TOWARDS EXAMINING RELATIONSHIPS BETWEEN FACTORS AFFECTING STUDENT ACHIEVEMENT AS A MEASURABLE INDICATOR OF EDUCATION QUALITY IN MONGOLIA

(NINE UNIT PROJECT WORK)

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CHAPTER 1: INTRODUCTION

1.1. Motive of the study and its actuality

The quality of school education in Mongolia is controversial. Its controversy is that Mongolia is placed at the top in terms of quantitative indicators of educational performance, namely enrolment rate, literacy rate, the percentage of female students in schooling and a number of colleges and universities per head whereas it is ranked at the end in terms of qualitative indicators such as employment rate, the degree of the satisfaction with the quality of life and a human development index. Speaking about the development index of Mongolia, it is equal to 0.916 whereby placing it at the 67th place out of 127 countries (EFA report 2007). Moreover, recent studies also indicate that there are no big differences between the poor peoples and the non-poor ones in terms of being satisfied with the quality of life. As a matter of fact, a number of people holding higher degrees in education constitute more than 10 percent of the whole poor (National Statistics Office 2002). Keeping in mind the afore-mentioned evidence, it could be sensitized out that the quality of educational services delivered by the education system in Mongolia is desperate to be advanced not only quantitatively, but also qualitatively.

Having recognized the desperate demands and needs to provide youths with educational services with higher quality, the Government of Mongolia highlighted that any progresses towards our future relied largely upon own peoples' capacities which were in turn dependent upon directly the quality of school education (Ministry of Education, Culture and Science 2007). Indeed, it prompted the Mongolian governmental institutions to take comprehensive measures for improving the quality of education whereby challenging our educationalists to set up a range of appropriate policies towards advancing the quality of educational services delivered by our institutions such as kindergartens, schools, colleges and universities. In response to the challenges and the desperate needs for advancing our awareness in the nature of the quality of education, this study is designated to

investigate factors affecting student achievement that is in turn recognized as a measurable indicator of the quality of education in Mongolia.

1.2. Research questions

The purpose of this study is to examine relationships between factors affecting mathematics achievement of Mongolian students at the fourth grade. In accordance with the research purpose, research questions are stated as follows:

1. To what extent do factors associated with student attributes affect the mathematics achievement of Mongolian student at the fourth grade?
2. To what extent do factors associated with teacher attributes affect the mathematics achievement of Mongolian students at the fourth grade?
3. To what extent do factors associated with school attributes affect the mathematics achievement of Mongolian students at the fourth grade?
4. How are these variables interrelated with each other?

1.3. Limitations of the proposed research

This study used the data of the TIMSS 2007 in which Mongolia participated in order to respond to the research questions. Thus, it has limitations dictated by using the secondary data in data analysis. Firstly, the scope of this research was delimited at the mathematics achievement of Mongolian students at the fourth grade in Mongolia. Next, the samples and populations in this study were limited to that of the TIMSS study and thus, the degree of any possible bias of any findings and results of this study should be limited to the extent of that of the TIMSS study.

1.4. Significance of research

This study bears theoretically and practically significant contributions in improving the quality of school education quality, particularly in mathematics education in Mongolia. In a theoretical sense, it proposes a model that enables us to sensitize out the major factors and indicators affecting the mathematics achievement of the fourth grade students and their interrelatedness. In a practical sense, it provides a range of evidence and ideas that can underpin a great deal of policies and measures towards improving the quality of mathematics education through advancing students achievements.

CHAPTER 2: BACKGROUND OF THE STUDY

2.1. Current Situation of Curriculum Development Policy in Mongolia

For the last two decades, Mongolia has exercised shifting from a socialist into a democratic society, facing diverse challenging issues that are often caused by the real needs and demands to replace the social relations embedded in a socialist ideology by new ones with the merits and values of democracy. Among such challenging issues, school education reform was regarded as the most desperate, however, the most complex one. Nevertheless, it has been realized into practice through polices towards restructuring the system of school education and decentralizing the centralized curriculum in Mongolia. Accordingly, the rest of this section is designated to outline such two reforms in school education in Mongolia in order to contextualize this study.

2.1.1. Structure reform: Shifting from 10 year into12 year schooling

In the beginning of the new millennium, Mongolia was one of a few countries that had still served peoples with school education lasted for ten years. Having recognized the desperate needs to extend schooling duration, the Government of Mongolia has led a reform to restructure the system of school education whereby changing school system from 10 year to 11 year to 12 year schooling (Law of primary and secondary education, 2002). In fact, the transition from 10 year to 11 year schooling was planned to be implemented within one school year or approximately 10 months whereas shifting from 11 year to 12 year schooling was planned to be implemented with the five school years (Ministry of Education, Science and Culture, 2008). As considerable reforms, both the transitions led to diverse decisions contributing towards improving the quality of school education in Mongolia.

As far as consequences triggered by the transition from 10 year 11 year schooling in Mongolia were concerned, it was most importantly noticed that the structure of school education was shifted from

(4+4+2) to (5+4+2). It was meant that in the new structure of schooling, learners were expected to be provided with five year primary education; four year junior secondary education; then two year higher secondary education whereas in the previous system, they were supposed to be provided with primary education lasted for four years; junior secondary education lasted for four years, and then higher secondary education lasted for two years. Moreover, this reform was also featured by legalizing that children should start schooling as they reach seven years old.

Followed by the shift from 10 year to 11 year schooling, another reform that brought about transiting from 11 year 12 year schooling commenced in 2008-2009 school year in Mongolia. From this reform, it was expected that the structure of school education should be shifted from (5+4+2) to (6+3+3) (Ministry of Education, Science and Culture, 2008) It was meant that learners should be provided with primary education lasted for 6 years; junior secondary education lasted 3 years and then higher secondary education lasted for 3 years. Remarkably, this school reform was characterized by legalizing that school age should be six. It was meant that children should enter schools as they reach 6 years old. The transition will continue until 2011-2012 school year.

2.1.2 .Curriculum reform: Decentralizing the centralized policy

In response to social-economic changes triggered by a shift from socialist to democratic society, Mongolian schools have witnessed a reform for decentralizing the centralized policy towards developing curriculum for the last decade. In fact, this reform has been implemented by a policy named as standard-based curriculum development in Mongolia.

An idea underpinning this policy is that education standardization is considered as not only a process to establish a tool to justify the quality of educational services and their outputs, but also it is regarded as a strategy to reach a harmony between centralization and decentralization in education. Moreover, education standards are defined as normative documents that comprise a set of norms or minimum criteria to assure the quality of educational services and their outputs at a national level. At the same

time, at a local level, schools are committed to develop school curricula so that they can meet standard requirements (Ministry of Education, Science and Culture, 2002).

As a result of pursuing the standard-based curriculum development policy, accountabilities for delivering educational services to the peoples in Mongolia should be shared with subjects engaged in schooling. Specifically speaking, governmental institutions at the national level are more responsible for educational measurement, assessment, monitoring and evaluation at the national level whereas at the local level, schools are more accountable for educational technological and methodological matters such as developing school curricula for each subject and developing teaching and learning strategies.

2.2. Review of Literature

Literature review aims to answer the following questions that were designated to elicit existing findings in the nature of student achievement and its associations with other measureable variables such as teaching quality as professionality of school teaching staff, school context and school background:

- Is student achievement regarded as a measurable indicator of education?
- What are measureable attributes if teacher and teaching quality?
- What are measurable constituents of school context?
- What are measurable constituents of student background?

2.1. Is student achievement as a measurable indicator of education quality?

Education quality has been recognized as a complex construct that bears multiple attributes associated with delivering services by education system. In contrast, there has been no consensus on determining ways and indicators whereby measuring it albeit different definitions and models proposed. Nevertheless, much of literature suggests explicitly and implicitly that student achievement serves as a measurable indicator to measure the quality of education in terms of educational policy.

Education quality is literally defined as excellence (Peter & Waterman, cited in Chen &Tam 1997), value (Feigenbaum, cited in Chen &Tam 1997); fitness for use (Juran & Gryna, cited in Chen &Tam 1997); conformance to specifications (Gilmore, cited in Chen &Tam 1997); conformance to requirement (Crosb, cited in Chen &Tam 1997); defect avoidance (Crosby, cited in Chen &Tam 1997); meeting and/or exceeding consumers expectations (Parasuranman et al., cited in Chen &Tam 1997); Analysing the following definitions of education quality, Chen &Tam (1997) defined as education quality as follow:

> *"Education quality is a character of the set of elements in the input, process and output of the education system that provides services that completely satisfy both internal and external strategic constituencies by meeting their explicit and implicit expectations"(Cheng&Tam 1997, p.2)*

In the light of this definition, student achievement is likely to be seen as a measureable character of output element rather than input and process in education system whereby delivering educational services. It is also considered as an indicator whereby measuring the achievement of the stated goals and conformance to given specifications according to the goal and specification model that explains education quality as achievement of stated goal and conformance to given specifications. Moreover, in the light of satisfaction model that determines education quality as the performance of educational

institution that can satisfy the needs and expectations of its power constituencies, for instance, in school settings, power constituencies include teachers, school boards and parents, it is again recognized as a measurable indicator whereby measuring the satisfaction of major constituents, namely student and parent, in education services delivered by education system. Hence, it is mostly likely to be sensitized out that student achievement has been theoretically recognized as a measurable indicator to measure education quality.

In a practice, student achievement has been plausibly used as a main component in assessment, examination, and evaluation in education whereby measuring educational quality by and large. Mortimore and Stone (1991) emphasized that public examination whereby measuring student academic achievement, has been used as one of four major approaches to measure educational quality for past 150 years in Britain. Likewise, most countries has witnessed by examining educational quality through measuring student achievement by public examinations. For instance, In Mongolia, state examination has served as a tool to evaluate education system through student achievement as a measurable outcome for over the past 50 years (Ministry of Education, Mongolia, 2003). Moreover, international studies such as PISA and TIMSS have paid strong attention on measuring student achievement and exploring its impacts on improving education quality. Hence, it is evidenced that student achievement is more likely to be used as an indicator to measure educational quality in a practical sense.

In brief, it is summed up that student achievement has been recognized as a sole measurable indicator that is likely to be theoretically recognized and practically used to measure education quality according to relevant literature. As a matter of fact, student achievement is likely to be considered as an output or outcome rather than input, and process in education system whereby delivering educational services. Moreover, it is also highly likely to be recognized as an indicator whereby

measuring the achievement of the stated goals and conformance to given specifications whereas it might be identified as an indicator to measure the satisfaction of major constituent, namely, students and parents with educational services.

2.2. Is teacher professionality as a measurable attributes of teacher and teaching quality?

Teacher quality measurement is inevitable in an administrative sense; however, it is complicated because it bears in itself complex phenomenological and constructive attributes that are in turn dependent upon subjectivity, conceptuality and contextualization. As a matter of fact, student achievement has been recognized as a measurable measure to measure teacher quality. Nevertheless, the student outcome-oriented measurement of teacher quality is not quite consistent with teacher quality because it does not function well to discriminate reliably between teachers and also measure teachers' performance valuably whereas standard based measurement of teacher quality tends to function well to measure only *professional qualities of teacher* rather than one's personal qualities. Thus, teacher professionality in teaching might be revealed as a measurable attribute to teacher and teaching quality.

Referring to recent and relevant literature, it is known that there are two main rationales in teacher quality measurement: One is that student outcome is a measure to measure teacher quality while the second is that teacher quality as a whole is professional and therefore, it is measured by professional standards.

A rationale behind student outcome-oriented measurement of teacher quality is that teacher quality is not isolated from student achievement (Darlin-Hammond 2000, cited in Neck 2007);

> Quality of the school's teaching staff as an organizational property that varies across schools is related to observable differences in students' achievement and growth (i.e., measures of schools effectives) (Neck 2007, p.22)

And, therefore, student achievement is an only measurable measure to measure teacher quality. Accordingly, testing and its results tend to be tools to measure teacher quality. However, this conceptualization of measuring teacher quality has been criticized that it often leads to use students' scores on nationally standardized tests and examinations to assess the performance of teachers. Besides, it is questioned that student score-based assessments function to differentiate between students, not teachers with regard to their primary purposes (Ingvarson & Rowe 2007).

The concept governing the standard-based measurement of teacher quality is underlined by following ideas:

> Quality is subjective and slippery construct which will be differently defined by groups and constituents, perhaps, the only common assumption is that some kind of quality is desirable (Meg 1991, p11)

> Quality is synonymous with meeting professional standards through a system of supervision, inspection and control. In practical and more specific sense, being professional is certain quality traits whereas in pure descriptive sense, the quality equates to the mental and moral characteristic associated with being a teacher. … when the word (quality) is related to a degree of excellence or attributes that are regarded as something vitally important, it bears normative meaning. Thus, as he proposed, quality in teaching as a whole is about values that are intrinsically associated with the professional (Carr 1989, cited in Warrior 2002).

With reference to the Quality Assurance Agency (2001), teaching quality characterizes two dimensions:

> The first is the appropriateness of a set of standards by an institution and effectiveness of teaching and the second is the effectiveness of teaching and learning support in providing opportunities for students to achieve those standards (QAA, 2001, cited in Warrior 2002)

Referring Wise & Leibbrand (2000), it is also known that there are two different views on improving teacher quality. One is that teachers are well specialized in both what they teach and how they teach whereas second is that teachers need only subject matter knowledge so that they teach well.

As a public service, teaching is essentially regarded as a profession that, is, in turn, referred as an occupation with an important social function which requires a high degree of skill and drawing on a systematic body of knowledge (Sockett, 1985, cited in Warrior 2002). Thus, as a public service with a particular social function, teaching must be identified as a professional service (Apple, W, Michael 2001) that must be performed by professionals with demanded professional knowledge and skills and, therefore, its performance ought to be governed or guided by standards reflecting societal and individual demands and needs in association with free market and 'cost effectiveness' principle in public sector. It is a rationale that leads to standardize teaching and thus, measure its quality by the established standards. As discussed in the previous part, standard-based measurement of teacher quality is a prevailing approach that has been tested in many countries' educational practices involving the United States of America, Japan and Mongolia. At the same time, this approach has, however, faced with diverse criticism (Apple 2001, Davis 1999) that often raises a question of how consistent it is with the nature of teacher quality in terms of measurement. Accordingly, in this part, it will be argued that teaching standards tend to dismiss the immeasurable attributes of teacher qualities such as loving children, being empathetic, having a sense of humor and being ethical that, indeed, affect it tremendously.

Loving children, empathy, having a sense of humor and being kind-hearted, calm, are identified as personal qualities of a teacher that contribute considerably to teacher quality (Hopkin & Stren 1996; Arnons & Reichel 2007; OECD report of Quality in Teaching 1994, cited in Fredriksson 2004). As a matter of fact, it is almost agreeable that the degree of loving children, being empathic, having a sense of humor and being calm varies from a teacher to a teacher. Consequently, their effects on teacher

qualities are heterogeneous from a case to a case. At the end, it can be inferentially noted that teacher quality varies from teacher to teacher, and thus, it ought to be measured differently from a case to a case. In other words, it can be seen that the nature of teacher quality is heterogeneous rather than homogenous in terms of measuring the influences of personal qualities of teachers on it.

Another challenge to teaching standards is that teacher quality is contextual (Hopkins & Stern 1996; Meg 1991) and, thus, its measurement ought to be sensitive to contextual differences. The authors can advocate that school conditions essentially affect teacher quality. In fact, it is almost agreed upon that school conditions vary from a location to a location and from a staff to a staff. As a consequence, it can be implicitly proposed that teacher quality ought to be measured differently from school to school because of the diversity of school conditions' effects on it. Hence, it can be contended that the heterogeneousness of the nature of teacher quality is again observed in dealing with the effects of school conditions on it.

Teaching standards can judge teacher quality in the extent to which teachers' measurable attributes, namely, *professional qualities* such as or homogeneous parts, in fact, not heterogeneous ones, are taken into account. As a matter of fact, they dismiss the effects of the immeasurable attributes of teacher quality, namely, the personal qualities or attributes of teachers such as loving children, empathy, having a sense of humor and being kind-hearted and school conditions on it as well.

As a whole, it is referentially revealed by and large that the professional qualities of teacher, that is to say, teacher professionality in teaching that might be simply observed by his or her professional licence, certification, have been recognized as a measurable factor to measure teacher and teaching quality.

2.3. What constitutes student background? How is it often measured?

Much of literature suggests that student background is an underlying input element of education system whereby affecting considerably education quality. In fact, it can be also proposed as an important indicator of education quality according to resource-input model (Chen&Tam 1997, p3). Moreover, it can be recognized as a net of independent variables that are mainly associated with student's family socio-economic status and often measured by parental involvement (Ho Sui-Chu & Willms 1996), family structure (Pong 1997), parent income, parents education, home work (IEA, 2009).

2.4. What constitute school context? How is it often measured?

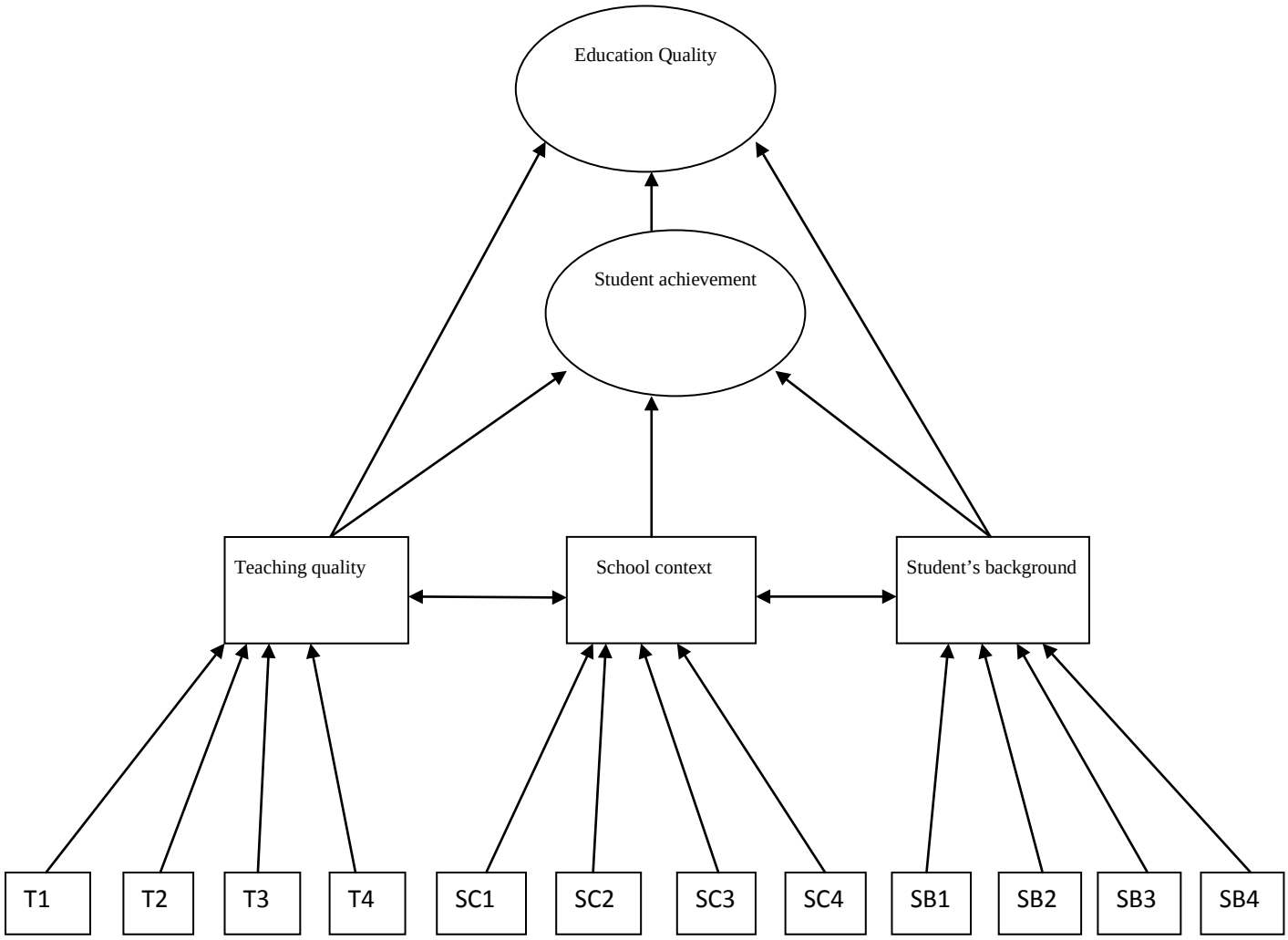
Literature suggests that school context has been recognized as both an input and process element of education system whereby affecting in education quality tremendously. In fact, it often refers to educational environment and internal processes of educational institutions according to the organizational learning model (Chen&Tam 1997, p5). In addition, it can be recognized as a net of independent variables that are mostly related to school environment such as school facilities and equipment, school staffing and often measured by such sub-independent variables such as school location, school size, staff-student ratio, student composition, class size, principle stability and library, teacher interaction, teacher working space.

2.5. Conceptual framework and statements of research hypothesis

As the most previous literature suggests, student achievement is recognized as a measurable indicator to measure education quality. At the same time, it has been recognized an observable measure to measure teacher quality that is in turn prevailingly judged or measured by teaching standards (Darlin-Hammond 2000; QAA, 2001, cited in Warrior 2002). On the other hand, there are three factors

affecting student achievement: teacher (*teaching)* quality as *a process factor*, school context as a process factor and student's background *as an input factor* (my italics) (Heck 2007). Moreover, at school level, these factors can be considered as variables since their values vary from school to schools. Taken those facts together, it can be seen that student achievement as an output is to some extent dependent upon the rest of three factors or variables that are in turn measurable to some extent.

Teaching quality in school as professionality of school staff is defined as a mean percentage of school staff qualified and licensed and certified by authority bodies. Since the percentage of the qualified, licensed and certified staff varies from school to school, it can be identified as a variable. As most relevant literature suggest, students' background variable includes gender, family involvement, social-economic factors related to students' background whereas 'school context' variable involves school size, student composition, free and reduce lunch, principle stability, school location and environment, library and other services (Figure1)



T1- Professionality of school staff

T2- Teacher interaction

T3- Teacher experience

T4-Teacher personality

T5- Teacher room

SC1- School size

SC2- Student composition

SC3- Principle stability

SC4- Environment (Library)

SC5- School location

SB1- Family involvement

SB2- Family social status (class)

SB3- Family economic status (income)

SB4-Gender

Figure 1: Student achievement -based model of education quality measurement

CHAPTER 3: DATA AND METHODS

3.1. Data

In order to deal with the research questions, this study used the secondary data collected under an international study known as Trends in International Mathematics and Science Study (TIMSS) in 2007 in which Mongolia participated at the first time. The data of the TIMSS 2007 was collected with three questionnaires from three populations, namely students, teachers and school principles (IEA, 2009).

The questionnaire for the fourth grade students bearing 17 items were responded by 4365 students at the fourth grade participated in TIMSS 2007 study from Mongolia while the teacher questionnaire composed of 36 items and mathematics curriculum questionnaire containing 22 items were responded by 3959 subjects involving teachers and principles. The items in the aforementioned three questionnaires in the study were mostly scaled by the Likert scale albeit a few of them scaled dichotomously.

3.2. Methods of Data Analysis

In accordance with research purpose to examine relationships between factors affecting mathematics achievement of Mongolian students at the fourth grade, this study employed mainly the following two statistical methodologies: factor analysis and a structural equation modeling. The factor analysis was carried out by SPPS 11.5 whereas the structural equation modeling was performed AMOS 4.0.

Factor analysis

Factor analysis is a statistical methodology that can be employed to identify relationships among a number of inter-related variables and items so that underpinning constructs and dimensions can be ascertained (Norusis, 1994 in Darmawan 2003); to reduce the number of variables so that items are

represented by a small number of hypothetical variables (Hair, Anderson, Tatham, Black 1995 in Darmawan 2003); and to allow the examination of the underlying structure of the overall measure (Kerlinger 1986 in Darmawan 2003). In the factor analysis, each factor is expressed as a linear combination of observed items and thus, mathematically speaking, it is represented a system of linear combination. As Darmawan (2003) once summarized, it is usually performed by the following four steps: (1) computing a correlation matrix for all items, (2) extracting some factors poorly related to others; (3) rotating the factor matrix so that factor loadings are redistributed to make factors more interpretably and (4) computing factor scores for each case on each factor. Remarkably, all necessary estimates needed to pursue these steps were already programmed. A statistical package for the social sciences (SPSS) should be named as one of well-known software for doing factor analysis.. In this study, SPSS 11.5 was employed to carry out the factor analysis needed to respond the research questions.

Structural equation modeling

Structural equation modeling (SEM) is another statistical methodology that is often employed to test or confirm a hypothesized model of a structural theory of some phenomenon whereby representing causal processes which in turn produces observations on multiple variables (Bentler, 1988 in Byrne 2001). As a term, *structural equation modeling*, suggests, this methodology bears two major aspects of procedures: (1) representing causal processes under study by a series of structural or regression equations; (2) modeling pictorially these structural relations to enable a clear conceptualization of the structural theory under the study. Then, the hypothesized model can be tested statistically in an analysis of entire system of variables to determine the degree to which it is consistent with data. If goodness of fit is adequate, the model is proposed to explain the postulated relations among the variables, if it is not adequate, it is rejected (Byrne, 2001).

SEM is featured by examining a series of dependence relationships in a set of dependent and independent variables wherein one dependent variable can play a role as an independent variable in subsequent dependent relationships (Hair et al., in Darmawan 2003). Moreover, it is also characterized by two basic components: (1) the structural model and (2) the measurement model. The first is often known as a path model whereby dependent variables are related to independent ones whereas the second one enables researchers use a several variables (indicators) for single independent or dependent variable.

A path diagram resulted from the path modeling can be drawn by a several statistical techniques such as LISREL and AMOS. This study prefers to use AMOS 4.0 (Analysis of Moment Structure) to draw a path diagram whereby displaying the relationships among observed and unobserved (latent) variables. In the diagram drawn by AMOS, it could be often seen that the observed variables are represented by boxes whereas latent ones are drawn by circles or ellipses. Moreover, causal relationships are represented by single headed arrows, however, covariance are pictured as double headed arrows.

CHAPTER 4: RESULTS AND DISCUSSIONS

This chapter is composed of three parts, each of which contains the results of the analysis of the data in TIMSS 2007 Mongolia with SPSS and AMOS 4.0 in order to respond to research questions and justify the conceptual framework. The first part provides the demographic and descriptive information of factors of interest whereas the second one presents the results of t-test and F-statistics about the group differences on interest factors. The last part brings in the factor loadings of interest variables, indicators of constructs and a path model of factors affecting student achievement.

4.1. Demographic and Descriptive Information of Factors of Interest

This section aims to provide demographic and descriptive information about particular variables of interest in accordance with student, school and teacher questionnaires in the TIMSS 2007. Accordingly, it comprises three parts. The first part is designated to present the demographic and descriptive information about student factors whereas the rest of two parts is to bring in that of school and teacher factors.

4.1.1. Demographic and Descriptive Information about Student Factors

Out of 4365 fourth grade students participated in TIMSS 2007 study from Mongolia, 2227 (51%) were male while 2138 (49%) were female in accordance with Figure 1.

All students participated in TIMSS 2007 study were subjected to a questionnaire composed of 16 items, each of which was constructed to contribute in eliciting factors associated with students' background, learning style and attitude that were in turn assumed to have impacts on student achievements. According to the data collected by the student questionnaire, the following descriptive information could be figured out.

As far as the variable so called as *a number of books in home* owned by students was concerned, it was revealed that the majority of student (42%) has access to only less than 10 books whereas only three percent of students participated in TIMSS study were provided with more than three book cases with over 200 books. Besides, students with one shelf containing from 11 to 25 books represented 34 percent; students with two bookcases with from 26 to 100 books, 17 percents; students with two cases containing from 101 to 200 books, 4 percents in reference with Figure 2.

Figure 1: Student gender ratio

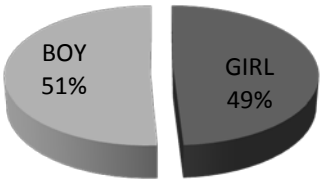
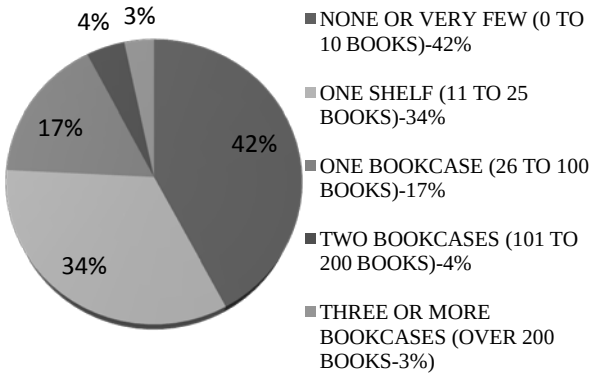


Figure 2: Book distribution in student home



With regard to variables, *students' calculator and computer possession in home*, it was figured out that more than two third of the students (70%) possessed a calculator in home; however, approximately, one third of them (30%) did not own any calculators (Figure3)

Figure 3: Student ratio of calculator possession in home

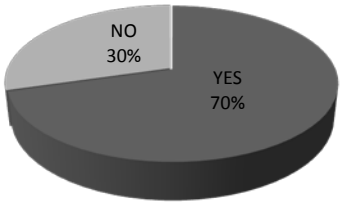
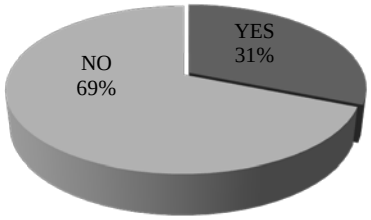


Figure 4: Student ratio of computer possesion in home



Speaking about students' possession of a study desk and a dictionary and an internet connection in home, it was ascertained that the majority of students possessed a study desk (70%) and a dictionary (63%) (Figure4).

However, 26 percents of students had no study desks and 37 percents of them had no dictionaries in home (Figure 5&Figure6). Almost, one fourth of students have no internet connections in home (Figure7).

Figure 5: Student ratio of desk possession in home

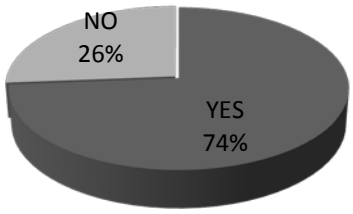


Figure6: Student ratio of dictionary possession in home

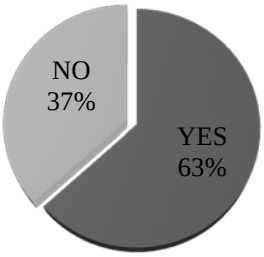
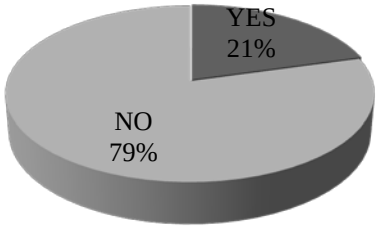


Figure 7: Student ratio of internet connection in home



The student questionnaire in TIMSS 2007 has some items designed to collect the data from respondents that were to measure student self-confidence about learning mathematics, student learning style and student extra-curricular activity. According to the student questionnaire design, it could be seen that the data, presumably, required to measure a construct, student -self confidence, was designed to be collected by a table with 6 rows and 4 columns that displayed six items or measurable variables along with its four alternative responses coded with the first four natural numbers as such: *agree \ a lot (1), agree a little (2), disagree a little (3) and disagree a lot (4)*. Likewise, the data collected for measuring a construct, named as student learning style were collected by a table with 6 rows and 4 columns that presented six items or measurable variables along with its four alternative responses coded with first four natural numbers as such: *every or almost every lessons (1), about half the lessons(2), some lessons(3), never(4*); however, that of a construct called as a student extra-

curricular was collected by a table with 8 rows and 5 columns which showed eight items or measurable variables along with five alternative responses coded with first five natural numbers: *no time (1), less than 1 hour (2), 1 to 2 hours, more than 2 (3), but less than 4 hours (4), 4 or more hours(5*).

Referring to the frequency distribution of variables of student-self confidence (student attitude) shown in Table1, having asked whether you usually do well in mathematics, 91 percents of respondents (48% agree a lot, 43% agree a little) did agree it whereas only 9 percents (6% disagree a little, 3% disagree a lot) disagreed that. Besides, 94 percents of respondents (79% agree a lot, 15% agree a little bit) liked to do more mathematics while only 8 percents disliked doing so. As for an item enquiring how students feel how hard mathematics was, the half of the respondents agreed that mathematics was hard for them (20% agreed a lot, 30 % agreed a little bit) whereas the rest half of them (13% disagreed a little bit, 37% disagreed a lot) disagreed that. Interestingly, 83 percents of the respondents agreed a lot that they enjoyed learning mathematics while 54 percents of them (16% disagree a lot, 39% disagree a lot) disagreed that they were not good at mathematics. Moreover, 89 percent of them (53 % agreed a lot, 36 agreed a little) agreed that they did learn things quickly in mathematics. In brief, it could be statistically described that the most of the fourth grade student participated in the study, might bear much positive attitudes toward learning mathematics rather negative ones.

Table 1: Frequency of Variables of Student

Self-Confident about Learning Mathematics by Percents

Items and codes	Measurement scale			
	1	2	3	4
	Agree a lot	Agree a little	Disagree a little	Disagree a lot
Usually do well in math (as4mawel)	48	43	6	3
Like to do more mathematics (as4mamor)	79	15	4	2
Is math harder for me (as4maclm)?	20	30	13	37
Enjoying learning mathematics (as4maenj)	83	11	3	3
Are you just not good at mathematics (as4manot)?	16	29	16	39
Do you learn things quickly in mathematics (as4maqky)?	53	36	8	3

Apart from estimating the frequency distribution of the item responses, it could be remarked that in the measurement of this construct, the responses with higher agreements were coded with numbers with lower values. Therefore, it is bound to be recoded so that the item responses with higher agreements have to be recoded with the numbers with higher values in building a path model.

As far as the frequency distribution of the variables of student learning style was concerned, it could be seen that the majority of students at the fourth grades who participated in TIMSS 2007 from Mongolia memorized the procedures to work with mathematics problems. 58 percents of the students used memorization techniques for working with mathematics problems in almost every lesson. Followed by it, 24 percents of them did it in about the half of their lessons; 12 percents in some lessons and only 6 percents of the students had never used memorization techniques to work with any problems in mathematics.

With regard to how often you explained your answers, 41 percents of the respondents explained own answers in almost every lesson, moreover 30 percents in about half of their lessons, 19 percents in some lessons. However, 10 percents of the students at the fourth grade had never explained own answers.

Speaking about working in groups in learning mathematics, the majority of the participants (51%) responded that they worked in groups in almost every lesson while 11 percents of them never took part in group working in mathematics learning. The rest of them (49%) took part in group learning in mathematics classroom to some extent.

Having asked whether how often they work with problems in mathematics learning, the majority of the respondents (65%) did agree that they did it in almost every lesson. Moreover, one third of them responded that they worked problems in mathematics learning to some extent. Only 5 percents answered that they never worked any problems in mathematics classroom.

In response to a question how often you used calculators and computers in mathematics lessons, the majority of the respondents (80% as for calculators, 68% as for computers) had never used calculators and computers in learning mathematics anymore while approximately, one fifth of them used any calculators and one third did computers in mathematics classrooms to some extent.

Table2: Frequency of Variables of Student

Learning Style by Percents

Items and codes	Measurement scale			
	1	2	3	4
	Every or almost every	About half the lessons	Some lesson	Never
How often do you memorize how to work with problems (as4mhmwp)?	58	24	12	6
How often do you explain your answers (as4mhexp)?	41	30	19	10
How often do you work in groups (as4mhwsg)?	51	21	17	11
How often do you work problems (as4mhwpo)?	65	21	9	5
How often do you use calculators (as4mhcal)?	8	7	5	80
How often do you use computers (as4mhcom)?	13	11	8	68

Apart from estimating the frequency distribution of the item responses, it could be remarkably noted that in the measurement of the construct above, the responses with higher agreements were coded with numbers with lower values. However, it was recoded that the numbers with higher values could express the more degree of agreements in creating a path model.

As far as student extra-curricular activities were concerned, it could be descriptively said that one third of the students at the fourth grade had no time to spend for watching or video; 57 percents for playing games; 58 percents for using internet; 14 to 22 percents for the rest of extra-curricular activities listed in the table below. Interestingly, 14 percents of the fourth grade students who took part in TIMSS study 2007 had not time for doing home. At the same time, the same proportions of the students spent four or more hours for doing jobs at their homes. Approximately, 16.6 percents of the students spent 4 or more hours for doing home work while 16.1 percents of them had no time for reading books for enjoyments. Moreover, one out of two participants spent less than 1 hour for talking with friends.

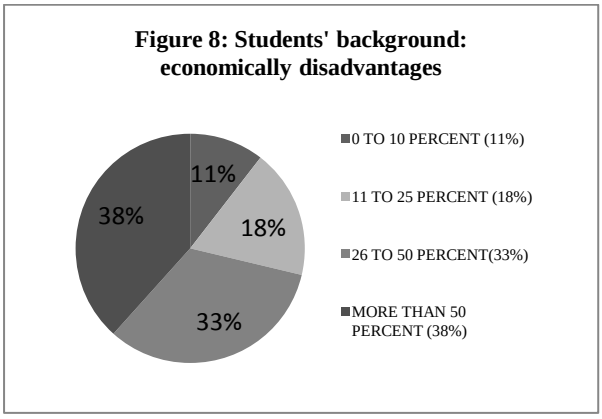
Table 3: Frequency of Variables of Student Extra-Curricular Activity by Percents

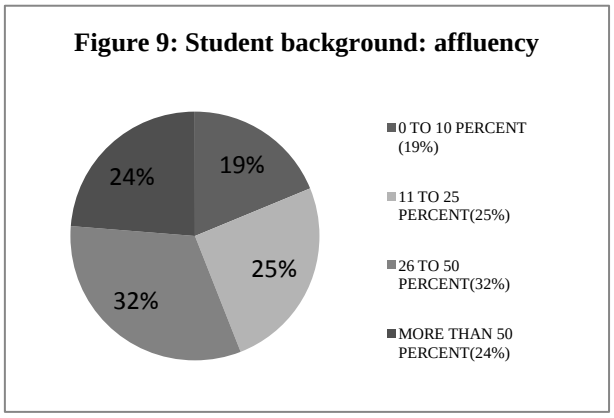
Items and codes	Measurement scale				
	1	2	3	4	5
	No time	Less than 1hour	1 to 2 hours	More than 2, but less than 4	4 or more hours
Watching TV or Video (as4gwatv)	32.6	44.4	12.4	4.7	5.8
Playing computer games (as4gplcg)	55.7	28.0	7.5	3.0	5.7
Talking with friend (as4gplfd)	20.5	49.5	18.2	5.9	5.9
Playing sports (as4gplsp)	22.5	38.3	20.3	9.3	9.4
Doing jobs at home (as4gjohm)	16.2	29.8	27.2	12.6	14.2
Reading book for enjoyment (as4grebo)	16.1	37.6	23.6	11.2	11.6
Using internet (as4gusin)	58.1	23.3	7.9	4.2	6.5
Doing homework (as4gdohw)	14.2	26.1	28.8	14.2	16.6

4.1.2. Demographic and Descriptive Information about School Factors

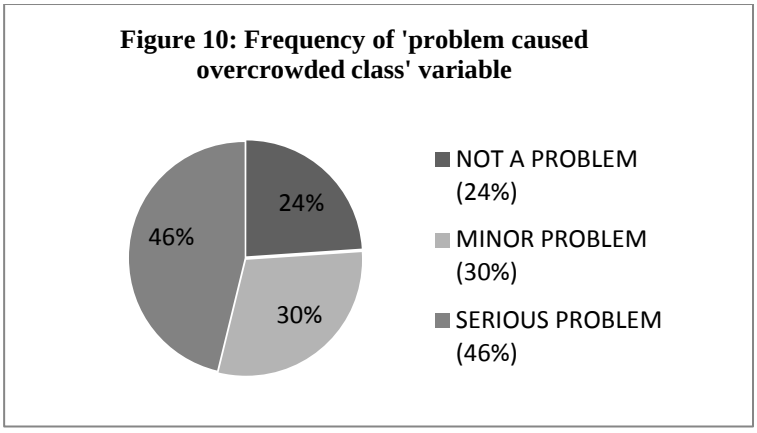
With reference in the school questionnaire asking the responents how percentages of students belong to economically-disadvanaged families, it could be ascertained that 38 percents of the participans responded that more than the half of students belonged to the family with economic disadvantages (Figure 8) whereas 24 percents of them believed that the half of students belonged to affluent families. Approximately, one third of

the respondents considered that less than 26 and more 50 percents of students belonged to both affluent and economical- disadvantaged-families (Figure 9).





As far as problems triggered by overcrowed class in the school questionnaire was concerned, it was descriptively revealed that 46 percents of respondents believed it resulted serous problems and 30 percents of them considered that it triggred minor problems. However, 24 percents of the respondents believed that it did not bring in any problems in schools (Figure 10)



In order to to measure a school shortage construct, school questionnaire contained 11 items each of which was designed to collect data by the following response format: *none, a little, some, a lot.* As displayed in the following bar graph, the range of percents of the respondents favoring that schools had no shortages in all domains of variables of interests was 25.8. Likewise, that was 19 for the respondents preferring that they had a little bit of shortage; 22 for the respondents preferring that they had some shortage and 35.3 for the respondents believing that they had a lot of shortages. As can be seen in the bar graph, there was appearently

some more considerable shortage in instructional materials, budget supply, lighting and heating, computer hardware and library materials that were in fact favored by less than 30 percents of the respondents.

Table 4: Frequency of School Shortage (Resource) Variables by Percents

Items and their codes in data	Measurement scales			
	1	2	3	4
	none	a little	some	a lot
Shortage of intsrucitonal material (ac4gst01)	9.2	28.4	39.9	8.7
Shortage of budget supply (ac4gst02)	19	29	35	17
Building shortage(ac4gst03)	33	22	24	21
Shortage in heating and lighting (ac4gst04)	31	28	30	31
Instructional space shortage (ac4gst05)	15	27	26	15
Shortage in equipment for handicapped (ac4gst06)	31	10	23	36
Computer hardware shortage (ac4mst07)	16	14	31	39
Computer software shortage (ac4mst08)	17	20	21	42
Shortage in library materials(ac4mst09)	13	27	45	15
Shortage in visual resources(ac4mst10)	14	16	26	44

Parental involvement regarded as a factor of interest in terms of having considerable effects on student achievement was intended to be measured by the following four dichotomous variables in the TIMSS 2007: attendance to special events, participation in fund raising activities, volunteering and serving school committee and ensuring homework. As seen in the table below, more than the half of respondents was engaged in the interested school activities to encourage to parental involvement. In fact, 89 percents of the respondents answered that they attended special events and 85 percents of them ensured student homework. In contrast, 36 percents of the participants replied that they did not take part in volunteering and serving school committees.

Table5: Frequency of Parental Involvement

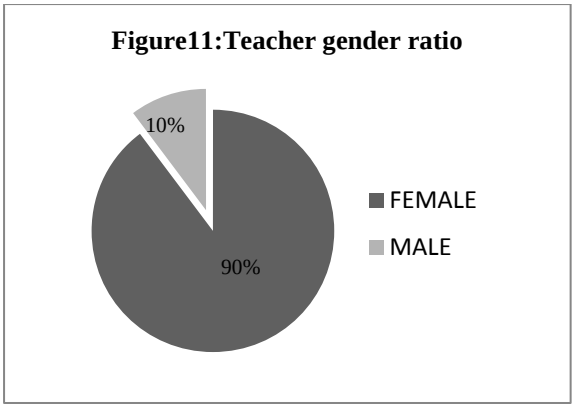
Variables by Percents

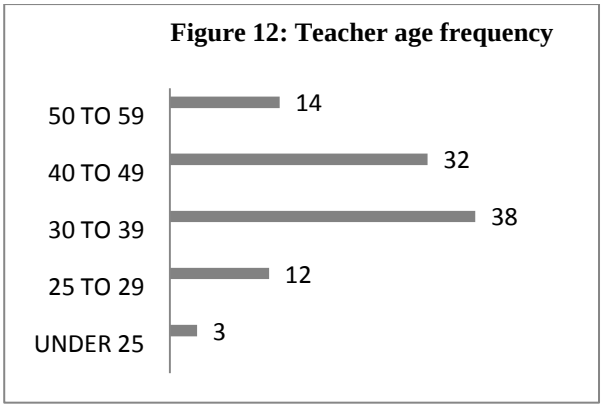
Items and codes	Measurement scale (dichotomous)	
	Yes	No
Attending special events (ac4gapse)	89	11
Participating fund raising	57	43
Volunteering (ac4gapvo)	64	36
Serving committee(ac4gapsc)	64	36
Ensuring homework(ac4gapch)	85	15

4.1.3. Demographic and Descriptive Information about Teacher Factor

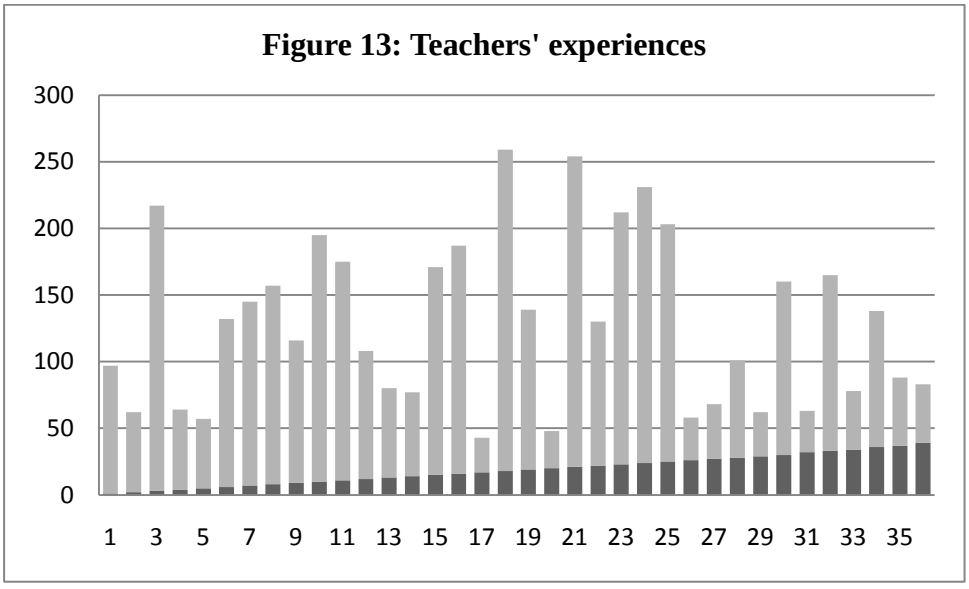
Out of 3959 teachers participated in TIMSS 2007 from Mongolia, 3553 (90%) were female and 406 (10%) male. Stated differently, nine out of ten teachers participated in this study was female according to Figure 11.

As far as teacher age was concerned, it could be seen that teachers with middle ages from 30 to 49 a number of teachers made up 70 percents of the respondents (38% as for teachers with ages from 30 to 39, 32% as for teachers with ages from 40 to 49) whereas the rest of teachers belonging to other three age intervals made up together 30 percents (3% as for under 25, 12% as for 25 to 29, 14% as for 50 to 59) (Figure 12)





With regard to teachers' experiences in teaching, a number of years that teachers participated in the TIMSS study had spent fluctuated from 1 to 39. Among these years, 18-year duration is revealed as a prevailing period for which the largest percents of the participants (6.1 percents) had spent in teaching. Interestingly, a number of teachers who had spent 1 year in teaching made up 2.4 percents (96 persons) whereas that of teachers who had worked 39 years constituted 1.1 percents (44 persons). The frequency of years which teachers participated in the TIMSS 2007 from Mongolia had experienced in teaching was displayed below (Figure 13)



As far as teachers' education level and job satisfaction were concerned, it could be seen that the majority of the teachers finished the first degree in teaching whereas the rest of teachers were holding other degrees associated with teaching to some extent (Figure14).

Almost one third of teachers subjected to the TIMSS study responded that they had higher satisfaction with their jobs and 42 percents with medium satisfaction; 11 percents with very high; 9 percents with low; 5 percents with low satisfaction (Figure15)

Figure 14: Frequency of Teacher Education Level

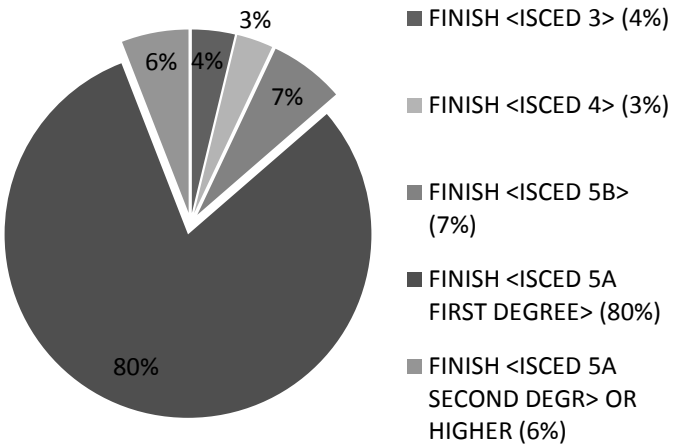
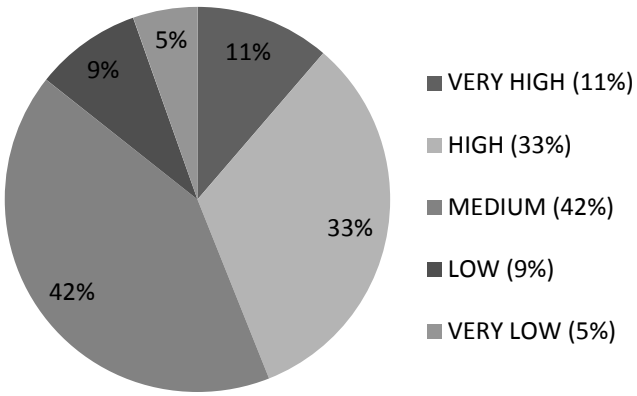


Figure 15: Frequency of teacher job satisfaction



A teacher questionnaire in TIMSS 2007 was designed to contain some items designed to collect data from respondents that were to measure teacher preparation, teacher interaction and teacher participation. Having

explored the teacher questionnaire design, it could be figured out that teacher preparation as a construct was presumably measured by a several measurable variables with the values assigned by respondents based on their preferences or ratings of four alternative responses coded as such: *not applicable (1), very well prepared (2), somewhat prepared (3), and not well prepared (4).* Likewise, a construct, teacher interaction was going to be measured by four measurable variables with values in four alternative responses coded as such: *never or almost never (1); 2 or 3 times per month (2), at least weekly (3), daily or almost daily (4).* However, teacher participation construct was intended to be measured by five dichotomous variables.

As far as the degree of teacher preparation was concerned, it could be pointed out that more than 90 percent of respondents believed that they were to some extent prepared (very well -38% or more; somewhat -47.2% or more) for teaching underlying topics of the major content domains of mathematics curriculum such as number representation number relationships and geometrical relationship and data reading. At the same time, less than 10 percents of teachers subjected to the study favored that they were not well and applicably prepared for teaching mathematics.

Table 6: Frequency of Teacher Preparation Variables by Percent

Items and their codes	Measurement scale			
	1	2	3	4
	NOT APPLICA	VERY WELL	SOMEW HAT	NOT WELL PREPAR
Number Representation (at4mtto4)-	1.0	51.9	45.5	1.6
Number Relationship (at4mtt10)-Algebra	1.8	47.6	47.2	3.4
Geometrical Relationship (at4mtt13)-	2.8	38.4	55.7	3.1
Data reading (at4mtt18)-Probability	4.3	40.2	53.0	2.5

As far as the coding of the item responses is concerned, it can be ascertained that this coding was carried out so that the large value of code numbers indicated the less degree of teacher preparedness. Therefore, it was recoded so that the large values of the code indicated the higher degree of teacher preparation in order to build a path model in the last part.

Speaking about the frequency of variables of teacher interaction, almost more than one third and less than the half respondents had been engaged in teachers' interactive activities, namely visiting other classrooms, teacher discussions, working together on preparation for lessons and observations of other teachers' classrooms 2 or 3 times per month whereas more than a quarter and less three fourth of the teachers had been took part in it at least weekly. Interestingly, a number of the teachers (at maximum, 21.2%) never engaged in any sort of the interactive activities anymore, was almost doubled than that of teachers (at maximum 11.4%) participated daily or almost daily in the afore-mentioned interactive activities (Table7).

Table 7: Frequency of Teacher Interaction

Variables by Percents

Items and codes	Measurement scale			
	1	2	3	4
	Never or almost never	2 or 3 times	At least	Daily or almost daily
Visits to other classrooms (at4gotvt)	13	49	29	9
Teachers discussions (at4gotdc)	15	33	44	8
Working together on prepation (at4gotpm)	13.2	39.1	36.3	11.4
Observations (at4gotat)	21.2	50.7	24.5	3.6

With regard to variables to measure the degree of teacher participation, it could be figured out that there had been considerable differences in teacher participation in curriculum development and critical thinking. In fact, a number of the teachers participated in curriculum development and critical thinking was approximately more than two times than that of teachers who did not take part in it. However, a number of teachers not engaged in applying ICT into mathematics teaching, was approximately more than three time than that of the teachers being part in it. As for the frequencies

of variables concerning teacher participation in pedagogy and assessment, it could be pointed that a number of teachers engaged in such two interactive activities were more than that of teacher disengaged in them.

Table 8: Frequencies of Teacher Participation Variables by Percent

Items and codes	Measurement scale (Dichotomous)	
	Yes	No
Participation in pedagogy (at4mpdmp)	47	53
Participation in curriculum development (at4mpdmc)	68	32
Participation in applying IT into mathematics (at4mpdit)	26	74
Participation in critical thinking (at4gpdct)	63	37
Participation in assessment (at4mpdma)	45	55

4.2. Group Differences on Interest Factors: T-test and F-statistics

This section is designated to deal with a question of which factors have any effects on mathematics achievement of Mongolian students at the fourth grade that vary from group to group. Accordingly, the following questions are detailed below in the extent of the TIMSS 2007 using SPSS.

Are the achievements of Mongolian students gendered?

Are the student achievements differed by the amount of time spending for doing homework?

Are the student achievements differed by the amount of time spending for talking with friends?

Are the student achievements differed by the amount of time spending for playing computer games?

Are the student achievements differed by the amount of time spending for doing jobs at home?

Are the student achievements differed by the amount of time spending for watching TV or Video affect the student achievement?

Are the achievements of Mongolian students gendered?

In response to a question of whether gender affects the mathematics achievement of Mongolian students at the fourth grade, it is initially hypothesized that there is no gender differences on student achievement (a null hypothesis). Using ANOVA in SPSS, we can examine whether the null hypothesis is accepted and rejected.

As was presented in the preceding section, 4365 fourth grade students participated in TIMSS 2007 study from Mongolia were categorized into two groups by gender, a dichotomous variable: male student (51%) and female students (49%). Hence, it can be asked whether there is a statistically significant difference between two means of two groups.

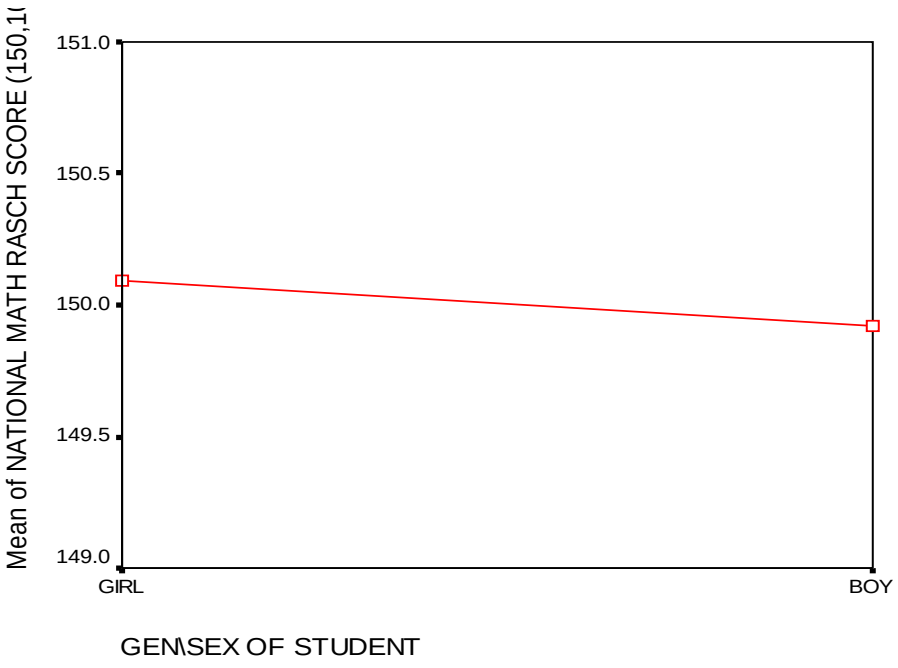
In order to deal with such task to compare two means of two samples (male students, female students), we need to calculate the ratio (t-test) of the difference of two variances of two means of samples divided by standard deviation of sample distribution (t-distribution) and then find out a probability level of that value of t-test in t-distribution tables using both degree of freedom and the value of the t-ratio. If the probability level corresponded to the value of t-ratio is less than a critical level of probability set up in advance (0.05 is often used as a critical level of probability in social sciences) then a null hypothesis is rejected. It is meant that an event, in this case, gender having no difference on student achievement randomly occurs by a little chance (less than 5 percents). Stated differently, the probability of the event occurring non-randomly or by not chance is not less. If the probability level corresponded to the value of t-ratio is more than the critical one then a null hypothesis is accepted.

Using SPSS, we can produce a table indicating the probability level corresponded to the value of t-ratio along with F-statistics (Table 9). As was seen the table, the probability level corresponded to the

value of t-ratio was 0.571. Since it is more 0.05, it can be said that the null hypothesis is accepted. Stated differently, it can be said that student gender has no statistically significant differences on the fourth grade student achievement of mathematics according to TIMSS 2007. This difference is also illustratively shown in the graph below.

Table 9: F-statistics of gender difference on student achievement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	32.170	1	32.170	.321	.571
Within Groups	436838.829	4363	100.123		
Total	436871.000	4364			



Are the student achievements differed by the amount of time spending for doing homework?

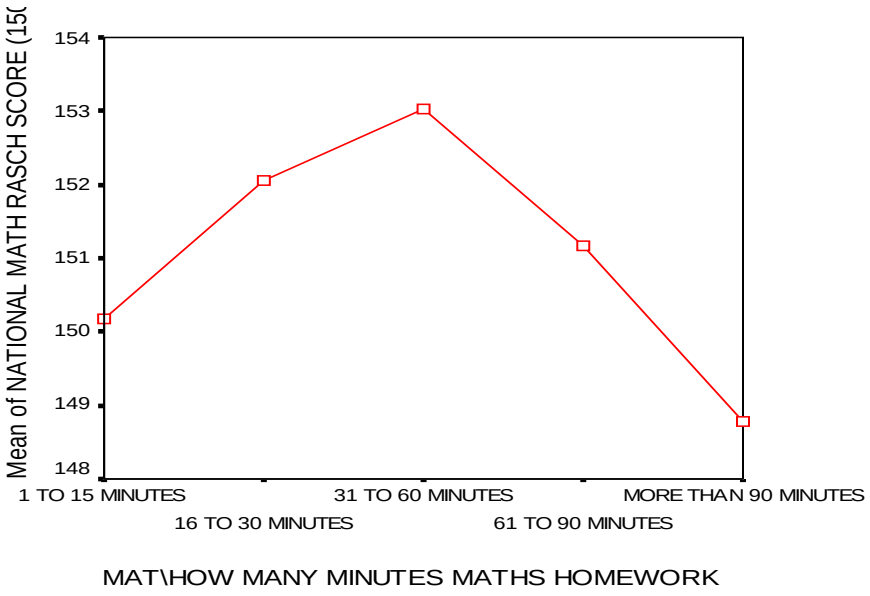
In accordance with the TIMSS 2007 study from Mongolia, the fourth grade students were categorized into five groups differed from each other by the amount of times spending for doing homework by a item with five alternative choice of responses: 1 to 15 minutes, 16 to 30 minutes, 31 to 60 minutes, 61 to 90 minutes and more than 90 minutes. Thus, it can be questioned whether such five groups differed from each other by mathematics achievement. Stated differently, it could be wondered whether the amount of times spending for doing homework affect the mathematics achievement of Mongolian students at the fourth grade. As for this question, a null hypothesis was claimed that there were no effects resulted from the amount of times spending for homework on the student achievement of mathematics.

Having a look at the table below generated by ANOVA in SPSS, it could be realized that the probability corresponded to the value of t-ratio (0.000) was less than 0.05, the critical level of the probability. In other words, the null hypothesis was rejected. Thus, one can figure out that the amount of times spending for doing homework has statistically significant differences on mathematics achievement of Mongolian students at the fourth grade according to the TIMSS 2007. Those differences were also presented in the graph.

Table 10: F statistics of the homework differences on student achievement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3152.025	4	788.006	8.768	.000
Within Groups	295218.669	3285	89.869		
Total	298370.694	3289			

As was shown in the graph below, it can be pointed out that the mathematics achievements of the group of Mongolian students at the fourth grade who spend 31 to 60 minutes for doing homework is better than that of the rest of four groups. Stated simply, it can be said that students' achievements at the fourth grade in Mongolia are differed by the amount of the time spending home work. Students spending for doing home such moderate amount of time that should be labeled as "not too long, however, not too short", have better achievements that are significantly differed from the rest of the students.



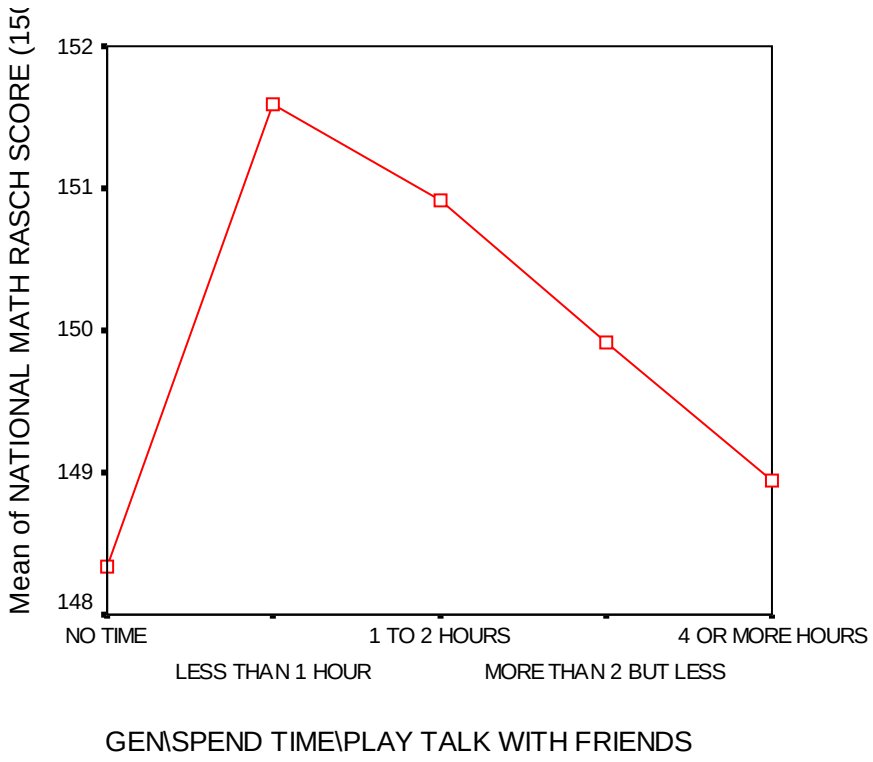
Are the student achievements differed by the amount of time spending for talking with friends?

The fourth grade students were categorized into five groups differed from each other by the amount of time spending for talking with friends by an item with five alternative choices of responses: no time, less than 1 hour, 1 to 2 hours, less than 2 hours, but less, 4 or more hours. As was detailed in dealing with the previous questions, a null hypothesis was formulated that there were no any differences resulted from the amount of times taking with friends on the student achievement of mathematics.

Analyzing a table produced by ANOVA in SPSS, it could be seen the null hypothesis was rejected at 0.05 critical level of the probability. It was meant that the amount of times spending for doing homework has statistically significant differences on mathematics achievement of Mongolian students at the fourth grade according to the TIMSS 2007 at the critical level.

Table11: F statistics of a variable of talking friends

	Sum of	df	Mean	F	Sig.
Between Groups	6902.500	4	1725.625	18.141	.000
Within Groups	377541.929	3969	95.123		
Total	384444.429	3973			

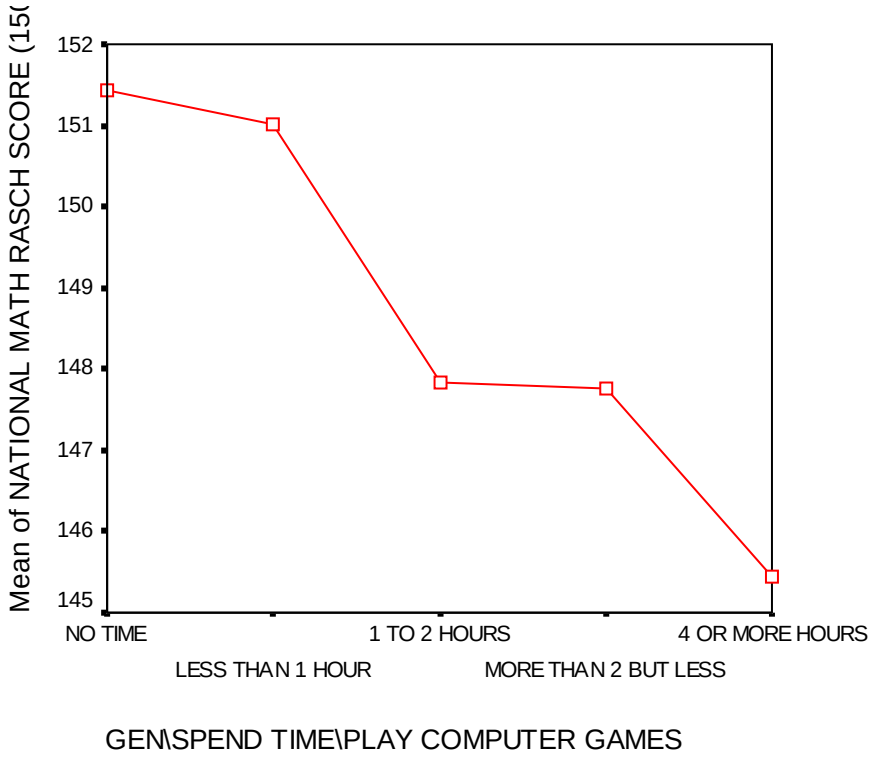


Referring to the data, the fourth grade students were categorized into five groups differed from each other by the amount of times spending for playing computer games by an item with five alternative choice of responses: no time, less than 1 hour, 1 to 2 hours, less than 2 hours, but less, 4 or more hours. As was detailed in dealing with the previous questions, a null hypothesis was formulated that there were no any differences resulted from the amount of times playing computer games on the student achievement of mathematics.

Analyzing a table produced by ANOVA in SPSS, it could be seen that the null hypothesis was rejected at 0.05 critical level of the probability. It was meant that the amount of times spending for doing homework has statistically significant differences on mathematics achievement of Mongolian students at the fourth grade according to the TIMSS 2007 at the critical level. Interestingly, as the graph displays, the more hours students spend for playing games the less mathematics achievements they attain.

Table 12: F-statistics of a variable of playing computer games

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	10854.901	4	2713.725	28.709	.000
Within Groups	369965.530	3914	94.524		
Total	380820.430	3918			



Are the student achievements differed by the amount of time spending for doing jobs at home?

As was explained in the previous questions, the students at the fourth grade were categorized into five groups by a variable to measure the degree to which they do jobs at home according to measurement scales.

Analyzing a table produced by ANOVA in SPSS, it could be said that a null hypothesis stated that there was no any differences resulted from students jobs at home on student achievement, was

rejected at 0.05 critical level of the probability. In other words, the amount of times spending for doing jobs at homework has statistically significant differences on mathematics achievement of Mongolian students at the fourth grade according to the TIMSS 2007 at the critical level.

As was depicted in the graph, it can be, interestingly, pointed out that the groups of students doing jobs at home by more than hour an less than 2 hours had comparatively better mathematics achievement than the rest of groups.

Table 13: F-statistics of a variable of doing jobs at home

	Sum of Squares	df	Mean	F	Sig.
Between Groups	14422.047	4	3605.512	38.949	.000
Within Groups	368982.137	3986	92.570		
Total	383404.184	3990			

Are the student achievements differed by the amount of time spending for watching TV or Video affect the student achievement?

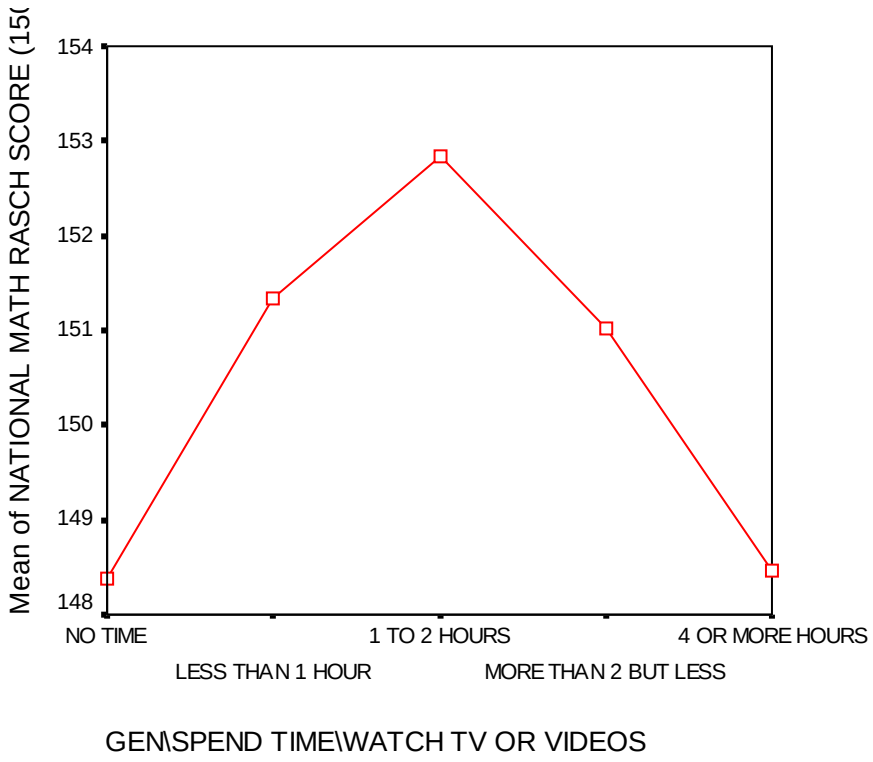
The students at the fourth grade were categorized into five groups by the values of a variable to measure the amount of times watching TV or video according to its measurement scales.

Analyzing a table produced by ANOVA in SPSS, it could be said that a null hypothesis was rejected at 0.05 critical level of the probability. That is to say, the amount of time spending for watching TV or video has statistically significant differences on mathematics achievement of Mongolian students at the fourth grade according to the TIMSS 2007 at the critical level.

As was depicted in the graph, it can be figured out that the groups of students watching TV or video 1 to 2 hours had comparatively better mathematics achievement than the rest of groups.

Table14: F-statistics of a variable of watching TV or video

	Sum of	df	Mean Square	F	Sig.
Between Groups	10931.947	4	2732.987	28.625	.000
Within Groups	387253.662	4056	95.477		
Total	398185.609	4060			



4.3. Factor Loadings of Interest Variables and Indicators of Constructs

This section aims to identify measureable variables that have considerable contributions or factors loadings with more than 0.4 in the measurement of eight particular constructs, namely, school resource, student learning style, student attitude, student extra-curricular activities, teacher preparation, teacher interaction and teacher participation using SPSS 11.5 and AMOS 4.0.

In the TIMSS 2007, a construct, so called as school resource or shortage was expected to measure by ten measurable variables listed in the previous part (Table 4). As a result of using SPSS and AMOS to estimate the values of factor loadings of each variable, it was, however, revealed that out of such ten variables, only four variables namely, instructional material, school building, heating and lighting, and instructional space, which were, in fact, bearing factor loadings whose values were not less than 0.3 had considerable contributions in the measurement of the construct. At the same time, it was ascertained that the rest of six variables bearing the factor loading less than 0.3 had no considerable contributions in the construct measurement. Thus, those variables were eliminated from the configuration displaying the factor loadings of the variables having considerable contributions in the measurement of the construct, named as school resource or shortage.

As was indicated in the configuration below, school building with a consistent factor loading (0.88) and heating and lighting (0.81) might be recognized as major measurable indicators of the school resource in terms of the degree of contributions in measuring the construct.

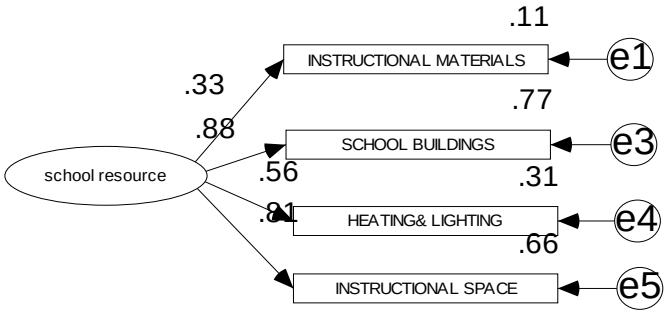


Figure 13: School Resource Indicators

As far as a construct named as student style was concerned, it can be pointed out that out of six variables designed to measure the construct under the TIMSS 2007 (Table2), four variables, namely working problems (as4mhwpo), explaining answers (as4mhexp), working in groups (as4mhwsg) and memorization (as4mhmwp) had considerable contributions in the measurement of the construct in terms of bearing the consistent values of factor loadings that was than 0.3 in accordance with the results of the analysis performed by SPSS and AMOS. Moreover, it can be said that those four variables could be recognized as underlying indicators to measure the construct.

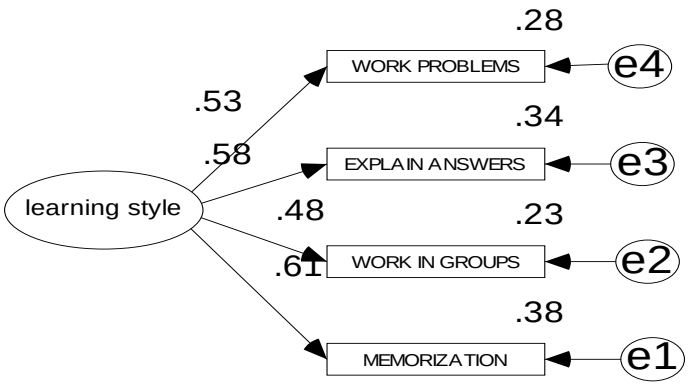


Figure14. Learning Style Indicators

A construct named as student learning attitude, is designed to be measured by six variables under the TIMSS 2007 as was shown in Table 1. As analyzing the nature of the variables, it was revealed that there were two items bearing a negative direction against the rest of items, namely, “Is math harder for me (as4maclm)?” and “Are you just not good at mathematics (as4manot)?” Thus, it was needed to recode so that all six items had the same directions to measure the construct. In fact, such recoding was carried out with help of SPSS before carrying out the factor analysis.

it can be pointed out that out of six variables designed to measure the construct under the TIMSS 2207 (Table1), four variables involving doing well in math (as4mawel), liking to do more math (as4mamor), enjoying math (as4maenj) and learning things quickly (as4maqky) bore considerable contributions in the measurement of the construct in terms of bearing the consistent values of factor loadings that was than 0.3 with regard to the results produced by SPSS and AMOS. Besides, those except enjoying math learning could be recognized as underlying indicators to measure the construct.

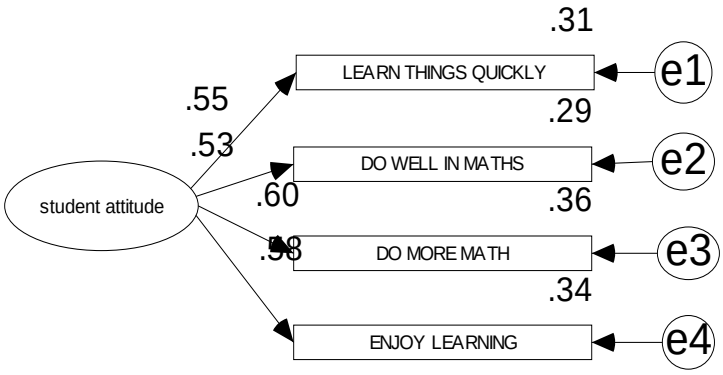


Figure 15: Student learning attitude indicators

With regard to a construct, so called as student extra-curricular activity, it can be ascertained that out of eight variables designed to measure the construct under the TIMSS 2207 (Table3)), five variables such as playing computer games (as4gplcg), talking with friends (as4gplfd), playing sport (as4gplsp), watching TV or video (as4gwatv) and using internet (as4gusin) had considerable contributions in the measurement of the construct in terms of bearing the consistent values of factor loadings that was than 0.3 with regard to the result produced by SPSS and AMOS. Thus, among them, playing computer games with 0.66 factor loading and watching TV or video with 0.57 might be determined to be underlying indicators to measure the construct.

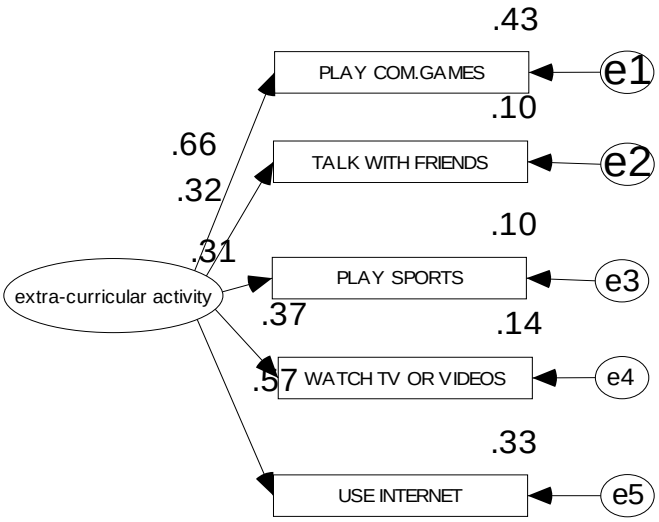


Figure 16: Indicators of Student Extra-Curricular Activity

As was presented in the configuration generated by AMOS, teacher preparation as a construct was consistently expressed by four variables such as number (at4mtto4), algebra (at4mtt10), geometry (at4mtt13) and probability (at4mtt18) each of which bore a factor loading that was more than 0.3. Accordingly, it can be figured out that algebra and number variables should be regarded as underlying indicators for the measurement of teacher preparation in Mongolia.

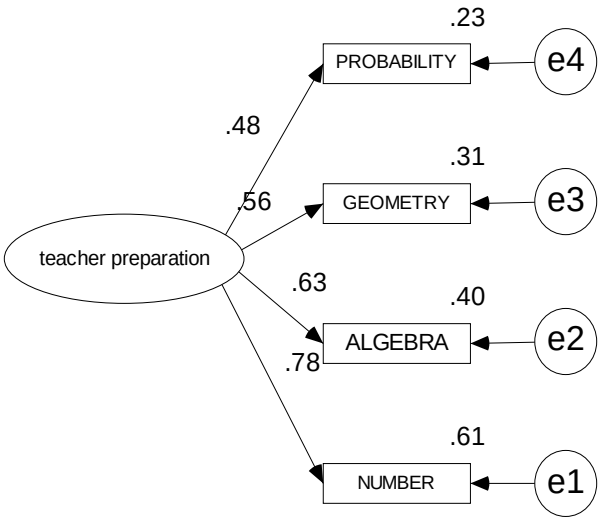


Figure 17: Teacher Preparation Indicators

As was displayed in the configuration produced by using AMOS, teacher participation, a construct (was consistently measured by six variables such as pedagogy (at4mpdmp), curriculum development (at4mpdmc), curriculum development (at4mpdmc), applying IT into mathematics (at4mpdit), assessment and mathematics content) which had considerable contributions in the measurement of the construct by consistent factor loadings. Importantly, all six variables could be recognized as underlying indicators to measure the construct.

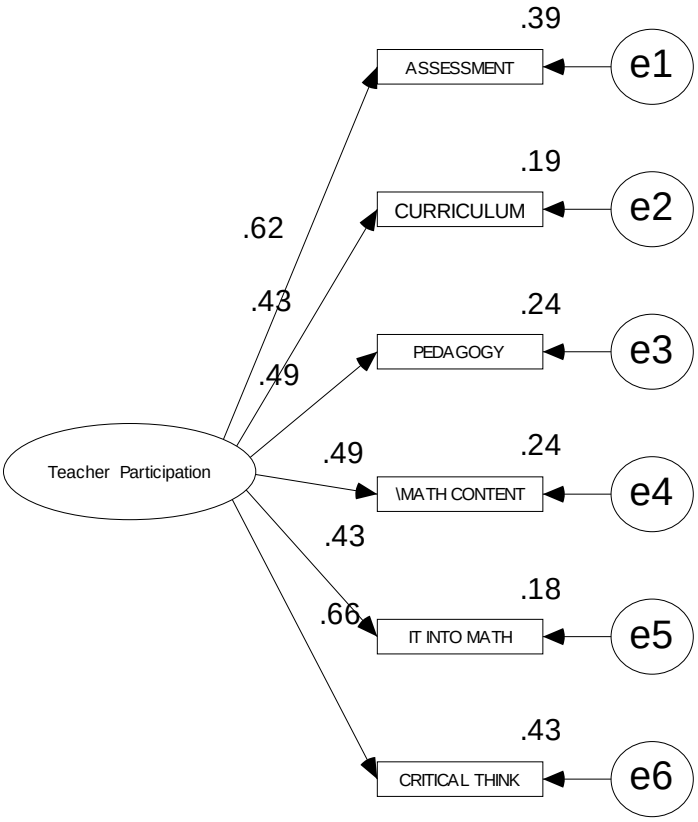


Figure 18: Teacher Participation Indicators

Using AMOS 4.0, we can produce the configuration displaying variables to have considerable contribution in measurement of a construct, teacher interaction along with their factor loadings. In fact, all values of factor loadings except a variable named as visits to other classrooms (at4gotvt) were not less than 0.3. As a result of comparing the values of the factor loadings of the variables, it can be pointed out that working together on prepation of lesson (at4gotpm) is recognized as an underlying indicator for measuring the degree of teacher interaction.

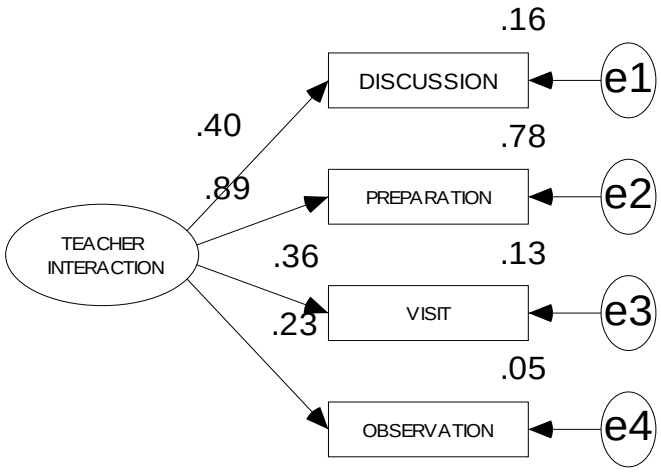


Figure 19: Teacher Interaction Indicators

4.4. Path Model of Factors Affecting Student Achievement

This chapter intended to present a path model generated by AMOS 4.0 using the data of TIMSS 2007 whereby revealing partial correlations among nine underlying constructs (factors) and 33 measured variables directly and indirectly affecting mathematics achievement of Mongolian students at the fourth grade along with their effects on it and also to interpret factors effects on student achievements.

4.4.1. Exploring Correlations among Factors Affecting Student Achievement

In order to draw a path model so that it can reveal the relationships among the factors affecting student achievement, we need to consider first a linear equation in which constructs play as variables. Having mentioned that any construct is in turn manipulated itself as a linear equation of several independent variables, the relationships among nine factors or constructs affecting mathematics achievement of Mongolian students at the fourth grade according to the data of TIMSS 2007 is mathematically modeled as a system of nine linear equations of 33 independent variables. Any

solutions of the system of linear equations will be considered as a model whereby expressing mathematically the nature (structure) of the relationships of the factors of interests.

Using AMOS 4.0, a path model with the best fit to the nature of the relationships among the factors affecting mathematics achievement of the fourth grade students in Mongolia in the extent of the data of the TIMSS 2007 was presented below.

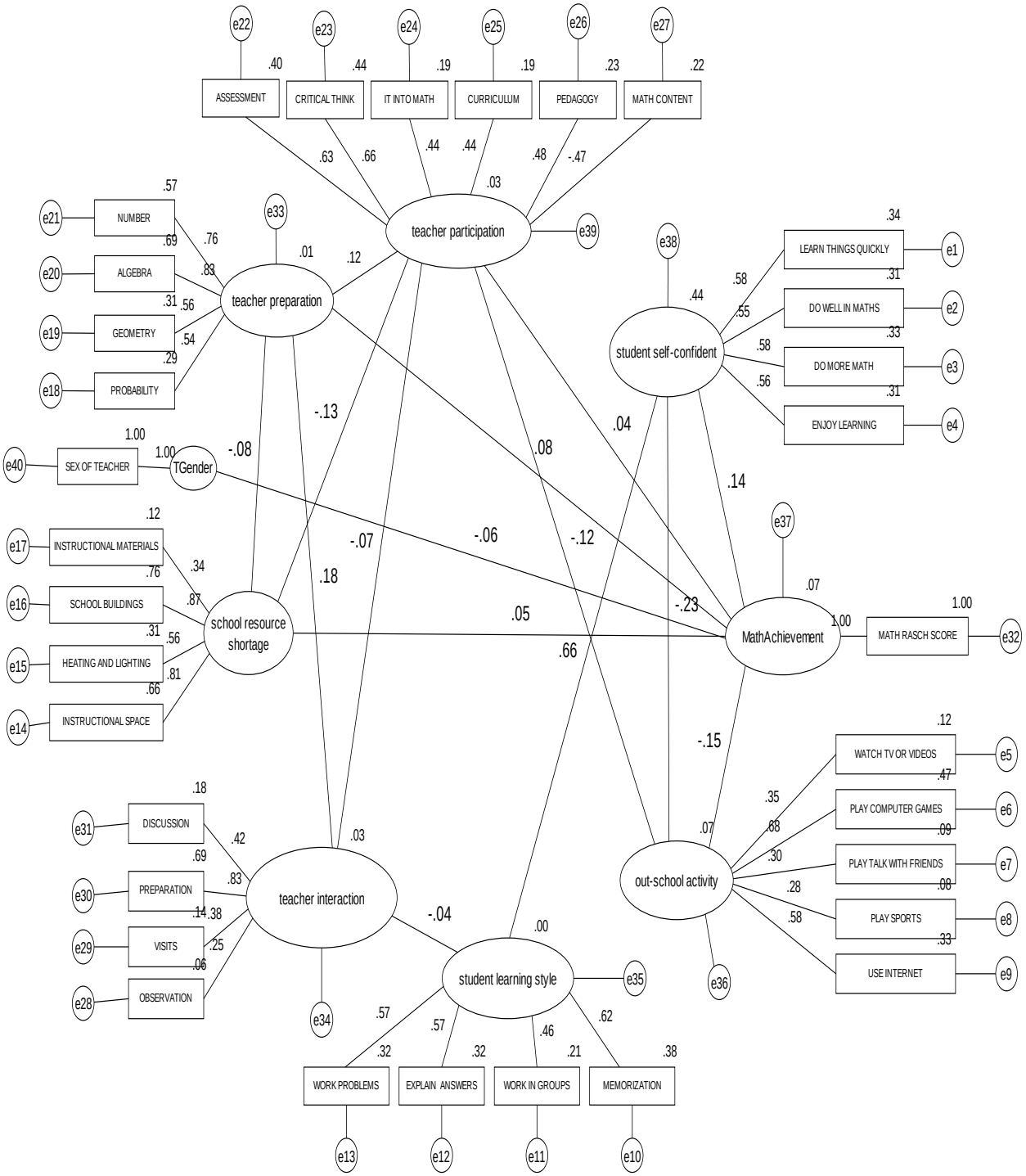


Diagram 1: Path model of Factors Affecting Student Achievement

According to the path model shaped above as a diagram, it can be figured out that student achievement is positively affected by school resource shortage factor (path coefficient (l) = 0.05); teacher preparation (l=0.04); teacher participation (l=0.08); student self-confident (l=0.14) whereas it

is negatively affected by out-of-school activity or extra-curricular activity (l=-0.15) and teacher gender (l=-0.06). However, there are no direct effects of other two factors, namely, student learning style and teacher interaction on student achievement revealed in the extent of the data of the TIMSS 2007 and the capabilities of AMOS 6.0 in terms of good fitness.

The rest of the correlations among some factors of interest revealed in the path model were presented as follows:

School resource shortage factor negatively affect both teacher preparation (l=-0.08) and teacher participation (l=-0.13).

Teacher participation is positively affected by teacher preparation (l=0.12).

Teacher interaction is positively affected by teacher preparation (l=0.18).

Teacher participation is negatively affected by teacher interaction (l=-0.07)

Out-school activity is negatively affected by teacher participation (l=-0.12).

Student learning style is negatively affected by teacher interaction (l=-0.04), however, it bears strong positive effects on student self-confidence (l=0.66).

Student self-confidence had negatively effects on out-school activities (l=-0.23).

4.4.2. Interpreting Factor Effects on Student Achievement

As was pointed out in the previous section, the mathematics achievements of Mongolian students at the fourth grade are directly and positively affected by the factors such as school resource shortage, teacher preparation, teacher participation; student self-confident whereas it is directly, however, negatively affected by out-of-school activity or extra-curricular activity, and teacher gender.

Having mentioned that a factor so called as a school resource shortage affected positively on the student achievement and also it is consistently measured by four variables such as school building, instructional space, instructional material and lighting and heating, it can be interpreted that the better resources schools have the higher achievements students attain. Likewise, it can be interpretatively stated that the better prepared teachers are the higher achievements the students attain; the more engaged teachers are in delivering mathematics curriculum the higher achievements students gain; the more confident students are the better achievements they attain.

In contrast, as for the factors bearing direct and negative effects on the mathematics achievements of the fourth grade student, it could be interpreted that the more engaged student are in out-school activities the lower achievements they gain. Moreover, keeping in mind that a factor, teacher gender (at4gsex*)* was in turn measured dichotomously (female-1, male-2) in the TIMSS 2007, and also it had negative effects on student achievement, it can be interpreted that female gender made up more weights in teacher gender's negative effects on the student achievement than male one.

As far as the inter-dependence of other factors affecting indirectly the student mathematics achievements are concerned, the following interpretative statements with reference to the previous section could be provided:

The more resource shortages schools have the worse teachers are prepared and engaged in delivering mathematics curriculum. The better teachers are prepared the better they interact with each other and participate in delivering mathematics curriculum. However, the more teachers interact the less participation or contributions they have in delivering mathematics education. Moreover, the more engaged students are in out-school activities the less participation teachers have in teaching and learning mathematics. The more different learning styles students have the less teachers interact. Nevertheless, the more students are distinguished by their learning styles the higher self-confidence they have. Besides, the higher self-confidence students have the less engaged they are in out-school activities.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

This section is designated to present the responses to the research questions, conclusions and recommendations towards taking relevant measures and making appropriate policies in order to improving education quality, particularly in advancing the quality of mathematics education for the fourth grade students in Mongolia.

5.1.1. Responses to Research Questions

As a result of analyzing the data of the TIMSS 2007 with the help of the comprehensive software such as SPSS 11.5 and AMOS 4.0, responses towards the research questions of this study can be detailed as follows:

In response to the research question 1, it can be noted that this study has identified 13 independent variables (single factors) and 3 constructs (complex factors) associated with student attributes affect directly or indirectly the mathematics achievement of Mongolian student at the fourth grade. A construct named as student learning style bears no direct effect on the mathematics achievements of Mongolian student at the fourth grade albeit that it has a strong positive relation to student self-confidence that in turn affects directly and positively the mathematics achievements of the fourth grade students in Mongolia. However, a construct, extra-curricular activity or out-of-school activity affects it negatively.

As for the research question 2, it can be pointed out that this study has revealed 14 independent variables configured into 3 constructs such as teacher preparation, teacher participation and teacher interaction which directly or indirectly affect the mathematics achievements of the fourth grade students in Mongolia. Specifically speaking, two out of three constructs associated with teacher attributes, namely teacher preparation and teacher participation directly and positively affect the

mathematics achievements of the students whereas a construct, teacher interaction, has no any direct effects on it.

With regard to the research question 3, it can be stated that there have been 4 independent variables and 1 construct associated with school attributes affect the mathematics achievement of Mongolian students at the fourth grade in the extent of the data of the TIMSS 2007 study. The construct measured by such variables as school building, heating and lighting, instructional material and instructional space, affects directly and positively might the mathematics achievements of Mongolian students at the fourth grade.

At last, as for the research question 4, it can be addressed that 33 variables (single factors) configured into 9 constructs (complex factors) are interrelated by and large and the degree of their interrelationships is estimated in a path model proposed by this study.

5.1.2. Conclusions

Education quality has been recognized as a complex construct that bears multiple attributes associated with delivering services by education system. As a complex construct, it has been defined alternatively from time to time. In fact, it is defined as excellence; fitness for use; conformance to requirement; defect avoidance; meeting and/or exceeding consumers' expectations; a character of the set of elements in the input, process and output of the education system that provides services that completely satisfy both internal and external strategic constituencies by meeting their explicit and implicit expectations. Depending upon the diversity of the nature of its definitions, many indicators have been proposed to respond to desperate needs and demands to assure the quality of education. Among them, as much literature suggests, student achievement is, however, regarded as only measurable indicator to measure the quality of education in terms of educational policy.

Student achievement recognized as a measurable output of educational services delivered by school systems is often affected by factors associated with three main subjects, namely, student, teacher and school. Having

investigated the factors affecting mathematics achievements of Mongolian students at the fourth grade using the data of the TIMSS 2007 with help of the comprehensive software such as SPSS 11.4 and AMOS 4.0, this study has brought in the following conclusions:

School resource shortage, teacher preparation, teacher participation, student self-confident, out-of-school activity or extra-curricular activity, and teacher gender are mostly likely to be recognized as underlying factors that affect directly the mathematics achievements of the fourth grade students in Mongolia. Moreover, school resource shortage, teacher preparation, teacher participation and student self-confident should affect it directly and positively whereas out-of-school activity or extra-curricular activity, and teacher gender influence it directly, however, negatively.

School building and heating and lighting are highly likely to be recognized as major measurable indicators of the school resource in terms of the degree of contributions in measuring the school resource whereas playing computer games and watching TV or video are probable to be identified underlying indicators to measure the degree of extra-curricular activities of the four grade students in Mongolia. Moreover, students' self-determination to do mathematics well might be recognized as an indicator to reveal the students' attitudes about learning mathematics while working together on the prepations of lessons is mostly likely to be identified as an indicator for measuring teacher interaction.

Student gender bears no statistically significant differences on the mathematics achievement of Mongolian students at the fourth grade. Nevertheless, the amount of time which the students spend for doing home work, watching TV or video, talking with friends, doing jobs at home has statistically significant differences on the mathematics achievement of Mongolian students at the four grade.

5.1.3 Recommendations

Having taken into account the afore-mentioned responses to the research questions along with the conclusions, this study should comment the following ideas on taking relevant measures and making appropriate policies for improving the quality of school education, particularly in mathematics education for the fourth grade students in Mongolia:

School resources such as school building, instructional space and material should be continuously be advanced and updated from time to time so that they can advantage the mathematics achievements of Mongolian students at the fourth grade.

Ways and approaches by which teachers have been prepared and interacted with each other and participated in delivering education services through schooling, should be permanently diagnosed, and then innovated so that their direct and positive effects on the mathematics achievements of Mongolian students at the fourth grade can be kept.

Schools and communities should reconsider and resolve the nature of extra-curricular (out-of school) activities in which student are engaged so that those can affect positively their mathematics achievements.

Governmental institutions accountable for advancing the quality of school education such as the department of education and public and private schools should be committed to reconsider employment policy so that the mathematics achievements of the fourth grade students in Mongolia can be freed from any negative effects driven by teacher gender.

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