda, Bankariya, Raute, Surel, Hayu, Raji, Kisan, Lepcha, Meche and Kusbadiya
Highly marginalized	Majhi, Siyar, Lohmi, Thudam, Dhanuk, Chepang, Satar(Santhal), Jhangad, Thami, Bote, Danuwar, Barumu
Marginalized	Sunuwar, Tharu, Tamang, Bhujel, Kumal, Rajbansi, Gangai, Dhimal, Bhote, Darai, Tajpuriya, Pahari, Topkegola, Dolpo, Free, Mugal, Larke, Lohpa, Dura and Walung
Disadvantaged	Gurung, Magar, Rai, Limbu, Chhairotan, Tangbe, Tinganule Thakali, Bargaule, Marphali Thakali, Sherpa, Yakkha, Chhantyal, Jirel, Byansi, Yolmo
Advanced	Newar and Thakali

2. Low ethnicity by caste

Hill Dalit	1. Kami, 2. Sarki, 3. Damai, 4. Lohar, 5. Sunar, 6. Gaine, 7. Badi, 8. Kuche
Newar Dalit	1. Kusule, 2. Kasai, 3. Chyame, 4. Pode
Terai Dalit	1.Tatma, 2. Paswan (Dusadh), 3. Dhobi, 4. Bantar, 5. Mushahar, 6. Khatwe, 7. Chamar, 8. Dom, 9. Santhal, 10. Satar, 11. Halkhor.

Source: Central Bureau of Statistics. Nepal Living Standard Survey 2011, Kathmandu, Nepal

Appendixes 7: Correlation Coefficient of Family Characteristics, Student Characteristics, Parental Involvement, and School Characteristics

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
1	1																											
2	-.238	1																										
3	.32	-.145	1																									
4	.421	-.227	.497	1																								
5	.088	-.108	.166	.152	1																							
6	.384	-.142	.288	.249	.179*	1																						
7	.337	-.169	.378	.414	.224	.347	1																					
8	.165	-.107	.031	.039	.098	.078	.134	1																				
9	-.297	.161	-.193	-.220	-.091	-.175	-.153	-.105	1																			
10	-.298	.073	-.255	-.266	-.055	-.194	-.242	-.035	.140	1																		
11	-.364	.102	-.220	-.187	-.102	-.211	-.162	.035	.167	.203	1																	
12	.316	-.101	.137	.127	.028	.202	.072	.029	-.136	-.148	-.128	1																
13	.201	-.089	.132	.083	.025	.126	.096	.086	-.125	-.112	-.095	.156	1															
14	.377	-.058	.206	.165	.042	.158	.182	.123	-.081	-.195	-.184	.189	.175	1														
15	-.305	.139	-.256	-.222	-.087	-.192	-.276	-.131	.184	.177	.127	-.154	-.093	-.180	1													
16	.263	-.138	.227	.200	.130	.157	.200	.057	-.097	-.129	-.114	.097	.049	.091	-.195	1												
17	.372	-.162	.172	.186	.022	.211	.153	.078	-.171	-.181	-.155	.209	.161	.292	-.145	.116	1											
18	.459	-.149	.410	.348	.134	.248	.264	.057	-.152	-.210	-.223	.233	.167	.277	-.252	.356	.243	1										
19	.460	-.219	.306	.289	.119	.300	.295	.182	-.185	-.242	-.184	.292	.207	.338	-.258	.252	.512	.435	1									
20	.170	.029	.069	.107	-.042	.051	.029	.046	-.056	-.088	-.096	.076	.040	.096	.014	-.011	.057	.083	.000	1								
21	-.509	.285	-.397	-.553	-.152	-.258	-.445	-.165	.253	.238	.155	-.144	-.065	-.163	.329	-.271	-.206	-.273	-.318	-.096	1							
22	.202	.136	.216	.286	.131	.069	.185	.041	.055	.082	.109	.047	.079	.136	.146	.146	.152	.143	.167	.097	.407	1						
23	-.112	-.129	-.077	-.034	-.071	.053	.029	-.023	-.071	.075	.056	.116	.012	-.153	.045	-.037	.029	-.046	.068	-.180	.132	.167	1					
24	.355	-.204	.199	.245	.061	.179	.220	-.007	-.088	-.050	-.101	.202	.152	.193	-.114	.122	.210	.191	.224	.042	-.288	.422	.259	1				
25	.307	-.121	.106	.179	-.059	.077	.067	.116	-.197	-.039	-.130	.221	.105	.067	-.069	-.015	.198	.085	.220	.058	-.309	.001	.109	.105	1			
26	.365	-.040	.209	.125	.095	.130	.031	.056	-.130	-.051	-.140	.182	.190	.253	-.124	.063	.166	.179	.161	.096	-.127	.207	-.181	.400	.214	1		
27	-.287	.208	-.238	-.327	-.163	-.152	-.296	.024	.129	.196	.113	-.053	-.007	-.048	.205	-.191	-.142	-.085	-.204	-.036	.679	.489	.040	-.207	-.120	.130	1	
28	.399	-.274	.200	.286	.084	.218	.198	.031	-.148	-.099	-.129	.214	.157	.132	-.203	.138	.300	.206	.346	.072	-.398	.467	.274	.498	.244	.307	-.43	1

Note: Numbers 1 to 28 indicate the variables examined in this study as explained in Table 5.3