A MULTILEVEL ANALYSIS OF JAPANESE MIDDLE SCHOOL STUDENT AND SCHOOL SOCIOECONOMIC STATUS INFLUENCE ON MATHEMATICS ACHIEVEMENT

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

EDUCATION

DECEMBER 2015

BY

Naomi Takashiro

Dissertation Committee:

Marie Iding, Chairperson
Ronald Heck
Michael Salzman
Min Liu
Xu Di

Keywords: bioecological theory, Japan, socioeconomic status, multilevel analysis, multilevel ordinal model, TIMSS,

ACKNOWLEDGEMENTS

Although I grew up in a low socioeconomic status family in Japan, I have made it this far. I have been interested in how my parents and my surrounding environments influenced me over the years. My dissertation helped me answer the questions that I have had for many years.

My sincere appreciation goes to all my committee members, Drs. Iding, Salzman, Heck, Liu, and Xu for their continuous support, guidance, and patience. I would not have completed my dissertation without their help. I also would like to express my appreciation to retired professor, Dr. Zhang, who wrote me a letter of recommendation to apply for the department and gave me guidance when he was teaching in our department.

I also would like to express my gratitude to my department for providing me the achievement scholarship and to Tim Fulkerson for financial support in research projects.

My continuous appreciation goes to my husband, Cliff, and our beloved cockatiel now deceased, Pata-Pata, and friends. They have supported me through the lengthy process of writing a dissertation.

ABSTRACT

This study consisted of two parts; a) Japanese eighth graders and Japanese middle school socioeconomic status (SES) simultaneous influence on student math achievement and b) parental educational influence on Japanese eighth graders' likelihood of participation in extra math lessons by utilizing the Trends in International Mathematics and Science Study (TIMSS) Japan data sets. Four-thousand-eight-hundred-fifty-six randomly selected Japanese eighth graders (male = 2,455, female = 2,401) from 146 public (national and other public) and private middle schools participated in their study. The theoretical framework was Bronfenbrenner's bioecological theory.

There were four challenges in this study to improve the extant literature: a) statistical issues, b) the combined influence of SES and non-SES, c) incongruent results on school SES impact, and d) insufficient number of quantity and quality studies. Two-level multilevel analysis and multilevel ordinal models were applied respectively to analyze the data sets.

The results indicated that at the student level, different aspects of student SES (i.e. number of books, the possession of computers, paternal, and maternal educational achievements were positively related to Japanese student math achievement. At the school level, two aspects of school SES (i.e. less populated schools and economically disadvantaged schools) were negatively related to Japanese student math achievement. Especially, Japanese students who attended schools in less populated areas were more disadvantaged relative to those who attended schools in more populated areas. None of the cross-level interactions were significant, but the random effect for computer slope was significant.

The results of the proportional reduction of prediction error explained by both student and school SES were small, meaning the residual variances at student and school SES were small. Small school SES residual variance may indicate a stratification of public middle schools.

The findings also showed that maternal educational background was related to their children's odds of participation in extra math lessons after schools. When mothers were more educated, Japanese students were more likely to participate in extra math lessons. From the results of the two study findings, the maternal level of education influenced Japanese students' academic areas.

The theoretical applications in the contexts of Japanese culture were also discussed.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The impacts of individual as well as school socioeconomic status (SES) seem to be global. Nonoyama-Tarumi (2008) found student SES influence in 40 Organisations for Economic Co-operation and Development (OECD) countries.

More specifically, when multidimensional student SES aspects were used, (i.e. parental occupation, education, and cultural resources), the influence on student achievement was stronger than that of simple SES (i.e. parental education and occupation). The multidimensional SES influence was not biased toward wealthy nations. Further, scholars discovered school SES impacts in many countries, such as US, Japan, Canada, Korea, and Taiwan (e.g. Beese, & Liang, 2010; Condon, Greenberg, Stephan, Williams, Gerdeman, Molefe, & van der Ploeg, 2012; Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Nochi, 2008; Kariya, 2008; Singh, 2011; Liu, Wu, & Zumbo, 2006). The measurement of school SES is conceptualized differently across countries. For example, in Japan, some researchers have used the percentage of social welfare in income, while in the U.S. the percentage of free or subsidized lunch is used.

A number of researchers have studied the impacts of individual socioeconomic status (SES) or school SES on student academic achievement in Japan only a decade (e.g. Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Kariya, 2008; Mimizuka, 2007). Many scholars consistently discovered that low SES students scored lower than high SES students in Japan (e.g. Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Hiragi, 2008; Kariya, 2008; Nara, 2010; OECD, 2013b). In addition, students from low-SES

schools lagged behind those from high-SES schools in math test scores in Japan (e.g. Ando, 2008; National Institute for Educational Policy Research, 2009a; Nara, 2010; Nukata, Sakaguchi, Fukuda, Ochiai, Arimoto, & Inoue, 2008; Shimizu & Fujii, 2009).

Researchers indicate that SES is defined by various factors, such as educational achievement, social standing, wealth, occupation, home possessions, and participation in social life (Hauser & Warren, 1997). Student academic achievement primarily refers to student test scores. Math achievement was chosen for the first part of this study because a gap between high and low achievers tend to be wider (Hamano, 2009a; Hamano, 2009b). Japanese students' participation in extra math lessons as supplemental education was the main theme for the second part of this study.

Examining SES is important for a number of reasons. The studies reveal inequalities (American Psychological Association, 2013) and injustices in student academic achievement and their participation in after school academic activities. The major issue of SES is that uncontrollable student family background, such as parental level of education, occupation, and income, greatly influences student achievement (Sudo, 2009). Furthermore, low SES affects not only student academic achievement but also many other factors, such as developing learning basis skills, learning competencies, parenting and child development, motivation, aspirations, expectations, and study hours (Hoffman, 2003; Kariya, 2004; Kariya, 2010; Kariya & Rosenbaum, 2003; Orr, 2003).

Several Japanese researchers expressed concerns related to low SES. Japanese society creates inequalities in student academic achievement because parental wealth is one of the predictors of student test scores (Mimizuka, 2007).

Uncontrollable family background variables such as parental education create inequality in the society (Sudo, 2009). It is imperative to address SES issues in Japanese compulsory education in order to create fairness. If these problems persist, young workers go to the workforce without appropriate skills (Kariya, 2008). Further, companies tend to avoid hiring students who are low achievers (Namba & Hatanaka, 2012) and are eager to employ students from high-ranking universities so that companies are able to train these students more effectively and efficiently than those who are from low-ranking universities (Kariya, 2010).
Consequently, inadequate job skills and poor academic achievement associated with low SES lead to detrimental lifetime influence on students.

While research has emphasized the SES influence on student academic achievement, some researchers have studied the SES impact on supplemental education. SES status influences students' likelihood of obtaining supplemental education. More specifically, high-SES students were more likely to participate in supplemental education relative to low-SES students (Matsuoka, 2012). There were also relationships between parental level of education and their children's participation in after school educational activities (e.g. Hirao, 2003; Nakazawa, 2013).

Despite the negative influence of low student SES on academic achievement, worldwide test such as Trends in International Mathematics and Science Study (TIMSS) showed high math scores for Japanese eighth graders. However, there is a performance gap between high and low achievers in Japan; TIMSS 2011 data showed that the gap was more than 667 points and the standard deviation was 82.31.

This performance gap between high achievers and low achievers is due largely to the factor of individual differences. Liu and her colleagues (2006) found out by using TIMSS data that individual influence was much greater for Japanese student achievement than school influence. Student factors, such as home resources and parental education accounted for 87%, whereas school factors, such as socioeconomic status, school size, and school climate accounted for 13% math achievement. While in the U.S., 71% was accounted for by student factors and 29% for school factors. However, variances explained by SES are not clear because the independent variables included both SES and non-SES without distinction.

Challenges

There are several challenges regarding individual and school SES in the area of student and school SES in Japan: a) statistical issues; b) limited quantity and quality of past studies; c) the combined influence of SES and non-SES; and d) incongruent results on school impact.

First, scholars and the governmental research agency in Japan conducted multiple regression, correlation, and descriptive statistical analyses to examine the influence of school and individual SES on student math achievement (e.g. Fujita, 2007; Hamano, 2009a; Hamano, 2009b; NIER, 2009a; Nukata et al., 2008). Shimizu and Kariya (2004) questioned some nation-wide test results based on basic descriptive statistics in order to draw their conclusions. Descriptive analysis is not very useful because it only uses means and standard deviation. Further, other analyses, such as correlations and multiple regressions, do not answer the simultaneous relations between individual and school SES, such as schools with economically disadvantaged students, in

relation to student achievement. These analyses may answer whether the overall impact of student SES is constant across schools; however, they are unable to answer whether the impact is varied across schools. In addition, these studies did not consider the hierarchical nature of data with Japanese students nested within school or contextual influence on student academic achievement. Many previous findings (e.g. Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Mimizuka, 2007; Nara, 2010; NIER, 2009a; NIER, 2010; Nukata et al., 2008) in Japan are based on single-level analyses of individual and/or school SES, and multi-layered factors have not been examined together. For example, scholars reported that student achievement was influenced by school SES characteristics, such as location of schools and the average income of the school area (Nukata et al., 2008). In order to analyze how student characteristics, clustered within school characteristics, influence student academic achievement, a multilevel analysis is the appropriate method (Raudenbush & Bryk, 2002). In other words, without a hierarchical nature of student and school-level analysis, the combined impacts of student and school SES on academic achievement are not clear. Hence, previous research findings may be questionable when based on either student-level or school-level analyses.

Another statistical issue is that researchers pointed out that small R^2 and their qualities of variables produced from the previous studies were problematic (e.g. Hamano, 2009b; Kariya, 2004; Mimizuka, 2007). For example, when Makino and her team (2004) conducted a multiple regression analysis, they found out that R^2 for individual SES was small. This means that the selection of SES variables can be problematic. Mimizuka (2007) concluded that the variances explained by these

variables were small; however, he was not very clear about the reasons. This may mean that variables may not be continuous variables and may not be normally distributed (NIER, 2009a), or the model specifications were incorrect, or the choices of variables may be inappropriate. Thus, the selections of SES variables based on literature review would be important to determine the impact of SES.

Second, research on SES in Japan has been actively pursued only for a decade and thus might have produced limited research findings of good quantity. The reasons for delayed studies on SES were based on the unique Japanese society and culture as follows: Firstly, since Japan did not have obvious social class or ethnic issues, unlike the U.S. and other European countries, differential academic achievement did not receive much attention (Sudo, 2009). Further, it was commonly misconceived that the poverty issue was not a concern when Japan made such rapid economic progress and became the second largest economic country after the war (Sudo, 2009). Thus, students' differential academic performance associated with SES was not even considered a topic for researchers to investigate (Mimizuka, 2007; Sudo, 2009).

Secondly, Japanese students' efforts were emphasized rather than their family's background probably due to Confucian influence. When students did not do well on tests, educators did not take a consideration of their family environment as a factor, but judged them based on meritocracy, lack of effort, and individual ability differences (Shimizu, 2004). Because it was commonly misconceived that Japan did not have different social classes (Kariya, 1995), this perception ignored the essence of SES issues.

Thirdly, studies of individual SES impacts on student achievement in Japan had been undeveloped for political reasons. The government rarely had conducted any systematic research on examining student academic achievement for 40 years until 2002 (Mimizuka, 2007). The Japanese Teachers' Association was strongly against the Ministry of Education conducting nation-wide tests because they were afraid that student test scores would be used against teacher evaluations and students for their future employment opportunities. Eventually, the Japanese Supreme Court supported the union and ordered the stoppage of nation-wide tests in the 1960s for the next 40 years (Kariya, 2006). Because of this, researchers were unable to obtain any public data, not to mention reliable and valid data unlike worldwide tests (Sudo, 2009).

Collecting parental responses is also discouraging and challenging due to the low response rate and the sensitivity of information. The Ministry of Education was reluctant to include any questionnaire items regarding social classes and that was why they did not obtain parental information (Sudo, 2009). Researchers also had difficulty in collecting information from parents (Sudo, 2009).

These three main reasons were obstacles to researchers in conducting research on SES in Japan; however, these predicaments have been alleviated after the 2000s for three reasons. The society recognized the poverty issues, social class issues, and the influence of parental social class on student academic achievement (Sudo, 2009). Japan's prolonged recession contributed to the poverty issues; Japan suffered more than a decade of depression in the beginning of the 1990s and it affected the employment situation, especially for young workers. For example, the unemployment rate hit more than 100 percent at the peak in 2003 for people in their

late teens and early 20s (Shinozaki, 2008). In addition, an economic organization, which compared Japan's economic situation with other Organisation for Economic Co-operation and Development (OECD) countries, (reported in OECD, 2013a) that poverty and social class issues had widened in Japan and that Japan placed sixth in the poverty rate among OECD countries.

Two different types of employment status, full-time and part-time workers, divided the labor market and caused such problems (OECD, 2013b). This new type of labor market worsened Japanese economy and created current diverse SES situation. This differential employment status evidently created low and high SES. The influence of low and high SES in terms of economic division is commonly known in Japan. The Japanese society finally identified SES issues in relation to student achievement. Student academic achievement associated with SES differences gained recognition as one of the social issues in Japan only a decade ago. Furthermore, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) officially acknowledged that family income is related to differential student achievement (Sudo, 2009). This is an official recognition of the existence of SES. The government officials publicly acknowledged how unequal income distribution negatively influenced student academic achievement (Sudo, 2009).

A national debate on student lower achievement occurred in the 2000s and the myth that Japan was a meritocratic society diminished (Sudo, 2009). The demise of the meritocratic society also encouraged researchers to conduct research in SES (Sudo, 2009) because parental income influence on their children's achievement became evident.

The existing international assessment results helped scholars to pursue research. Sudo (2009) indicated that anyone who is interested in international assessment results can also download them online, and the availabilities of such data accelerated researchers conducting research on the impact of SES. Despite the availability, it is still uncommon to conduct research in Japan by using worldwide tests results, such as Programme for International Student Assessment (PISA) and TIMSS, and there is a need to utilize such data (Kawaguchi, 2011). Even though world-test results are publicly available, there are limits in the data sets. Some SES-related variables, such as family income and occupation, are still unavailable in Japan's TIMSS data. Hence, researchers use substitute variables to assess these parental variables when they are unattainable such as parental income (Hamano, 2009b). In method section, a discussion is provided on how SES variables are assessed in this study by substituting parental variables with the existing variables from the public data.

Even though the Japanese government conducts nationwide tests every year, the nationwide tests have their own limitations. Even after the Ministry of Education, Culture, Sports, Science and Technology (MEXT) started collecting nation-wide data on elementary and middle school student academic performance after 2002, the availability of such data is still only limited to a handful of government researchers and other researchers have been unable to obtain such public data (Kawaguchi, 2011; Mimizuka, 2007). As a result of the inaccessibility of Japanese nationwide data, some individual researchers have chosen to collect their own data. This circumstance tends to create a lack of reliable and representative valid data due to the sampling selection bias (Kawaguchi, 2011). Because of the unavailability of Japan's public

data, this situation still makes it difficult for ordinary researchers to pursue the area of study (Mimizuka, 2007) even though international tests results exist. This is because some of SES variables, such as parental income, occupation, and lifestyles are included in nation-wide tests, but not in the international tests.

Compared to studies on SES in the U.S., Japan may not have sufficient quantity of studies with good quality in the SES field because of the short history of SES studies. Hence, it is imperative to conduct research on SES influence on student academic achievement and extra math lessons after school (shadow education) in Japan.

Third, researchers included combined SES and non-SES variables in relation to student achievement; thus, the proportion of variance for student and school SES alone was not clear. Scholars should isolate student and school SES with multiple variables, including technology-related variables, and Japanese-related variables with worldwide assessment test data.

Sirin (2005) stated that more researchers include multiple SES indicators such as home possessions, to evaluate SES-student academic achievement in the U.S.
In Japan, some researchers have included home resources in their nationwide studies (e.g. Hamano, 2009a; Hamano, 2009b); however, again these nationwide data are inaccessible to others. A few authors have included home resources in their studies with TIMSS data. For example, Liu et al.'s study (2006) and Oshio (2011) included use of a computer. Even though possessing computers was positively related to student math achievement, reasons for the possession of computers were unexplained. In the TIMSS Japan 2003 data, 82% or about 4,000 eighth graders possessed computers. As the majority of middle school students possessed technology those

days, there may have been an achievement gap between students who had such technology and those who did not from SES perspectives. This is why home-resource variables, such as technology-related predictors in addition to other SES-related variables should be included in research.

In addition, it is also critical to include unique variables relating to Japan. Some authors (e.g. Liu, Wu, & Zumbo, 2006; Mimizuka, 2007; Yamada, 2009) included extra lessons or tutors as a variable for one of the measurements of SES. As extra lessons or supplemental education are ubiquitous in Japan, also in East Asia, and are used for middle school students in order to pass competitive high school entrance exams, almost 50% or 2,400 eighth graders had some form of extra lessons in TIMSS 2003. Thereby, this distinctive variable should be included for assessing Japanese student academic achievement.

Fourth, even though authors are consistent about the impact of student SES in relation to math achievement, research conclusions on middle school SES and school locations are inconsistent. Several researchers concluded that students from low-SES middle schools scored lower in math than students from high-SES middle schools (e.g. Ando, 2008; NIER, 2009a; Nukata et al., 2008; Oshio, 2011; Shimizu & Sudo, 2008). Hojo (2011) also found school SES impacts on math test scores by using TIMSS data; however, other researchers did not find any school SES impact on math achievement (Nukata et al., 2008) or in different TIMSS data (Liu, et al., 2006). These discrepancies in the outcomes of school SES need to be re-investigated.

Regarding the location of schools, studies on this topic are scarce. A few studies utilizing TIMSS data concluded that students who attended schools in less populated

areas scored less in math than those who attended schools where the population was dense (Hojo, 2011; Oshio, 2011). Even though public middle schools are supposed to provide equitable education to all students in Japan, more research should examine the influence of the location of schools. Thus, it is important to investigate middle school SES and location of schools impact with TIMSS data. Kawaguchi (2011) stated that TIMSS is one of the large-scale representations of Japan data.

While TIMSS data provides math achievement results for middle school students, TIMSS Japan data with a wide variety of regions would be beneficial in clarifying the impact of geographical location of schools and school SES.

Purposes of This Study

There were two purposes in this study; a) to investigate how Japanese students (i.e. home resources, parental education, supplemental education) and school socioeconomic characteristics (i.e. location of schools and schools with economically disadvantaged students) simultaneously affected Japanese student math achievement and b) to examine how parental background (i.e. maternal and paternal education) influenced Japanese students' participation in supplemental education using TIMSS Japan data. The utilization of such a large international assessment data set also enables the examination of the combined impact of the variables in both of these purposes. Chapter 3 explains the rational of the purposes of this study.

Bronfenbrenner's bioecological theory (Bronfenbrenner & Morris, 1998) was used as a theoretical framework in the joint contexts of Japanese middle schools, parental influence, and Japanese student math achievement. This theoretical framework was incorporated into each research question. This bioecological theory may be helpful in

a) explaining how reciprocal interactions between Japanese middle school students and their parents influence student academic achievement and in b) understanding how parental education as student context influences students' likelihood of participation in after school math lessons as an outcome. This theoretical framework was discussed in detail in the next chapter on literature review.

Research Questions

There were five research questions that all incorporated the theoretical framework. The first three questions attempted to measure the first purpose of this study (a). Multilevel analysis models were used to assess the first part of the research questions in order to emphasize the overall student and school SES relationships in regard to math achievement. The detail of the model specifications will be presented in the methods section.

1. Do Japanese eighth graders' levels of math achievement influenced by their SES vary across schools?

Two home microsystems as contexts (i.e. home possessions and parental education), person (i.e. Japanese eighth graders), proximal processes (i.e. studying math as supplemental education), and developmental outcome (i.e. math performance) were used to assess student SES in the bioecological theory.

2. Do Japanese student levels of math achievement influenced by their SES and school SES vary across schools after controlling their individual SES?

There were two aspects of school microsystems (i.e. the location of schools and the economically disadvantaged school status), home microsystems (i.e. home resources, and parental education), person (Japanese eighth graders), proximal

processes (studying math as supplemental education), and outcome development (math achievement) in the bioecological theory.

3. Does Japanese middle school SES moderate Japanese student SES and math achievement relationships?

This research question involved developmental outcome (math achievement), person (Japanese eighth graders), school microsystems (the location of schools and the economically disadvantaged school status), home microsystem (home resources and parental education), and proximal processes (studying math as supplemental education) in the bioecological model.

The last two research questions, 4 and 5, attempted to measure the second purpose of this study (b). The second part of the questions further focused on parental education, which is the most frequently used indicator for student SES. The research questions were to examine the relationships between shadow education and level of parental education in the context of schools. Multilevel ordinal regression analysis was applied.

4. Does Japanese eighth graders' likelihood of participation in extra math lessons influenced by their parental education vary across schools?

Guided by the bioecological theory, relationships between person (i.e. Japanese eighth graders), home microsystem (i.e. parental and maternal education), and developmental outcome (i.e. extra math lessons) were assessed.

The last research question emphasized whether mother's educational background would make a difference from school to school in terms of the likelihood of Japanese

student participation in extra math lessons. Maternal education was chosen because it was a significant predictor in research question four.

5. Does the relationship between maternal education and Japanese eighth graders' likelihood of participation in extra math lessons vary across schools?

Applying the bioecological theory, person (i.e. Japanese eighth graders), home microsystem (i.e. maternal educational background), and developmental outcome (i.e. math achievement) were evaluated.

Significance of This Study

Examining the relationship between individual SES and school SES in Japan is important for educators, students, schools, and parents in order to understand how these factors contribute to student academic achievement. Suggested educational policies are presented in the discussion based on the findings. Good research findings would be beneficial especially for students and their parents, who could thereby understand how they can improve their children's academic achievements.

Further, school administrators could plan to provide education in their schools that could overcome the inequities and injustices that currently exist. In addition, as most studies in this literature review were written only in Japanese, the majority of researchers outside of Japan may not know the current Japanese SES situation. It is important to produce and disseminate research findings that can provide understanding and further develop the field. For example, good findings may contribute to establishing educational policy. Furthermore, since Japanese researchers have not investigated the bioecological theory widely (e.g. Takata, 2012), there is a strong need to utilize this theory for examining the Japanese SES issues.

Consequently, this study examined SES situations in Japan and contributed to the field of educational psychology.

In summary, research on SES in Japan has been around only for a decade. Such research challenges occur in four areas: a) inadequate quality and quantity of studies, b) statistical issues, c) the combined influence of SES and non-SES, and d) inconsistent results on school impact. The recent unique Japanese cultural issues (i.e. the unavailability of nationwide tests to ordinary researchers and limited parental responses contributed to some of the challenges.

In the next chapter, relevant literature on the bioecological theory, student characteristics, school characteristics, measurement of SES, current perspectives on solutions, and Japanese middle schools will be reviewed. The methods, results, and discussion sections are presented after the literature review.

CHAPTER 2

LITERATURE REVIEW

In this section, SES terminology, relevant literature on the bioecological theory, student characteristics, school characteristics, measurement of SES, current perspectives on solutions, and Japanese middle schools are reviewed. In particular, critical reviews of the extant literature are added in order to improve the research design of this study.

Terminology

Scholars have used different terms to indicate SES. Some have used socioeconomic status, social class, social status, social inequality, poverty, and disadvantaged. In this study, these words may be used interchangeably, however, they all mean to indicate SES.

SES was defined as Japanese student parent(s)' wealth, educational achievement, home resources, and neighborhood environment that indicate social standing in this paper. In the first part of this study, student academic achievement as the outcome variable as measured by paper-and-pencil tests was referred to as Japanese student math achievement. In the second part of this study, supplemental education was assessed by Japanese students' likelihood of participation in extra math lessons after school and it was the outcome of interest.

Bioecological Theory

Urie Bronfenbrenner's bioecological theory (Bronfenbrenner & Morris, 1998) as a theoretical framework takes into account the joint contribution of middle schools, parent(s), and Japanese students' characteristics on their academic achievement in the

context of SES in study one. Bronfenbrenner's theory was also incorporated into analyses of parental educational backgrounds in relation to supplemental education in study two. Bronfenbrenner's bioecological theory is based on the original ecological theory (Bronfenbrenner, 1979).

Lerner (2005) explained that the bioecological theory consists of four interrelated components of developmental processes (process), an individual's biological, cognitive, emotional, and behavioral characteristics (person), an individual's nested context (context), and the relationship with time (time).

This theory was chosen because the bioecological model explains joint functions of developing individuals and their various surrounding contexts in relation to their developmental outcomes (Tudge, Mokrova, Hatfield, & Karnik, 2009). Since the bioecological theory has not been widely tested in the Japanese context (e.g. Takata, 2012), it is worth investigating this model in relation to Japanese SES. For example, researchers have examined the ecological theory (Bronfenbrenner, 1979) in Japan, but have not tested the theory in the context of SES. In addition, researchers have not widely used the bioecological theory in Japan.

> "In the bioecological theory, an individual's development is defined as follows; …development is defined as the phenomenon of continuity and change in the biopsychological characteristics of human beings, both as individuals and as groups. The phenomenon extends over the life course, across successive generations, and through historical time, both past and future". (Bronfenbrenner & Morris, 2006, p. 793)

The bioecological theory explains interactions between proximal processes, personal characteristics, context, and time in relation to an individual's development (Bronfenbrenner & Morris, 1998). These terms will be described below.

Process

There are two key propositions in the bioecological model. The scholars explained Proposition 1 as follows:

> Throughout the life course, human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving biopsychological human organisms and the persons, objects, and symbols in its immediate external environment. To be effective, the interaction must occur on a fairly regular basis over extended periods of *time.* (Bronfenbrenner & Morris, 1998, p. 996)

The first core of this theory is process. These enduring forms of interaction between organism and environment in the immediate context are called proximal processes and these are the core engines of one's development (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006). In the literature, the terms process and proximal process(es) are both used, Tudge et al. (2009) explained that process and proximal process have the same meaning.

In order for an individual to achieve progressive development, proximal processes must be increasingly complex and prolonged and must occur on a fairly regular basis. In other words, participating in activities on weekends does not contribute to one's development. If constant interactions do not occur, an individual's development

slows down or even reverses its direction (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006).

Bronfenbrenner and his colleagues (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2006) explained proximal processes with examples as follows: Proximal processes are seen within a person-person interaction and also person-objects, and person-symbols interactions. Examples of such interactions are child-child activities, groups or a single play, learning new skills, studying, problem solving, and acquiring new knowledge. For example, through complex interaction with their parents, children become active agents of their own development. Through such mutual interactions, parents facilitate a child's different aspects of development (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2006). Thus, proximal processes are crucial for one's developmental outcome.

Bronfenbrenner and Morris (1998) explained who facilitates proximal processes. Parents are not the only ones who can engage in proximal processes for their child's development, but also a third person can also facilitate a child's competent development function by engaging in joint activities with the children. The existence of this person, like parent(s), can also commit to the child's well-being and to mutual emotional attachment. People surrounding children, for example, friends, and relatives can also reduce children's dysfunctional developmental processes, especially in single-parent families (Bronfenbrenner & Morris, 1998).

Even though proximal processes are important for an individual's healthy mental and intellectual growth, some factors can restrict effective proximal processes from occurring. Growing chaotic systems (e.g. unstructured activities and unpredictability

in life) and environmental chaos (e.g. such as residential noise and classroom design) can inhibit one's developmental process (Bronfenbrenner, 2005). In order for effective proximal processes take place, environmental factors are important.

Proximal processes are like engines and core of one's developmental process, albeit they neither reproduce their own fuel nor control their own movement. Person and context provide fuel and movement to proximal processes (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998).

Proposition 2 explains the model with four interrelated elements of proximal processes, person, context, and time as follows;

> The form, power, content, and direction of the proximal processes effecting development vary systematically as a joint function of the characteristics of the *developing person*, the *environment*-both immediate and more remote-in which the processes are taking place, the nature of the *developmental outcomes* under consideration, and the social continuities and changes occurring over *time* through the life course and the historical period during which the person has lived. (Bronfenbrenner & Morris, 1998, p. 996)

As the scholars explicated, proximal processes are not limited to an interaction between people but also include an interaction between objects and symbols (Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006). In part one of this study, proximal processes refer to Japanese middle school students studying math after school in order to acquire knowledge and to develop problem-solving skills. In part two of this study, there were no proximal processes. The bioecological theory was partially examined because only parental education as home context, Japanese

middle school students as personal characteristics, and extra math lessons as developmental outcome were tested. Having extra math lessons was treated as a developmental outcome even though the likelihood of student participation in shadow education may not result in one's developmental outcome. Since parental influence may be substantial to one's likelihood of participation in extra math lessons, having extra math lessons was examined as a developmental outcome.

Proximal processes involve mutual interactions, proximal processes may involve reciprocal student-tutor or student-teacher interactions as supplemental education, albeit this study will not emphasize such person-person interactions, but rather person-symbols interaction. As it is common to examine a person-person relationship within the bioecological theory, it is worth investigating person-symbols instead. When students study math, they deal with math symbols, such as equations and signs. As students' grades are advanced, math subjects become more complex. The scholars wrote that although these types of proximal processes do not involve interactions with people, proximal processes can become complex, because effective proximal processes with person-objects and symbols involve attention, imagination, and exploration in order to acquire knowledge and skills (Bronfenbrenner, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006). For example, when students deal with math problems, they become attentive, use imagination, and explore different ways to solve math problems. These developmental processes primarily facilitate effective proximal processes.

Proximal processes result in two developmental outcomes-competence and dysfunction (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998).

Developmental outcome is the result of one's human development. The examples of developmental outcome are mental ability, academic achievement, moral, and social skills (Bronfenbrenner, 1994). Developmental outcome was the Japanese eighth graders' math achievement in study one. Developmental outcome was Japanese students' likelihood of participating in extra math lessons in study two.

When the developmental outcomes are applied in the context of studying math, students who are competent in math are able to demonstrate their knowledge, skills, and ability in math. They are also able to establish logical, rational, thinking, and problem solving skills, which are applicable in daily life situations. On the other hand, students who are dysfunctional in math have not developed the skills that the competent students acquire through studying math. These students do not have math-related skills in life situations and tend to remain in their same developmental stage.

Propositions 1 and 2 are theoretically interdependent and the research design to investigate such propositions is called the Process-Person-Context-Time or PPCT model (Bronfenbrenner, 1994; Bronfenbrenner, 1999; Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006). Bronfenbrenner's research design was employed in order to assess one's developmental result in this study.

Person

There are three types of important biological and genetic personal characteristics that contribute to the processes mostly throughout the life course development in order to affect content, form, power, and direction of the proximal processes (Bronfenbrenner & Morris, 2006). They are dispositions, resources, and demand characteristics (Bronfenbrenner & Morris, 2006). Disposition characteristics are a

temperament, motivation, and persistence, which set proximal processes in motion and continue to maintain proximal processes (Bronfenbrenner & Morris, 1998; Tudge et al., 2009). Resource characteristics are an individual's ability, experience, knowledge, and skills, which are necessary for effective proximal processes (Tudge et al., 2009). Demand characteristics are demographic information, such as age, gender, ethnicity, which immediately create stimulus to another individual (Tudge et al., 2009). Different combinations of personal characteristics lead to different developmental trajectories and proximal processes (Tudge et al., 2009). For example, Bronfenbrenner and Morris (1998) explained that individuals with generative personal characteristics, such as curiosity and outgoingness, may be engaged in effective proximal processes more than individuals with developmentally disruptive personal characteristics, such as apathy and aggression.

In summary, the characteristics of the person are not only a producer but also a product of development (Bronfenbrenner, 1999). Three different types of personal characteristics (i.e. disposition, resources, and demand) affect one's proximal processes and one's developmental outcomes. In this study, the personal characteristics were those of Japanese eighth graders who attended middle schools in Japan. Since all Japanese eighth graders must attend middle schools as compulsory education, personal characteristics apply to all Japanese eighth grade students.

Context

Context or environment has four interrelated systems-microsystem, mesosystem, exosystem, and macrosystem, which influence proximal processes (Tudge et al., 2009). Microsystem refers to the relation between a developing individual and the

immediate environment, such as home or school. The examples of people in microsystem are parent(s), teachers, mentors, spouses, and close friends, who could influence an individual' s developmental outcome (Bronfenbrenner, 1994; Bronfenbrenner, 1995). This factor engages in frequent participation of an individual's course of developmental life on a regular basis over periods of time (Bronfenbrenner & Morris, 2006). Mesosystem consists of two or more microsystems and involves at least two settings, including a developing individual with, as an example, home-school relations (Bronfenbrenner, 1994; Bronfenbrenner, 1999). Exosystem also includes two or more environments, however, it indirectly involves a developing person and one of the environments, which does not contain the developing person. An example is the relation between parent's workplace and the child's home. Stress caused by a workplace may affect a mother's mood in dealing with her child at home (Bronfenbrenner, 1994). Macrosystem refers to social structure or institutional patterns of culture, such as customs, beliefs (Bronfenbrenner, 1994; Bronfenbrenner & Morris, 2006). This can be used for comparing different cultural values or comparing high and low SES families.

In terms of research design, Tudge et al. (2009) suggested that scholars should use at least two microsystems (e.g. home and school) or two macrosystems (e.g. middle and working-class families from different cultural backgrounds) to compare and contrast in a study in order to assess effectiveness of proximal processes. In study one, the context consisted of microsystems of home (to assess individual SES) and middle schools (to assess school SES). In study two, one microsystem (both parental

educational levels), a personal characteristic (Japanese eighth graders), and developmental outcome (extra math lessons) were examined.

In sum, context influences proximal processes and one's developmental competence such as academic achievement. Bronfenbrenner and his colleagues described how two different contexts in SES could either support or undermine an individual's developmental competence (Bronfenbrenner, 1995; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998). Effective proximal processes are enhanced under stable, consistent, and predictable environments, particularly within a family. To the contrary, proximal processes are weakening under an unstable and stressful family environment, such as low-SES students who have grown up in such an environment. In addition, high and low-SES families engage in proximal processes differently. Low-SES parents focus their time and energy on reducing dysfunction and providing for children's needs, such as providing safe environments and making-ends meet, whereas high-SES parents focus on children's growing competence and knowledge, such as helping with their homework and providing educational resources. Although proximal processes are more effective in high SES, proximal processes also buffer the contextual differences in one's developmental outcome. For example, when mother-child interaction (proximal process) is constant on a regular basis, a child's problematic behavior (developmental outcome) is reduced especially for low SES families (Bronfenbrenner, 1994). This suggests that when effective proximal processes take place in low SES families, they help in reducing the negative influence SES to some degree.

Time

Time also influences proximal processes. Time has three different aspects: micro-, meso-, and macro-. Microtime is created when ongoing proximal processes discontinue and continue (Bronfenbrenner & Morris, 1998). Mesotime is the time internal of the period of proximal processes, such as weeks and days (Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006). Macrotime marks changes over one's life course, such as a change in the employment status and place of residence (Bronfenbrenner, 1994). Chaotic events, such as divorce, economic depression, can interrupt and undermine one's development (Bronfenbrenner, 1995).

In order to assess the influence of proximal processes in terms of time, the data should be longitudinal in nature and have at least two measurement points (Tudge et al., 2009). Unfortunately, the existing data in this study did not have any such longitudinal data. Since the existing data had only one assessment point in time in student academic achievement, it is impossible to incorporate the time component into this study.

Research Design Issues in This Study

Regarding the research design using the bioecological theory, scholars had several suggestions. Researchers should incorporate all four components of proximal processes, person, context, and time; however, the details of each aspect are not required (Bronfenbrenner, 1999).

A team of researchers disagreed with Bronfenbrenner's approach. Tudge et al. (2009) critiqued Bronfenbrenner's failure to make clear connections between his theory and methodological guidelines. Bronfenbrenner discussed how the theory was

utilized in others' work, albeit none of the works were specifically designed to test the theory.

Tudge and his colleagues (2009) suggested the following methodological advice. If scholars are unable to include one or more elements of the bioecological theory, they should clearly state that in order to preserve the integrity of the model. Partial tests of the model are possible as long as researchers identify them as such. In this study, proximal processes, personal characteristics, and contexts were incorporated in relation to Japanese students' developmental outcome. The main point for utilizing the bioecological theory is to emphasize how proximal processes are influenced both by personal characteristics and context in relation to an individual's developmental outcome. Even though the existing data in this study does not include two points of time measurement variables, the research design in this study is nonetheless justified.

Japanese Middle Schools

An overview of Japanese middle schools here may provide some context for readers who may not be familiar with that system. Three years of middle school is a part of the compulsory education that follows after six years of elementary school in Japan.

All compulsory public education is complimentary for all students regardless of their nationality. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) is in charge of implementing the educational system. In the past, the Ministry of Education served the same functions in implementing educational systems.

According to the National Institute for Educational Policy Research (2010), middle schools are made up of national, public, and private schools. Since the public schools comprise more than 90% in 2009, how different educational acts and the Constitution have played a role for equalizing public middle school education is described.

Results from nationwide test in the 1950s indicated that student academic performance significantly differed from prefecture to prefecture due to the prefectural educational expenditures in addition to the student family's economical differences and to educational environment differences. Hence, the uniformity of educational expenditures and of educational environments for students became problems needing solutions at the prefectural level. Since the Japanese government was already aware of the inequalities of school expenditures at the prefectural level, they created different acts in order to provide equal opportunities for middle school education (Kariya, 2006). After the war, Japanese mandatory education was prepared based on educational acts and the Constitution that focused on educational equalities and complimentary principles. For example, the old Act on National Treasury's Sharing of Compulsory Education Expenses in the 1940s mandated the government administration to share the costs with the prefectures for students' school expenses (Kariya, 2008; MEXT, 2010).

The purposes of the National Treasury's Sharing of Compulsory Education Expenses Act were designed to address the following concerns; a) The government should provide necessary structures in order to support mandatory education, b) The success of mandatory education depends on maintenance and replacement of

competent school teachers and staff, and c) It is indispensable to maintain necessary educational budgets on a regular basis in order to maintain and replace qualified school staff (MEXT, 2010). In addition to this act, another act-the Act on the Organization and Operation of Local Educational Administration also supported the equal school systems by subsidizing school staff expenses and providing strict guidelines on expenses. The government subsidizes school staff expenditures, while prefectures pay for city and counties' staff. Furthermore, the government standardized school equipment, school buildings, textbooks, the curriculum guidelines, and the quality of teachers in detail in order to equalize the school differences in the 1950s (Kariya, 2008). For example, MEXT examined the contents of textbooks and confirmed their accuracy and uniformity. This standardization of textbooks controls the content and knowledge that students learn in school.
In addition, public school teachers are required to transfer to other schools in order to maintain the quality of teachers every several years unlike private schools. This is how the government constructed the foundations of the unique Japanese compulsory education system.

The government continuously has designed uniformity for equal education under the Act on National Compulsory Education and gave more power to local authority. In the current act, prefectures, cities, and counties are able to structure the numbers of school staff and their salaries (MEXT, 2010). For example, the government set up a maximum number of 40 students in a classroom in the 1950s; however, schools are able to adjust the number of students depending on the situation (MEXT, 2010).

In summary, implementing equal mandatory education for Japanese middle schools was discussed. The Japanese government, prefectures, and city and counties all work together in implementing the acts in order to equalize compulsory education for middle school students. The government gives flexibility to prefectures in order to meet the demands of prefectural situations and supports prefectures' educational expenses.

The Measurement of SES

Before presenting the previous studies on SES in this literature review, it is important to present the measurement issues of SES even though it is uncommon to do so. The pros and cons of different SES indicators proposed by several scholars were reviewed and the decision on these issues at the end of this section is discussed. Since the SES studies started burgeoning a decade ago in Japan, the measurement issue has not yet been widely discussed in Japan; hence, U.S. scholars' different points of view is presented. Since measurement issues of SES are complex, scholars have conceptualized SES differently and have not reached a consensus yet (Sirin, 2005; White, 1982). For example, White (1982) found by examining about 100 existing studies for his meta-analysis that researchers have used wide varieties of SES indicators from family income, parental education, occupation of head of house, home environments (e.g. parents' aspirations for their children, cultural and intellectual activities of the family), to other indicators (e.g. number of siblings, ethnicity, dwelling value, school resources).

Despite the conceptual differences among researchers, they seem to agree with two issues; multidimensionality of SES and the usage of parental education. First,

researchers have agreed that multiple SES indicators should be included instead of a single indicator in their studies (Hoffman, 2003; Nonoyama-Tarumi, 2008). This is because when researchers use a single entity, results tend to overestimate the effect size of SES (Sirin, 2005). Second, parental education is one of the stable SES variables because it is unlikely to change over the years and it tends to be established in adolescent years (Sirin, 2005). This variable is also easy to obtain for researchers in order to examine student SES-achievement relations (Hoffman, 2003; Sirin, 2005), but not in Japan (Mimizuka, 2007). Hoffman (2003) stated that parental education is a useful measurement of SES. Thus, parental education was incorporated into this study. Since the influences of parental educational backgrounds may be strong and recognized SES indicators, both maternal and paternal levels of educational backgrounds were included. They were used in both part one and part two studies as the explanatory variables.

Researchers have utilized different parental variables in the past and present. Traditionally, paternal indicators, along with other variables were used in assessing SES (Entwisle & Astone, 1994), whereas current studies are more interested in gathering both paternal and maternal information (Sirin, 2005).

Scholars have different conceptualizations when it comes to multiple SES.

Entwisle and Astone (1994) suggested family structure should be included as one of the SES indicators. Specifically, the household structure includes number of birth parents, a stepparent, and a grandparent. They recommended researchers should use all three family structures in addition to income and education. Others also proposed that household structure is a recent trend (Magnuson & Duncan, 2006; Schiller,

Khmelkov, & Wang, 2002; Sirin, 2005). The measurement of three types of family structure proposed by Entwisle and Astone (1994) may not be applicable for Japanese families because most eighth graders live with their nuclear family. The inclusions of all three types of family structure-birth parents, a stepparent, and a grandparent may be difficult. The data from the Ministry of Health, Labour and Welfare showed that 23 percent live with grandparents in the 2010 data. Thus, utilizing family structure as a part of SES is irrelevant in this study.

Some scholars advocated income as a predictor. Others are interested in income as a predictor of SES for different reasons (Entwisle & Astone, 1994; Hoffman, 2003; Sirin, 2005). For example, Sirin (2005) stated that children were aware of their parent(s) income, which may reflect an influence of social and economic resources. Some children may be aware that their parent(s) are wealthy, however, they may not know their parental income. This also depends on the age of children. Hoffman (2003) also indicated that income is important in studies of poverty, especially at an early age.

Even though scholars (e.g. Hoffman, 2003; Sirin, 2005) emphasized the importance of income, some researchers have addressed the difficulty of collecting such information. A few investigators pointed out that parental income level is difficult to procure and the nonresponse rate is higher than other SES indicators such as education and occupation. Furthermore, they claimed that children did not know the parental level of income (Entwisle & Astone, 1994; Hauser, 1994).
Japanese scholars also expressed difficulty in collecting such personal information when they conducted a large-scale study (Makino & Mimizuka, 2004; Mimizuka,

2007). For example, Makino and Mimizuka (2004) found that when students' response rates were between 70 to 90 percent depending on the grade level, parents' response rates were below 30 percent. In the current situation, ordinary Japanese scholars are unable to obtain government data. Income may be a less important indicator for the following reasons: Hoffman (2003) argued the importance of income at children's early age may be irrelevant here. Since the primary focus is on eighth graders as subjects and middle school students are young adolescents, Hoffman's suggestion may work better with elementary school students rather than middle school students.

Some authors expressed concerns about the usage of income. The causality of income and poverty on student academic achievement is still controversial (Magnuson & Duncan, 2006). Additionally, income is not a stable indicator and is volatile; one single point of income should not be used as an indicator of permanent income (Hauser, 1994; Magnuson & Duncan, 2006; Nonoyama-Tarumi, 2008). Since there are more cons than pros, this variable was excluded from this study.

Instead of income, some educators consider wealth as an indicator of SES (e.g. Hauser & Warren, 1997; Sirin, 2005; Orr, 2003). Sirin (2005) argued that researchers should use wealth especially for studies of minorities because income and wealth are not necessarily linked. In addition, wealth may be more stable and less volatile than income. Orr (2003) argued that wealth is an indicator of student achievement-SES relations. Her results indicated that wealth affected student math achievement even after SES indicators, such as parental education, occupation, and income were controlled. She claimed that wealth tends to intensify student achievement influence

more than income and provided an example of two families with similar income but different levels of wealth may have different degrees of opportunities for their children. She continued that parents could use wealth to provide different educational activities for their children so that children can advance their knowledge outside of school. By using Orr (2003)'s argument, wealth can be substituted and measured by after school educational activities, for example, as in having extra lessons or a tutor after school. Wealthy parents can afford the ongoing cost of extra lessons unlike some home resources. Especially, it may be critical for Japanese eighth graders to study after school because they need to prepare for competitive high school exams in the following year. Going to academically competent high schools and universities determine students' future employment. Parents, especially high SES parents want their children to go to a prestigious school because it determines their children's future and parents also influence which supplemental lessons their children choose. Since the middle school subjects become more complex and many parents are unable to help their own children academically, affluent parents tend to send their children to "juku"(private after-school classes).

In addition, when students have some questions about the class subjects, students may ask questions of their tutors or "juku" teachers rather than their schoolteachers in the classroom. The existence of "juku" is important. More detail about "juku" is explained in the shadow education section.

Occupation is another popular indicator and is linked to income and education and provides the social and economic status of the family (Hauser, 1994; Hoffman, 2003; Sirin, 2005). Even though Hoffman (2003) supported an occupational indicator,

Hoffman himself and Magnuson and Duncan (2006) admitted that direct causation to student achievement is not clear. Occupation may be an unstable indicator like income because it measures only a single point of time in a questionnaire.
When considering the current unstable work situations in Japan, parent(s) may not be able to hold the same jobs for long periods of time, especially when they work on a contract or on a part-time basis. Nakazawa (2007) indicated a doubling of people on part-time jobs from the late 1980s to the present. Workers' employment status has changed over the years and most companies seldom offer lifetime employment in Japan. Therefore, the usage of occupation may be a questionable indicator for this study.

The inclusion of home possessions is a recent trend in indicators. Sirin (2005) stated that the usage of home possession is not common in the U.S. compared to other indicators such as parental income; nonetheless, more researchers utilized home resource variables as one of the indicators of individual SES.

Despite the recent popularity, some researchers disagreed with home resources as a SES indicator. For example, Magnuson and Duncan (2006) argued that home resources might not be appropriate SES indicator because they reflect parents' preferences more than their social and economic status. Duncan and Brooks-Gunn (1997) also argued that home possessions become less important when children grow up because of increasing importance of the school and neighborhood environments.

However, many researchers (e.g. Hojo, 2011; Lee & Croninger, 1994; Liu, et al., 2006; Oshio; 2010; Yoshino, 2012) discovered the positive influence of home possessions in relation to academic achievement for young adolescence. Thus, the

inclusion of home resources is relevant for middle school students. The proponents of home possessions also argued that wealthy parents could afford educational-related items, such as computers and books, in order to enhance their children's academic achievement (Orr, 2003; McLoyd, 1998). Hauser and Warren (1997) also must have seen the importance of home resources and included them as a definition of SES. In addition, Sirin (2005) conducted meta-analyses on SES-academic achievement using U.S. studies, concluded that weighed ANOVA produced a highest mean for home resources in relation to student achievement more than traditional SES indicators, such as family's occupation and income. Thus, examining home resources-student achievement relations is important for this study.

Some research teams supported neighborhood environment as an indicator (Duncan & Brooks-Gunn, 1997; Magnuson & Duncan, 2006). Proponents of a neighborhood indicator discussed that neighborhood indirectly influenced children's development (Bronfenbrenner, 1986) and future studies should incorporate this indicator since it has not received much attention (Sirin, 2005). Some neighborhood environments are also underdeveloped in Japan; Examining a neighborhood environment indicator is crucial.

Despite the pros and cons of the selection of SES indicators, the choice of indicators depends on the study (Hoffman, 2003). After reviewing the various SES issues, the measurement of SES includes parental education, wealth (substituting after school academic lessons), home resources, and neighborhood environment in this study. Summary and critique of the previous literature on home possessions, wealth

as supplemental education, and parental level of education as student characteristics will follow in the next section.

Student Characteristics

Researchers have agreed on the impact of individual SES in relation to student academic performance in Japan (e.g. Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Kariya, 2008; Liu et al., 2006; Mimizuka, 2007; Nara, 2010; OECD, 2013b; Yoshino, 2012), and in both developing and developed countries (Nonoyama-Tarumi, 2008). The impact of student SES seems to be global. Previous research on the student SES-academic achievement relationship is explained in this section.

Home possessions, shadow education, parental education, and parental education-shadow education will also be presented.

Home Possessions

Several researchers have included different home possessions in their studies to examine the influence of home possessions in relation to math scores. For example, Liu et al. (2006) found that availability of computers and the number of books at home were both positively related to student math achievement in US, Korea, Singapore, Hong Kong, and Taiwan. Overall, home possessions seem to be relevant variables to student achievement.

In Japan, different researchers (e.g. Mimizuka & Makino, 2004) have included different home resources in their studies in order to examine the relationship between students' math achievement and home resources. Examples of home possessions are the possession of books, study rooms, computers, number of books, dictionaries, and Internet connection.

Some have included possession of books and study rooms as home possessions in their studies (e.g. Mimizuka & Makino, 2004). They concluded from an analysis of ANOVA that when parents had higher education, ninth graders had more books and possessed study rooms. A question asked students whether they had many books or not. This type of question might have been vague for students to answer and affected the finding. It would be helpful if students had several choices for answering number of books.

Several researchers conducted studies including home resources with Japan TIMSS data (Hojo, 2011; Liu et al., 2006; Oshio; 2010; Yoshino, 2012).
For example, scholars utilized different individual home resource variables, such as the possession of computers and the number of books (Liu et al., 2006; Yoshino, 2012) and found statistically significant results in student academic math achievement. Among home resources, Yoshino (2012) only included number of books as a variable, while Liu et al. (2006) included number of books and the possession of computers in their studies. It is not clear why Yoshino (2012) included the number of books variable in her study since her topic was student's math self-concept.

While researchers supported the positive relationship between number of books and math achievement, Hamano (2009a) did not find any relation between the amount of books and arithmetic scores for sixth graders based on a multiple regression analysis with the national test results. The reason for this non-significant result is unclear. This can be due to how the question item was framed; the question item stated, "There are many books in my home." and respondents were asked to answer

either “yes” or “no.” Students might have been confused about the definition of many books and this type of question might have skewed the findings.

A few scholars included more home resources from Japan TIMSS data. Both Hojo (2011) and Oshio (2011) included the possession of computers, study desk, dictionary, Internet connection, and the number of books at home. Even though they included a number of items as home resources, the authors could be more selective in the choice of their variables. The authors included the possession of a study desk and dictionary variables, and they are ubiquitous in Japan. TIMSS 2003 data showed that more than 90 percent of students, or 4,370 students possessed these common resources, it may not be relevant to include these variables into future analyses.

Regarding the number of books, both authors included four ordinal scales of number of books at home, such as 11-25, 26-100 and so on. They concluded that all levels of books students had at home made differences in math test scores; the more books students owned at home, the better grades they received. These findings imply that students who had many books might have had better reading skills than those who had fewer books.

The inclusion of other home possession variables such as computers is a more up-to-date and technology-related variable that should be incorporated into studies to be relevant to the current middle school students’ situation. TIMSS 2003 showed that 81 percent of eighth graders, or 3,900 students had computers at home. Even more middle school students may use technology, such as computers in their studies, in current and future studies. Previous research (e.g. Hojo, 2011; Liu, Wu, & Zumbo, 2006; Oshio, 2011) also supported that the possession of a computer made a

difference to math achievement. However, why the possession of a computer was positively related to student achievement is ambiguous. It would be useful to find out why computers are useful for student achievement. Furthermore, since buying a computer is more expensive item than any other home possession items and this reflects the level of parental income or wealth, it is important to include this variable in this study. Overall, home possessions make differences in student academic performance. Uncovering the impact of home possessions may help in understanding why some Japanese students had higher math achievement.

To summarize, researchers have conceptualized home resources differently. Some were more focused on the details of home resources and others were interested in overall influence of home resources. What is unclear in the extant literature is which home possession contributes to Japanese student math achievement. Identifying influential home resources variable helps researchers understand why some Japanese students had higher scores in math achievement.

Shadow Education

Shadow education (supplemental education) is ubiquitous, especially in East Asia, such as Japan, South Korea, and Taiwan (Bray & Kwok, 2003). The trend in shadow education is not limited to Asia anymore. Shadow education is not only common in East Asia, but also in other parts of the world, such as the US (Buchmann, Condron, & Roscigno, 2010; Yi, 2013), Europe (Bray & Kwok, 2003), Turkey (Tomul & Savasci, 2012), and Hong Kong (Bray & Kwok, 2003). The possible reason for the well establishment of shadow education in East Asian countries may be the influence of Confucian beliefs (Bray & Kwok, 2003).

First and foremost, shadow education is seen in a diverse range of societies regardless of one's ethnic background, socioeconomic status, and types of government (Bray & Kwok, 2003). Second, educational attainment is increasingly important in the competitive world economy. Most people need good college degrees to quality for good jobs and advancement (Yi, 2013).

Although shadow education has been popular, it has disadvantages as well. Shadow education creates student depression, academic dishonesty by students and parents, disassociation from peers, and institutional cheating (Yi, 2013). Foremost, it exacerbates social inequalities (Bray & Kwok, 2003).

Just like parents in other countries, parents in Japan tended to spend more on outside-of-school educational expenditures among the OCED countries (Aoki, 2005). This suggests that Japanese parents are more likely to spend money for their children's education. One of such educational expenditures is supplemental education. Supplemental education may be a crucial issue for assessing middle school student math achievement in Japan. In TIMSS 2003, almost 50 percent or 2,280 Japanese students of eighth grade have participated in either extra lessons or learning with tutors after school.

It is commonly believed that studying in public schools is inadequate; thus students attend many types of after school academic activities, such as "juku" (private after-school classes), "yobikō" (private schools for preparation for university entrance exams), mail correspondence studies, at-home tutoring (Nakazawa, 2013), and online tutoring (Yi, 2013). For the majority of Japanese students, the high-stakes tests are high school and college entrance exams. Outside school educational activities are

called shadow education and it is necessary for educational attainment for students (Stevenson & Baker, 1992; Yamamoto & Brinton, 2010). Yamamoto and Brinton (2010) explained that this is an important concept for understanding the Japanese educational situation. In Japan, there is a variety of after school activities for students. Some offer educational activities and others provide non-educational activities. This study focused on after school educational activities since they may have an impact on student math achievement.

Sato (2005) noted that shadow education, especially "juku", is a big business in Japan. "Juku" established their position in the 1930s as a supplement for learning after school. There are over 50,000 "juku" nationwide and the business has grown to $95 billion. "Juku" charges about $300 for three hours per day for three days a week per month (Sato, 2005). Furthermore, the prestigious "juku" that offer high school entrance exam preparation classes are able to charge more. They charge about $460 for middle school students per month (Tsumura, 2005). Obviously, wealthy parents can afford such after school activities. There are two types of "juku". The first type of "juku" is called "juken juku", which is used for students studying for high school entrance exams. This is different from western remedial classes. The second type is called "gakushū juku" and used for students to catch up on school subjects (Hamano, 2009b). Sato (2005), referencing the Ministry of Education, Culture, Sports, Science and Technology (MEXT)'s questionnaire results, indicated that 75 percent of public middle school students attended "juku" more than public elementary and high school students did, which suggests that studying at public schools is not enough.

Consistent with the popular demand in shadow education, shadow education was related to student achievement. In a study conducted in Turkey by Tomul and Savasci (2012), shadow education was also related to student achievement. Attending private lessons and the duration of private lessons were strong determinants of students' scores.

On the contrary, some studies found both positive and negative results in shadow education. Liu et al. (2006) found that shadow education measured by extra math lessons were significant in the US, Hong Kong, Singapore, Taiwan, and Korea. However, shadow education was negatively related to student achievement in Korea and Taiwan. The reasons for the negative impact of shadow education was explained by Yi (2013) as the negative side of shadow education, such as cheating, emotional distress, and fatigue experienced by Korean American in Southern California.

In the context of middle school students in Japan, it is prevalent that middle school students use shadow education in order to pass competitive entrance exams for high schools (Stevenson & Baker, 1992). Kariya (2008) concluded that students who do not use "juku" are underprivileged. He stated that middle school students, who neither had any private tutor nor went to "juku", scored the worst compared to those who had private tutors and who had participated in "juku". Kariya (2008) proclaimed that the public school education in addition to student SES negatively contributed to student achievement and stated that educational policies are one of the reasons for this situation.

Supporting Kariya (2008), many researchers drew the conclusion that participating in "juku" was related to student academic achievement (Hamano, 2009a; Hamano,

2009b; Hiragi, 2008; Kariya, 2004; Kariya, 2008; Liu et al., 2006; Makino & Mimizuka, 2004; Yamamoto & Brinton; 2010). For example, Hamano (2009a) concluded based on a regression analysis with the nationwide test that students who attended "juku" scored higher than those who did not. Hamano (2009b) further examined what types of "juku" were related to student math achievement.
He investigated how two types of "juku": one is for studying advanced math for high school entrance exams and the other one is for catching up with math would result in differences in students' test scores. He concluded that middle school students who studied advanced math in juken "juku" scored highest; however, his conclusion was based only on descriptive statistics. More advanced analyses would be helpful for understanding the roles of these two "juku" in relation to math achievement.

On the contrary, Kariya (2008) had different findings among others' and his own finding (2008). Kariya (2004) conducted a logistic regression and found out that "juku" did not make any difference in their likelihood of being below 50% in math scores. His finding was inconsistent with other findings (Hamano, 2009a; Hamano, 2009b; Hiragi, 2008; Kariya, 2008; Liu et al., 2006; Makino & Mimizuka, 2004; Yamamoto & Brinton; 2010). This result may imply that a specific type of "juku" was a predictor for student achievement.

A research team included extra lessons or tutoring variable from Japan TIMSS data for their two-level multilevel analysis models (Liu et al., 2006). Even though this variable was related to eighth graders' math achievement, the estimated regression coefficient was not strong. In a future study, it will be useful for understanding how extra lessons or tutoring would play a role in relation to other SES

related variables. Although it seems that extra lessons or tutoring variable has been used in several studies for middle school students, Yamamoto and Brinton (2010) criticized that the inclusion of this variable in many empirical studies at the high school level or in later educational attainment is problematic and recommended this variable should be used in order to assess early academic achievement as well as in later educational attainment.

The investigation of this variable is important at the middle school level.

In summary, the trend of shadow education is global. Even though shadow education is likely to be helpful for students, it also intensifies inequality in education. Shadow education is a distinctive educational phenomenon and has a long history in Japan. Students who do not participate in shadow education are likely to be underprivileged. Shadow education tends to differentiate student academic achievement and it is commonly believed that it is necessary to participate in shadow education to compensate for the public middle school education. Hence, it is essential to investigate the impact of shadow education as extra math lessons for Japanese eighth graders in the unique context of the Japanese culture.

Parental Education

Parental influence seems to be unavoidable for student academic achievement. Overall, indirect parental influence of students' home resources and shadow education contribute to student test scores. Furthermore, direct parental level of education influences their children's academic achievement in a nontangible way.

Entwisle and Astone (1994) stated that parents with higher education degrees could help their children's work, encourage them to pursue higher education, and

develop their language abilities. In addition, educated parents can afford a higher quality of educational services, whereas under-educated parents have limited access to such higher quality of educational services (Schiller, Khmelkov, & Wang, 2002). Hamano (2009a) confirmed that both father and mothers' level of education were correlated moderately with educational expenditures outside of schools and their income level.

Some researchers argued that parental level of education is more influential than parental income on children's educational attainment (Kariya, 1995; Kikkawa, 2009; Miwa, 2008). Kikkawa (2009) claimed that parental income seems to be more visible in relation to student educational attainment, however, other factors, such as parental educational background, are more deeply related to children's educational attainment. It seems that including parental educational background in analyses is more crucial than parental income because parental educational level affects their children a great deal.

Parental levels of educational achievement are also related to their children's achievement. A recent cross-national study revealed that both parental educational backgrounds were influential on student achievement in 32 mostly OECD countries using 2000 PISA data (Marks, 2008), Turkey (Tomul & Savasci, 2012), and Canary Islands (Sanchez, Montesinos, Rodriguez, 2013).

In Marks' study (2008), he found both father and mothers' education levels were significant to student math and reading achievements. Paternal influence was stronger in math, whereas maternal influence was stronger in reading. This may imply that there are gender differences in subject matters.

On the contrary, some studies presented mixing findings on parental education. Liu et al. (2006) found that parental education was related positively to math achievement in the US and Taiwan, but not in Korea, Singapore, and Hong Kong. The reason may be that they chose only the highest parental education from either mother or fathers' levels of education. This might have reduced the positive impact of either mother or fathers' levels educations.

Higher parental level of education affected student academic achievement more positively and lower parental education negatively influenced student test scores (e.g. Kaneko, 2004; Morota, 2004). There are three possible reasons why parental educational background affects their children's academic achievement (Namba & Hatanaka, 2012). First, Namba and Hatanaka (2012) argued that since there is a relationship between parental higher educational degrees and higher level of intelligence, their children may inherit those parental intelligence levels. Therefore, students with college degree parents do better than those with high school degree parents. Kaneko (2004) confirmed that elementary school students with college graduate fathers required less effort to do well in arithmetic than those who did not have college graduate fathers. Kaneko added that it is important for students with non-college degree fathers to make extra efforts in order to catch up with those who have college degree fathers, however, when it comes to advanced school subjects, efforts may become less effective. Second, since there is a correlation between parents' higher level of education and higher level of income, parents spend more educational expenditures on their children. Parents with higher income can afford to spend more money than lower income parents on their children's educational

activities (Namba & Hatanaka, 2012). Third, higher educational degree parents have, higher educational aspirations for their children. Hamashima and Takeuchi (2002) claimed that mothers' educational aspirations were most influential on their eighth graders' educational aspiration in the metropolitan Tokyo area. Since more than 14 percent of students attend private middle schools in the area (Mimizuka, 2007), maternal educational expectations may be higher than in other areas.

Whereas researchers have used the Japan TIMSS data sets from different years, some chose the highest educational level of one parent and others chose both parental educational levels. Liu and her team (2006) used the highest level of education of either father or mothers' educational attainments from Japan TIMSS datasets. Even though their research concluded that parental level of educational made a difference in student math achievement, their approach ignored the separate influence of father or mothers' educational influence. On the contrary, Yoshino (2012) incorporated both father and mothers' educational backgrounds and concluded that both educational levels had impacts on eighth graders' math achievement. The trend in the U.S in this matter has changed from the past and to the present. It is common to include both father and mothers' degrees in recent years (Sirin, 2005); however in the past, U.S. researchers had only used the fathers' educational degrees (Entwisle & Astone, 1994).

Another inconsistency in research is the operationalization of level of parental education. Some were interested in how each level of parental educational background from Japan TIMSS data was related to student math scores (Hojo, 2011; Oshio, 2011). Researchers used four levels of both father and mothers' education:

high school, junior college, college and beyond, and unknown from the same datasets (Hojo, 2011; Oshio, 2011). Oshio (2011) discovered that both fathers and mothers' four levels of education made differences to student scores. Japanese students with college graduate fathers had higher scores than any other groups. Hojo (2011) also supported Oshio's (2011) findings.

Another issue is that researchers had incongruent findings about which parental educational background was more influential on student academic performance.

Some scholars have discovered that fathers' educational backgrounds influenced their children's test scores (e.g. Fujita, 2007; Kaneko, 2004). Middle school students with college graduate fathers studied longer and received better scores in math (Fujita, 2007). Kaneko (2004) further explained when school subjects become more complex over the years, academic differentiation between students with college degree fathers and those without college degree fathers became wider.

Other scholars supported the usage of maternal education. Hauser (1994) recommended that scholars should use the educational attainment of mothers. This indicator is also most frequently used in the existing literature (Ensminger & Fothergill, 2003). Studies have found that maternal educational achievement was more influential than paternal educational attainment on student math scores. Hamano (2009a) discovered that only mothers' education was a predictor for sixth graders' arithmetic achievement based on a multiple regression analysis. Kikkawa (2009) also argued that mothers' educational background is a key to explain children's educational attainment. Hojo (2011) also found with Japan TIMSS data that the impact of mothers' educational background was more influential and that

students with community college degree mothers did better than students with college degree mothers. He did not explain why students with community college background mothers scored the highest among the groups.

Nonetheless, TIMSS had high level of "I don't know" responses in both paternal and maternal education and researchers uncommonly discussed this issue.

For example, Yoshino (2012) used both parental levels of education in the Japan data sets and did not discuss the missing values and "I don't know" responses. It seems that she had deleted all the missing values and "I don't know" responses. As a result, about 1,600 student responses or about 40% of parental responses were removed from her analyses, and this resulted in large loss in data. This large loss of data can create bias in her findings.

Some researchers had different approaches. For example, Marks (2008) did not include Japan's data sets due to the high missing values in parental levels of education. Nonoyama-Tarumi (2008) addressed their results in using Japan's data with the warning that due to the high missing values, their results should be interpreted with caution.

Hojo (2011) is the only one who mentioned this issue of parental levels of education. He used TIMSS 2007 data and found that 25 percent of students did not know their mother's highest educational attainment and 30 percent did not know their fathers' highest levels of education. In order to deal with this issue, he created another dummy variable "I do not know". Regardless, these researchers' different approaches did not solve the "I don't know" issue and the missing values issues. Statistically appropriate techniques should be addressed and conducted to deal with

high missing values and “I don’t know” issues. Please refer to the method section for solving these issues.

Parental level of education influences not only student academic achievement, but also parental educational aspiration. Parental educational aspiration also affects student achievement. Mothers’ educational aspiration was most influential on students’ test scores. Hamashima and Takeuchi (2002) concluded from a path analysis that mothers’ educational aspirations had direct influences on eight graders’ achievement. They also examined a cross-sectional study for three years and their sample size was more than 1,000. However, all their participants resided in Tokyo area, where parental aspiration tended to be higher than any other area in Japan. In Tokyo, more than 14 percent of students attended private middle schools, meaning that those students’ educational aspirations were high.

In summary, although the impacts of both parents’ education influenced student achievement, research findings were inconclusive on the influence of paternal and maternal education. Some supported a stronger influence of paternal education; others supported a stronger impact of maternal education. Further, Japan’s TIMSS had missing values and “I don’t know” responses, this issue should be resolved before analyses. Thus, it is important to clarify the following issues in parental education; a) which parent’s educational background is more influential, b) which parental levels of education, such as high school and college, is most influential, and c) the handling of “I don’t know” responses and the missing values.

Parental Education and Shadow Education

Besides the shadow education-student academic achievement relationship, the parental level of education and shadow education relationship should be considered. This is because factors other than economic status may influence students' participation in shadow education (Bray & Kwok, 2003). Especially a mother's influence in her child's shadow education seems to be more emphasized in societies, which have a "tiger mother", a Chinese mother who demands high academic excellence and "kyoiku mama", a Japanese mother who has excessive educational aspirations for her child. These terms both express the mothers' excessive high academic expectations and demands for their children's academic excellence.

Parental educational attainments are also a recognized and commonly used student variable to assess SES that should be further examined. Since parental education tends to influence their children's achievement, it is posited that parental level of education influences their children's participation in shadow education.

Even though it is more common to examine the impact of parental level of education to their children's academic achievement, several studies examined the relationship between parental education and shadow education.

Some researchers have studied the relationship between parents' educational levels and the likelihood of attendance in shadow education. About 73% of students of parents with university or higher degrees have participated in academic shadow education, whereas only 36% of students of parents with primary education or less have participated in Hong Kong (Bray & Kwok, 2003). In Japan, Matsuoka (2012) did not use parental education as a predictor, but confirmed that high SES students

were likely to participate in shadow education. These two study results indicated that high SES and higher parental education levels influence students' participation in shadow education.

Other studies examined the relationships between parental education and types and hours of participation in shadow education. Nakazawa (2013) investigated how both parental educational backgrounds influenced their children's experiences in different types of shadow education. There was no relationship between maternal and paternal level of education and their children's experiences in tutoring in logistic regression. However, female students with higher educational background mothers were more likely to participate in mail correspondence studies. Both male and female students who had middle school graduate parents were less likely to participate in any types of shadow education ("juku", mail correspondence studies, and tutoring).

In a study conducted in Hong Kong, Bray and Kwok (2003) found only maternal education influence on tutoring, but no paternal education level influence. Although there was no difference between undergraduate mothers and high school or lower education mothers in their choice in private tutoring, students with more educated mothers (i.e. college degrees) were 45.4% more likely to choose private tutoring, while students with postgraduate degrees, the probability was 45% less likely to choose private tutoring. The scholars suggested that those mothers may have different perceptions of schooling, but did not offer clear interpretations.

Hirao (2003) discovered that even though paternal level of education did not influence Japanese middle school students' number of hours of attending "juku" in

ANOVA, she found that high school and vocational school graduate fathers influenced their elementary school children's hours of attending "juku".
She concluded that these fathers may want their children to have a better social status; therefore, they tend to spend more educational expenditures on their children.
Her conclusion is the opposite of other researchers' findings such as Nakazawa' s (2013). Her findings may be due to a skewed sampling; her respondents were all from members of a Labor Union. As members of the labor organization, high school fathers might have had higher educational aspirations for their children's attending shadow education.

To summarize, the previous findings have examined students' participation in types of shadowing, hours of participation, and their likelihood of participation in shadow education. Thus, it is necessary to conduct how both parents' levels of educational backgrounds would influence Japanese eighth graders' chances of participation in shadow education (i.e. their frequency of participation in shadow education). Further, to identify which parental educational attainment is more influential to their children's participation in shadow education would be intriguing. As Hirao (2003) indicated different grade levels influenced the number of studying hours in "juku", investigating the impact of the eighth grade is important. Parental levels of educational backgrounds are crucial to investigating whether students' likelihood of participation in shadow education is influenced by their parents' educational level.

School Characteristics

Even though the impact of individual SES seems to be larger than school-related SES in Japan (Hojo, 2011; Liu et al., 2006; Oshio, 2011), the influence of school SES may be still influential in relation to student academic achievement. In the next section, literature on schools with economically disadvantaged student backgrounds and the location of schools in Japan will be examined.

Schools with Economically Disadvantaged Students

Economically disadvantaged school impacts seem to be global. Many investigators have found the influence of schools in relation to student academic achievement in the U.S. (e.g. Beese & Liang, 2010; Condon et al., 2012), and other countries (e.g. Beese & Liang, 2010; Liu et al., 2006). Condon et al. (2012) found that students who were not eligible for free or reduced lunch scored 9.77 percentage points lower in fifth grade and 7.37 percentage points lower in eighth grade science tests in Minnesota. Students' participation in school lunch programs is used to determine a schools' economically disadvantaged background in the US. In other countries, such as Korea and Taiwan economically disadvantaged schools were also negatively related to student math achievement while economically affluent schools were positively related to math achievement in Taiwan (Liu et al., 2006).

Generally, research on Japanese economically disadvantaged schools in relation to math achievement by Japanese researchers is congruent (Makino & Mimizuka, 2004; NIER, 2009a; Nukata et al., 2008; OECD, 2013; Shimizu & Fujii, 2009).

The research findings in Japan were mostly based on descriptive statistics, correlation, and multiple regression analysis and only a small number of findings

were based on multilevel analysis. For example, Nara (2010) used the findings of descriptive statistics from the nation-wide math achievement tests and concluded that middle school students from economically disadvantaged schools underperformed compared to those from high economically affluent schools. As Kariya (2008) critiqued, many research findings were based on averages of student test scores and correct answers. These basic statistical findings only gave the readers basic information about the data. NIER in Japan (2009a) used multiple regression analysis with the nation-wide tests and concluded that school SES was one of the predictors for middle school student math scores. They claimed that nationwide tests, which have student data nested within school data, are under utilized and suggested the importance of conducting more sophisticated analyses to understand the relation between variables and test scores. In this way, they continued, some weak variables in relation to student achievement may become relevant. Thus, more sophisticated analyses, such as multilevel analysis, would be useful for making an advancement in Japanese SES studies (NIER, 2009a).

Many statistical analyses from previous research (e.g. Nara, 2010; NIER, 2009a; Nukata et al., 2008; Shimizu & Fujii, 2009) examined only student-level variables on student academic achievement and their results have limitations. For example, Nukata et al. (2008) used an average income level of the communities of over 15,000 middle schools and found mixed findings of the influence of school economic status. Student math scores were positively correlated with an average income level in some prefectures; however, student scores were negatively correlated with average income level in other prefectures. In some prefectures, there were no relationships between

the variables. Their research indicated that there were regional differences on the impact of school surroundings. Nukata and his colleagues (2008) suggested that it is necessary to include other school characteristic predictors to clarify the impact of schools in a future study. Hiragi (2008) stated that scholars commonly use the percentage of social welfare in income as an indicator for family economic status to measure school with economically disadvantaged students in Japan. However, this is not the case for most researchers who are unable to obtain such data. As Hiragi (2008) pointed out, his conclusion was only based on comparison between prefectures, but not on individual-based comparisons. He continued, this approach would create an ecological fallacy, which is to draw a conclusion on individuals based on group data. He recommended that a multilevel analysis is needed for school, individual, and prefectural level.

Several scholars drew conclusions based on multilevel analysis. Shimizu and Sudo (2008) analyzed sixth graders' arithmetic test scores in a prefecture with two-level multilevel analysis models. Findings indicated that using only one economically disadvantaged school predictor was significant, but the regression coefficient was small (-.06). In addition, they entered class size and school SES variables into one equation and compared the two districts within the same prefecture. They discovered the influence of both class size and school economic status were significant with arithmetic achievement and concluded that elementary school students were more susceptible to the location of schools but these regional effects were diminished with ninth graders. Since Shimizu and Sudo (2008) did not find any

middle school impact, which suggests that grade level may be another important factor.

The impact of grade level has mixed findings in U.S. studies (Sirin, 2005). In his meta-analysis, the correlation between student achievement and student SES increased with the grade level, except for high school students. White's (1982) meta-analysis of SES studies in U.S. concluded that when the unit of analysis was student, the correlations between higher-grade levels and achievement were reduced. There are two possible reasons for this result as follows (White, 1982): First, as schools provide equalizing experiences to students, the relation between student SES and achievement is diminished when students grow older. Second, as more low-achieving students in higher grades drop out of schools, the magnitude of the correlation between SES and achievement is reduced. These possible explanations may not be applicable to studies including grade level in Japan. If the first explanation is applicable, there should be a stronger student SES-achievement relationship in elementary school rather than middle school. The second reason probably does not apply in Japan because student high school dropout rates are a slim 1.6% in 2010 (MEXT, 2010).

One scholar used multilevel analysis for school analyses. Ando (2008) conducted another two-level multilevel analysis of school and district level and discovered that size of school and school economic status were statistically related to school average test scores in arithmetic in one prefecture. Even though his analysis did not involve the individual-level analysis, his research still indicated the overall effect of school economic status. These scholars' (Ando, 2008; Shimizu & Sudo, 2008) purpose was

to investigate only one prefecture and they did not examine the impact of overall schools with economic backgrounds in Japan. In addition, the researchers did not investigate the combined influence of student and schools with economic backgrounds (cross-level interactions) nor whether the proportion of within and between group variances accounted for math scores. Further, as the scholars did not conduct any model comparison, the most parsimonious model, and variance reduction was not clear.

Moreover, the researchers' studies were based on sixth graders and middle school students may be affected less by the impact of school economic background (Ando, 2008; Shimizu & Sudo, 2008). Further, Ando's (2008) and Shimizu and Sudo (2008)'s analyses included only public schools and did not include private and national schools. The impact of schools with students with different status of economic backgrounds and the location of schools should be examined with middle school students in a large-scale database, such as TIMSS.

Several researchers used Japan TIMSS data sets in order to analyze school SES. Oshio (2011) revealed that more than 25 percent of eighth graders who had economically disadvantaged backgrounds in schools were about 24 points behind in math compared to their counterparts; however, he did not find any significant result when the students' percentage was less than 25 percent. Hojo (2011) used the same Japan TIMSS data and he also concluded that regardless of the percentage of low economic status, students in low economic status schools scored less than those in high economic status schools.

Even though a majority of scholars supported the negative influence of low school SES, one research team did not find any school SES impact using the Japan TIMSS data set (Liu et al., 2006). These scholars also used two-level multilevel analysis models with two school economic status (i.e. high and low economically disadvantaged schools) predictors and other school variables with respect to eighth graders' math performance. Liu et al. (2006)'s result on school economic impact was contradictory to other results (e.g. Hojo, 2011; NIER, 2009a; Oshio, 2011; Shimizu & Sudo, 2008). For example, NIER in Japan analyzed a large-scale dataset and revealed that school SES was a predictor for middle school math achievement. They found out that low economic status schools scored lower than high economic status schools. One possible reason for Liu and her team's findings is the variables that they chose. This means that schools' responses were inconsistent. They entered school economically affluent and disadvantage and other school variables together into an equation. This can be problematic because economically affluent and disadvantage variables were identified by opposite-end responses on a continuum. For example, when a school administrator in a school filled in a questionnaire to answer two different questions about the percentages of students in the school who come from economically disadvantaged and economically affluent homes with a four ordinal scale, the principal answered high on both questions. This means that the school had both high percentages of students from economically affluent and disadvantaged home at the same time. If Liu et al. (2006) had chosen to use only one of these variables, their result could have been different. Another reason for the incongruent results between other scholars (e.g. Hojo, 2011; NIER, 2009a; Oshio, 2011; Shimizu

& Sudo, 2008) and Liu and her team (2006) was a difference in analytical methods. NIER conducted multiple regression analysis on the relation between math test scores and low-SES schools, whereas Liu and her colleagues performed a series of two-level multilevel analyses on low and high economic status schools and math test scores. This discrepancy on school SES needs to be investigated.

In summary, schools with economically disadvantaged students tend to score lower compared to schools with economically affluent students globally.
The previous findings also supported the relationships between schools' levels of economic backgrounds and student math achievement in Japan. Some scholars even acknowledged that the school economic status is a recognized issue among researchers. However, congruent results using the same TIMSS Japan data sets with multilevel analyses in school economic backgrounds needs to be re-investigated.

Location of Schools

School location seems to matter in many countries, but findings were inconsistent, especially in a comparison between rural and urban schools. Some research found students from urban schools outperformed those from rural schools and others found the opposite.

A cross-national study found that eighth graders from urban schools outperformed those from rural schools in 19 countries (Mohanmmadpour & Ghafar, 2014). Nigerian secondary school students in urban areas also outperformed their peers in rural areas (Owoeye & Yara, 2011). Students in town centers scored highest compared to city centers and villages in Turkey; however, the results were based on

mean comparisons (Savasci & Tomul, 2013). Reasons for positive student performance in urban area are unknown.

On the contrary, Tayyaba (2010) found that rural students outperformed -0.56 SD compared to urban students in Pakistan. The scholar described that the difference was due to school resources, academic resources, teacher qualification, and student background. Thus, these regional differences seem to favor rural students over urban students in Pakistan. Thirunarayanan (2004) using US data sets also supported Tayyaba's (2010) findings. Fourth and eighth graders in urban area performed worse than their peers in rural area in the National assessment of educational progress (NAEP) in the US; however, there was no difference between rural and urban areas for twelfth graders (Thirunarayanan, 2004). The scholar explained that urban areas have issues, such as poverty, unemployment, crime, lack of affordable housing, and teacher shortage. These negative impacts seem to negatively contribute to students' performance in urban area in the US. As for grade level impact, Thirunarayanan (2004) did not explain why the school location difference was not apparent in 12th graders, but this could be that student SES impact may diminish with age (White, 1982). From reviewing some international studies, it seems that the US' unique characteristics in school location contribute to the findings.

Japan has its own unique characteristics in school location. The principles of Japanese middle school education are to provide equal education to all students no matter which public schools they attend. Japanese students attending schools in rural areas should have similar academic performance relative to those who attend schools in metropolitan areas. However, regional differences may matter.

Regional differences determine different successful predictors for student achievement. For example, going to private middle schools may be one of the primary predictors for student scores in metropolitan and the surrounding areas. This suggests that successful predictors are reflected by which region they live in. Since the 2000's researchers have emphasized primarily the differentiation in student academic achievement in metropolitan areas and the surrounding areas. That is why researchers should extend their studies to other regions in the future (Mimizuka, 2007).

The impacts of regional differences or location of schools are ambiguous. Some research supported the idea that elementary students in metropolitan areas did better than those in small town areas (Hamano, 2009a) and others supported that there were regional differences even within the surrounding metropolitan areas (Shimizu & Sudo, 2008).

On the other hand, a few scholars concluded based on nation-wide tests that regional differences created by prefectural budgets in relation to student math performance no longer exist in Japan (Hiragi, 2008). In order to understand the regional differences from middle school points of view, location of schools should be examined. Especially, more studies on comparisons between metropolitan and other regions are necessary (Kawaguchi, 2011). Location of schools seems to be related to schools' socioeconomic status. School SES incorporates family's SES. There are few jobs available and family income tends to be lower in rural area relative to metropolitan area; thus, location of schools also tends to be related to family' income. Hojo (2011) reported that students from economically disadvantaged schools tend to

score lower than their counterparts. This school variable represents the average income and social classes surrounding schools, thus, there is a relation between the location of schools and family environment.

The location of schools is linked to social as well as economic resources available to students and should be included in a study in the U.S. A small number of researchers have done studies to examine the neighborhood characteristics as a part of SES in relation to student achievement (Sirin, 2005). This also applies to the SES studies in Japan.

In order to overcome the sample size and the limited regional differences, Hojo (2011) and Oshio (2011) both examined the influence of location of middle schools with Japan TIMSS data and concluded that students attending less crowded schools had more advantage in achievement compared to those attending more crowded schools. Hojo (2011) indicated that when schools were located in areas with less than 15,000 people, students scored 2.5 points higher than those in other schools in more densely populated areas. Oshio (2011) also supported that when the location of school was less than 15,000 people, students scored 18 points higher than those in more densely populated areas. Both studies indicated that the location of schools made a difference when the populations were smaller. This suggests that Japanese students tend to learn better in less populated schools. Yet it is too hasty to make a conclusion of the influence of the location of schools based on the two studies.

In summary, school location matters in many countries. Some found rural students outperformed urban area and others found the opposite. It seems that the countries' unique school location characteristics contribute to findings. Even though

Japanese middle schools are founded for providing equal educational opportunities for all children, school locations may affect student achievement. Incongruent research findings in the area need to be clarified. Thus, the influence of the location of schools should be further examined, especially that of metropolitan versus rural areas.

Current Perspectives on Solutions

Since the negative impact of poverty on student academic achievement became well known in Japan, the Japanese government, prefectures, and researchers have made an effort to alleviate the gaps between higher and lower achievers who are influenced by SES. In this section, such outcomes will be introduced.

Uchida (2014) summarized how public service helps families who need assistance as follows: Over 90 public organizations provide a variety of support services to economically disadvantaged families. The examples of such services are guidance for high school advancement, prevention for dropping out of high schools, and free supplemental education. For instance, in Saitama prefecture, educators visit economically disadvantaged families on a regular basis in order to give advice to students on advancement into high school and provide free private tutoring to those students on a weekly basis. As a consequence, 97% students, or 321 of the 331 students made educational advancement into high school (Uchida, 2014), whereas the average high school advancement rate was 98% according to the government data (MEXT, 2012).

At the government level, besides standardizing the public middle schools as explained in the Japanese middle school section of this literature review, the Japanese

government created other laws for economically disadvantaged families, such as proving free after school academic lessons and assisting their financial needs (Uchida, 2014). Uchida (2014) suggested that the social welfare administration should link with the local educational administration and the community to provide complementally educational services for all disadvantaged students.

However, these systems may be helpful for some low SES families, not all families take advantage of these services. In the example of Saitama, only 331 out of 782 or only 42% of the economically disadvantaged families utilized such services (Uchida, 2014). The reasons may be related to parental negative perceptions about their children going to high schools and their children's academic aspiration and gender differences. There may also be gender and academic attitude differences about students' willingness to participate in shadow education. Matsuoka (2012) found that Japanese high school students with high academic attitude increased the likelihood of receiving free supplemental lessons; whereas, female students were less likely to seek supplemental education relative to male students.

For economically disadvantaged families to take advantage of numerous public support systems, it is essential to pinpoint why there is a gap between low SES families and public administrations.

At the academic level, some researchers study effectiveness of schools and classes (e.g. Kawaguchi, 2006; Kawaguchi, 2010; Shimizu 2012; Shimizu & Fujii, 2009; Shimizu & Kariya, 2004; Yamada, 2009). Shimizu (2012) attempted to discover the characteristics of academically competent elementary and middle schools from a qualitative perspective. Some of the effective school characteristics were good

teamwork among teachers and staff, excellent student guidance, and excellent teaching. He also identified that support from the community, the district administrations, and the local educational administrations, is crucial for public schools' success.

Kawaguchi (2006) used a quantitative approach to discover the effectiveness of schools. Nurturing class environments and friendships were important for elementary school students, while reviewing class notes and studying incorrect answers for tests were crucial for middle school students.

Yamada (2009) used two-level multilevel analysis models on class effectiveness in elementary schools. He found that the effective classes were related to teachers' pedagogy, which was to provide the applications of the class subjects and to repeat the basic subject knowledge. He concluded that Japanese schools provide equitable education since there were no class differences in arithmetic scores and suggested that because individual differences within classes were large, narrowing these gaps based on social class differentiations may be difficult.

In short, a different current perspective on alleviating economically disadvantaged families was presented. Although complementary educational services are available to those families, many families are unwilling to utilize such support. In order to maximize public services, it is important to find out why economically disadvantaged families are reluctant to utilize them. Researchers also have added research on school and class influence in relation to academic achievement.

In this chapter, the overall review of literature was presented as follows: the terminology of key words, the bioecological theory, Japanese middle schools, the

SES measurement, student SES, school SES, and the current perspectives on solutions to SES. The critiques on the relevant literature were also discussed in order to improve the extant research. The method section will be introduced next.

CHAPTER 3

METHODS

The research purposes of this study were as follows; a) to investigate how Japanese students and school socioeconomic characteristics simultaneously affected student math achievement and b) to examine how parental educational background influenced Japanese students' likelihood of participation in shadow education by using TIMSS data sets. This chapter includes participants, materials and procedure, variables, missing values, and multiple imputation. Study one was to examine purpose "a" above. This section included models, sample weights, centering, and model comparisons. Study two was to investigate study purpose "b" above. This section included generalized linear models, sample weights, centering, and model comparisons.

Participants

Scores from four-thousand-eight-hundred-fifty-six randomly selected Japanese eighth graders (male = 2,455, female = 2,401) from 146 public (national and other public) and private middle schools from the Trends in International Mathematics and Science Study (TIMSS) Japan 2003 data were used. TIMSS 2003 data was chosen because this data had a questionnaire pertaining to shadow education. Other data sets beyond the year do not contain this information anymore.

The number of students per school ranged from 8 to 43 and the average number of students in each school was 33 students. The average age of Japanese students was 14.76 (SD =.43) and 94 percent of students reported that they always spoke Japanese at home. This large sample size and large number of schools at each level will be

sufficient to conduct multilevel analysis which will ensure sufficient statistical power to detect effects since this analysis is demanding (Heck, Thomas, & Tabata, 2014). The TIMSS data also used the complex sampling method as explained below, samples were likely to be representative of Japanese eighth graders. Thus, research results could be generalizable to the whole population.

Materials and Procedure

The National Institute for Educational Policy Research or NIER (2003) used two-stage stratified probability sampling techniques for selecting schools and individuals in order to meet the TIMSS guidelines for assessing students' educational progress. They randomly selected a variety of national, other public and private schools from different regions of the country in the first stage and then randomly selected a few classes from these selected schools in the second stage. The International Association for the Evaluation of Educational Achievement (IEA) set the mean math score at 500 points with a standard deviation of 100 in the previous TIMSS scores. The TIMSS measured two domains of math abilities: cognitive domain (knowing, applying, and reasoning) and content domain (number, algebra, geometry, data, and chance) (NIER, 2003).

All students took Japanese translations of 80 test questions in math in 90 minutes. Each student had five plausible values in math because students took different math tests from 14 different booklets; hence, IEA estimated students' test scores to compare with their academic performance across countries (NIER, 2003).
The questions consisted of multiple choices and fill-in-the-blanks. Students also filled in questionnaires for 30 minutes regarding their demographic information,

family background, school climate, and teacher effectiveness (NIER, 2003). Some of these student and school questionnaire responses were utilized for the purpose of this study.

Variables

Dependent Variables

This study included two parts. In the first part of this study, the dependent variable was an individual average of five plausible math test scores, which was used to assess student overall math achievement. Math achievement was chosen for this study because the impact of individual SES was large in math scores (Hamano, 2009a; Hamano, 2009b). Math achievement was also the result of developmental outcomes. Developmental outcomes reflect developmental competence, such as academic achievement (Bronfenbrenner 1995; Bronfenbrenner & Ceci 1994). Thus, it seems to be reasonable to utilize student math scores in order to assess the effectiveness of proximal processes in part one of this study. In the second part, the dependent variable was extra math lessons.

Independent Variables

The choice of student-level variables was based on the literature review (e.g. Bronfenbrenner, 1986; Fujita, 2007; Hamano, 2009a; Hamano, 2009b; Liu et al., 2006; Yoshino, 2012) and was used as a way to measure individual SES. Student-level variables in study one included extra math lessons, the possession of a computer, number of books at home, and father and mothers' level of education in study one. In study two, father and mothers' education were used. Please note that extra math lessons were used in both studies one and two. In study one, extra math

was used as an exploratory variable. In study two, extra math was used as a dependent variable.

Middle school students rather than elementary school students were chosen in this study because the math achievement gap in middle schools was wider than in elementary schools (Kariya, 2008). In addition, investigating age effects of SES on young adolescents is important.

Substituting the parental wealth variable from the literature with an after school educational variable from TIMSS data is reasonable. An extra math lessons variable was chosen for two purposes: a) to measure proximal processes from the bioecological theory and b) to substitute parents' wealth. Proximal processes were Japanese students' study of math to acquire knowledge and to develop problem-solving skills after school in study one. There was no proximal process in study two.

As Orr (2003) discussed, parental wealth can be converted to after school activities for their children in order to enhance their knowledge. In addition, as previously pointed out in the literature section, taking lessons in "juku" after school can be costly. It is a privilege for wealthy parents to be able to afford this expensive educational service.

Questions on extra math lessons asked students on a four-ordinal scale how often during the school year they received extra lessons or were tutored in math outside of their regular classes. This variable was re-coded as follows: (3 = every or almost every day, 2 = once or twice a week, 1 = sometimes, 0 = never or almost never).

Home possessions included the number of at home, and the possession of computers. Students were asked to check either yes or no for possession of

computers. This variable was originally coded as yes (1) and no (2) and the coding was changed to yes (1) and no (0). Students were also asked how many books they had at home (1 = 0-10 books, 2 = 11-25, 3 = 26-100, 4 = 101-200, 5 = more than 200). The coding was changed to (0 = 0-10 books, 1 = 11-25, 2 = 26-100, 3 = 101-200, 4 = more than 200).

Father and mothers' levels of education were based on the international standard of education with a five ordinal scale (3 = junior school, 4 = high school, 5 = vocational school, 7 = university, and 8 = graduate school). Both parental educational backgrounds had originally eight International Standard Clarification of Education (ISCED) definitions in the data set; however, the three categories (i.e. did not go to school or finish ISCED1, finish ISCED1, and 5B) were eliminated because these categories were not applicable in Japan and no single person belonged to the categories. The coding was changed to 0 = junior school, 1 = high school, 2 = vocational school, 3 = university, and 4 = graduate school.

The selection of school-level variables was also based on the literature review (Kariya, 2008; Nukata et al., 2008; Makino & Mimizuka, 2004). School variables were used to assess different aspects of school SES. More specially, school-level predictors were schools with student background levels of economic disadvantage and the school locations. School questionnaires asked school principals about the percentage of students in schools who come from economically disadvantaged homes with a four ordinal scale and re-corded to 0 = 0-10%, 1 = 11-25%, 2 = 26%-50%, 3 = more than 50%.

School principals were also asked the type of communities where the schools were situated with a six ordinal scale (1 = more than 500,000 people, 2 = 100,001 to 500,000 people, 3 = 50,001 to 100,000 people, 4 = 15,001 to 50,000 people, 5 = 3,001 to 15,000 people, and 6 = fewer than 3,000 people) (IEA, 2011a; IEA, 2011b). Although in the original data set, the variable was called the type of communities where the schools were located, in this study, this variable was used to assess the location of schools. It was recoded to 0 = more than 500,000 people, 1 = 100,001 to 500,000 people, 2 = 50,001 to 100,000 people, 3 = 15,001 to 50,000 people, 4 = 3,001 to 15,000 people, and 5 = fewer than 3,000 people.

Missing Values

Missing Patterns

Before conducting a series of analyses, missingness in the data sets should be addressed. As it is useful to examine the missing values and the patterns of missing values for preparing data before analyses (Heck, Thomas, & Tabata; 2014), missing values for each variable were examined. Since it is unavoidable in any data set to have completed data without any missingness, this is an important process to resolve before analyses of the data because the handing of missing values influences the parameter estimation (Heck, Thomas, & Tabata; 2014). Table 3.2 shows the differences in parameter estimation depending on how missing values were treated.

Missing values are first reported. Three student predictors (i.e. possession of computers, extra math lessons, and the amount of books) had less than 1% of missing values. Maternal and paternal levels of education had equal missingness of .4%, and “I don’t know” responses were 30.5% and 35% respectively. In the analyses, “I don't

know" responses were also treated as missing values. Total missing values and "I don't know" responses were about 35% for mothers' and 40% for fathers' education. While, school predictors (i.e. school locations and the percentage of disadvantaged schools) had 1.5% and 3.4% missing values respectively. There were no missing values in the outcome (student math achievement).

The patterns of missing values were inspected regarding whether they were missing at random (MAR). Enders (2010) discussed MAR means in the context of missingness missing items in an outcome variable; however, there are no missing values in the outcome variable in this study. MAR means in this study that although the missingness can relate to other explanatory variables, there are no relationships between the tendency of missingness on the explanatory variables and the value of the outcome variable after partialling out other variables. If the missing patterns are MAR, imputing missing values (i.e. multiple imputation) can be conducted.

A multiple regression was conducted with all the independent variables and math achievement as a dependent variable to examine whether the missing values would be MAR. Seven predictors for both levels 1 and 2 were examined for the missing patterns. Each variable was dummy coded (missing = 0, non-missing = 1) and math achievement was treated as an outcome.

Table 3.1 shows the missing patterns. Most results were non-significant, meaning that the variables were MAR. Although missmathlessons (missingness on extra math lessons, $p = 0.035$) was significant, since the sample size was large, p-value less than .001 was also acceptable (R. Heck, personal communication, May 14, 2015).

It is also reasonable to assume that the missingness in several variables may be related to each other (Heck et al., 2014).

The directions of the regression coefficients of the missingness also suggested that the regression coefficient of misspaternal (missingness on paternal education) was positive like the other variables (except missbooks), the pattern of this missingness seems to be related to other variables. Since the rests of the variables were non-significant, misspaternal was considered MAR even though p-value was .000 (R. Heck, personal communication, May 14, 2015).

To summarize, the missing pattern results suggest that there were no specific patterns or relationships between the missingness in the explanatory variables and math achievement; thus, the assumptions of MAR were met.

Table 3.1 Results of Missing Patterns

Variable	
constant	483.39***(20.15)
missbook	18.58(14.11)
misscomputer	33.96(21.53)
missmathlessons	48.14**(22.88)
missmaternal	4.17(3.28)
misspaternal	13.68***(3.17)
missschloc	1.26(9.98)
missshdisadv	9.61(6.06)

Note. Standard errors are in parentheses.
**p<.05, ***p<.001

Multiple Imputation

Based on the MAR assumption being met, multiple imputation (MI) was conducted. Although there are other options for imputation, MI was chosen for the following reasons: a) it is recommended as one of the approaches for handing missing values in the methodological literature and b) it produces realistic standard errors and

unbiased inferences about the parameters as long as the data is MAR (Raudenbush & Bryk, 2002). MI replaces missing values by creating a number of imputed data sets, and each data set contains a different plausible value of the missingnessness instead of creating one imputed data set for estimating the missing values (Peugh & Enders, 2004). MI procedure was conducted with the Mplus program five times for maternal and paternal level of education, location of schools, and schools with disadvantaged students. Mplus examines the patters of missing values and plausible values are imputed using the expectation maximization (EM) algorithm (Heck & Thomas, 2015).

Even though the school predictors had less than 5% missing values, it was still necessary not to have any missingness at school level. The deletion of the missing values in the school data would also result in the deletion of the student data since students were nested within school. The deletion of missingness at school level would result in a large deletion eventually and estimation problems as seen in Table 3.2.

Since the missing values in the student predictors (i.e. possession of computers, extra math lessons, and the amount of books) were less than 1%, these missing values were automatically deleted during analyses.

Table 3.2 shows a comparison of listwise and MI approaches using the Mplus program. The listwise approach is to delete all the missing values from the data sets. Both tests were analyzed with a two-level multilevel analysis with random intercepts models at student and school-levels with math achievement as an outcome.

Table 3.2 A Comparsion of Listwise and MI

Parameter	Listwise	MI (N = 5)
Fixed Effects		
intercept	517.14***	513.79***
maternal edu	5.86***	3.94**
paternal edu	12.69***	13.34***
books	10.29***	10.96***
computers	16.13***	14.21***
extra math lessons	0.14	0.24
sch location	–5.43**	−4.81**
sch disadv	−13.43***	−12.69***
Variance Components		
level-1 residual	4271.06***	4321.29***
level-2 intercept variance	517.14***	513.79***
Sample Size		
Level 1 students	2765	4785
Level 2 schools	135	146

**p <.05, ***p<.001

One of the major differences between the listwise approach and the MI approach was the large reduction in the sample size. The original sample size was 4,856 and 146 schools. The sample size was 2,760 in listwise and 4,785 in MI. Please note that as missing values in extra math, computers, books were less than 1%, they were deleted during the analyses. The listwise approach deleted almost 2,000 students from the original data sets. The number of schools was 135 in listwise and 146 in MI. The listwise approach reduces statistical power and generally produces large errors in estimating the parameters as seen in Table 1 (Heck and Thomas, 2015). It is clear that the MI approach is more favorable than the listwise approach. Thus, the MI approach was chosen over the listwise approach. The imputed data sets were used as the final data sets.

Study One: Multilevel Analysis

Models

There were two parts of model specifications in this study. The first part of this study was to examine the research questions 1 to 3 by two-level multilevel analysis models using full maximum likelihood (full ML) estimation with EM algorithm. Maximum likelihood (ML) was chosen for a few reasons: ML is a commonly used approach for estimation of parameters in multilevel modeling and the estimates for the population parameters can maximize the likelihood or probability of a particular sample of the observing data (Hox, 2010). ML approach is also desirable since parameter estimates are consistent, unbiased, and efficient (Raudenbush & Bryk, 2002). Among ML, full ML was selected because when the sample size is large, REML and full ML produce close estimation (Raudenbush & Bryk, 2002).
When sample weights were applied, only a full ML option was available.
As described in the method section, multiple imputation (MI) was chosen for dealing with the missing values and "I don't know" responses. Since the ML approach is also an acceptable method for dealing with the issues, the results for ML with missing values are listed in the footnote after the references section. [1]

The research questions were presented in the introduction section. The first analysis focused on the overall relationships between student and school SES with math achievement as an outcome. Model 1 was a null model with no predictors. Please note that since this model was created in order to test intraclass correlation coefficients (ICC), this model did not examine any research question. Models 2, 3, and 4 were designed to investigate the research question 1, 2, and 3 respectively.

Model 2 included random intercepts with student-level predictors. Model 3 contained random intercepts with both student and school-level predictors. Model 4 included both student and school-level predictors with cross-level interactions.

The differences between models 3 and 4 were that Model 3 examined the respective student and school SES impacts, whereas Model 4 investigated cross-level interaction effects of school SES on student SES. Interaction effects of school and student SES were added to Model 4. A total of eight interactions were added to Model 4. More specifically, four interactions between school location x four student variables (i.e. books, computer, father, and mothers' education) and disadvantaged schools x four student variables (i.e. books, computer, father, and mothers' education) were added. This also identifies whether schools would provide more or less equitable education for student SES-math achievement relationships (Heck et al., 2014).

In this research question, the focus of interest was how two aspects of school SES would enhance or diminish the student SES-math relationships. Figure 3.1 indicates the proposed final a two-level multilevel analysis model. This explains how school SES would moderate the student SES-math achievement relationship.

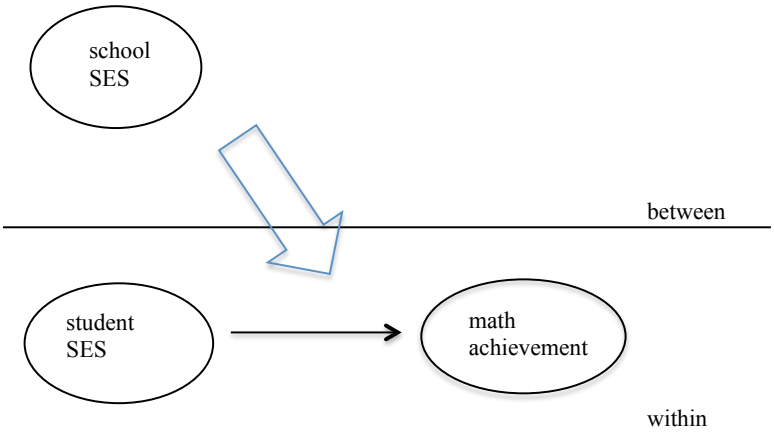

Figure 3.1. Proposed Final Two-Level Multilevel Analysis Model

The model for student-level was

$score_{ij} = \beta_{0j} + \beta_{1j}*(books_{ij}) + \beta_{2j}*(computers_{ij}) + \beta_{3j}*(maternal\ education_{ij}) +$

$\beta_{4j}*(paternal\ education_{ij}) + \beta_{5j}*(extra\ math\ lessons_{ij}) + r_{ij}$ Eq. 3.1

where $score_{ij}$ is math achievement for *i* student in *j* school, β_{0j} is school mean, β_{1j} is the student-level predictor book for *j*th school, and r_{ij} is the student residual in school *j*. At student-level, $r_{ij} \sim N(0, \sigma^2)$.

The model for school-level was

$\beta_{0j} = \gamma_{00} + \gamma_{01}*(school\ location_j) + \gamma_{02}*(disadvantaged\ school_j) + u_{0j}$ Eq. 3.2

where γ_{00} is the school grand mean, γ_{01} is the school intercept for school location, γ_{02} is the school intercept for school disadvantaged schools, and u_{0j} is a school residual related to the intercept.

If the student SES slopes are allowed to vary randomly across schools, possible variance in each slope (e.g. books-math score slope) would be explained by the school-level predictors (i.e. school location and disadvantaged schools).

The variation in random slope is indicated by adding a variance paramater (e.g. u_{1j} for the books-math random slope). However, it is likely that most potential randomly-varying paramters below are to be fixed at the school level (i.e. where the variance parameters *u* are removed). Generally, possible variation in student-level regression slopes at the school-level is examined using only one random slope at a time as seen below in Eq. 3.3.

$\beta_{1j} = \gamma_{10} + \gamma_{11}*(school\ location_j) + \gamma_{12}*(disadvantaged\ school_j) + u_{1j}$

$\beta_{2j} = \gamma_{20} + \gamma_{21}*(school\ location_j) + \gamma_{22}*(disadvantaged\ school_j) + u_{2j}$

$\beta_{3j} = \gamma_{30} + \gamma_{31}*(school\ location_j) + \gamma_{32}*(disadvantaged\ school_j) + u_{3j}$

$\beta_{4j} = \gamma_{40} + \gamma_{41}*(school\ location_j) + \gamma_{42}*(disadvantaged\ school_j) + u_{4j}$

$\beta_{5j} = \gamma_{40} + \gamma_{51}*(school\ location_j) + \gamma_{52}*(disadvantaged\ school_j) + u_{5j}$ Eq. 3.3

where γ_{10} is the student intercept for books, γ_{11} is the cross-level interaction between school location and books, and γ_{12} is the cross-level interaction between disadvantaged schools and books, and u_{1j} is school residual related to the book slope. At school-level, the below assumptions are made.

$\begin{bmatrix} u_{0j} \\ u_{1j} \end{bmatrix} \sim N_2\,[0, \mathrm{T}]$, where $\mathrm{T} = \begin{bmatrix} t_{00} & t_{01} \\ t_{01} & t_{11} \end{bmatrix}$ Eq. 3.4

Sample Weights

When researchers analyze secondary data sets, it is important to apply sample weights because they are utilized to readjust the sample to be representative of the population and produce the correct parameter estimates. If sample weights were not used, results will create biased parameter estimates and create bias for over-proportionate samples (Thomas & Heck, 2001). When sample weights are used correctly, they produce accurate parameter estimates and also affect the hypothesis testing (Heck et al., 2014). For example, in this study, 81 percent of eighth graders possessed computers, whereas 18 percent did not possess computers. If sample weights were not used, the impact of computers would be overly estimated even though there may not be any effect. Since TIMSS 2003 data sets provided sample weights for both school and student levels, these weights will be used to analyze the data. According to the TIMSS instruction manual (2011), student house weight for students and total school weight for schools were employed to estimate the correct parameter estimates for all models.

Centering

Centering on both student and school-level predictors were applied in order to make intercepts meaning and interpretable because random intercept models treat intercepts as outcome (Heck et al., 2014). Raudenbush and Bryk (2002) explained in detail why centering is necessary as follows: The meaning of the intercepts in student-level models depends on the location of student-level predictors. In this study, because most research questions emphasized how intercepts would vary across schools, the location of student-level predictors become important. If student-level variables were equal to zero (i.e. no home resources and no parental education), intercepts are not meaningful to interpret because there would not be any student who has no books, no computers, and parents with no educational backgrounds.
In this case, one may choose the location of predictors in order to make intercepts meaningful (Raudenbush & Bryk, 2002).

In this study, student-level predictors (number of books, maternal education, paternal education, and extra math lessons) were group-mean centered; whereas, the possession of computers were uncentered due to the dichotomous nature. Group-mean centering in student level was chosen because this study involved a cross-level interaction (Heck et al., 2014) and the focus of research questions (1, 5, and 6) was student-level predictors. With regard to school-level predictors, both location of schools and schools with disadvantaged students were grand-mean centered because they were groups of schools.

Model Comparisons

The purpose of model comparisons was to provide information about the integrity and trustworthiness of models (Ferron, Hogarty, Dedrick, Hess, Niles, & Kromrey,

2008). Akaike Information Criteria (AIC) was used for model comparisons. Model selection is an important part of multilevel modeling and comparing models is necessary to identify the most superior model (McCoach & Black, 2008). Since the models in this study were not nested, AIC was applied instead of model deviances produced from maximum likelihood estimation. The smaller AIC value is the best model regardless of the number of parameters in the models (Heck et al., 2014). Since HLM software did not produce AIC, Mplus was used to obtain AIC.

The results of each AIC were presented in the results section. Proportion of reduction in prediction errors can be interpreted like proportion of reduction in variance for both student and school-levels. The results for proportion of reduction in prediction errors were also presented in the results.

Study Two: Multilevel Ordinal Analysis

Generalized Linear Models

In the second part of the analysis, the relation between extra math lessons (shadow education) and parental education was examined. The participation of extra math lessons after school as an outcome and it had four categorical responses. Maternal and paternal levels of education were the explanatory variables. School-level predictors were not included in study two since the focus was the influence of parental education in relation to extra math lessons (shadow education).

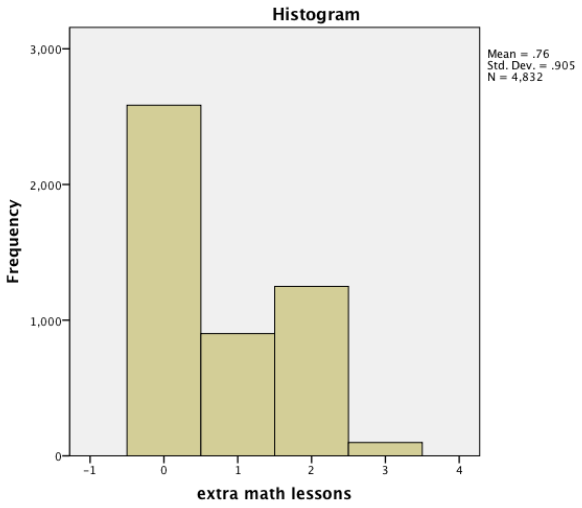

Figure 3.2. Frequency Distribution of Extra Math Lessons

The issues of the extra math lessons as the outcome variable will be first discussed and multilevel ordinal regression will be explained. Figure 3.2 indicates frequency distribution of extra math lessons participation for Japanese eighth graders. As seen in figure 3.2, the extra math lessons variable was not normally distributed. The ordinal outcome variable is also likely to violate the assumptions of homoscedastic errors (Hox, 2010). The common approach is to normalize data using a nonlinear transformation, to use robust estimation approach, or to use both methods. If ordered categories are treated as continuous variables, which assumes normal distribution and homoscedastic errors, parameter estimates, and standard deviations create bias. Ordinal outcomes can be transformed using a statistical model, the generalized linear model (GLM), to achieve normality and reduce the heteroscedastic errors (Hox, 2010).

GLM consists of three components for categorical outcomes at the student-level: a) an outcome variable Y has a specific error distribution that has mean μ and variance σ, b) a linear equation produces latent predictor η of the outcome variable to

a set of predictors of the model through the linear regression model, and c) a link function links the expected value or mean of μ of Y to the transformed predicted values η [$\eta = f(\mu)$]. The link function transforms the expected value y (μ = E[Y]) to the transformed linear predictor η (Heck, Thomas, & Tabata, 2012; Hox, 2010). Combining these three components in GLM reproduces regular student-level model in multilevel analysis (Raudenbush & Bryk, 2002).

Before conducting analyses, one should determine the particular sampling distribution and link function for building models (Heck et al., 2012). The choice of link function must be determined initially for GLM to develop models, which will predict the likelihood of the outcome event happening (Heck et al., 2012).

Thus, GLM for ordinal outcome is the cumulative probability model as follows: a) the sampling distribution is multinomial distribution with mean 0, b) the linear predictor is reproduced based on proportional odds formulation, and c) the link function is the cumulative logit. Detailed explanations will follow with the examples below.

Ordinal outcomes specify multinomial distribution. In multinomial distribution, an individual response falls into specific category c and there are C possible categories (c = 1, 2, 3, 4 and C = 4 in this study). Since the ordinal outcomes are ordered categories, ordinal response models predict the probability of an outcome response being at or below the particular outcome category as follows: (Heck et al., 2012).

$$P(Y \leq c) = \pi_1 + \pi_2 + \ldots + \pi_c . \qquad \text{Eq. 3.5}$$

where P stands for probability, Y is the outcome, c is the specific category, π is the probability that an individual falls into the specific category. In this study, there were four probabilities since the extra math lessons had four categories:

$$P(Y=1) = \pi_1$$

$$P(Y=2) = \pi_2$$

$$P(Y=3) = \pi_3$$

$$P(Y=4) = \pi_4 \qquad \text{Eq. 3.6}$$

Since π indicate probabilities, cumulative probabilities can be used. Because of the ordered nature of the outcome, it is convenient to deal with cumulative probabilities rather than probabilities themselves (Raudenbush & Bryk, 2002). The cumulative probabilities in this study were:

$$p^*_1 = \pi_1$$
$$p^*_2 = \pi_1 + \pi_2$$
$$p^*_3 = \pi_1 + \pi_2 + \pi_3$$
$$p^*_4 = \pi_1 + \pi_2 + \pi_3 + \pi_4 = 1 \qquad \text{Eq. 3.7}$$

Cumulative probability or cumulative odds models are also referred to as proportional odds models (O'Connell, Goldstein, Rogers, & Peng, 2008). There were four response outcomes (C = 4) in this study, 3 (4 –1) comparisons were used to compute the cumulative probabilities and cumulative odds. The last category is not compared since it is redundant as indicated above (Hox, 2010).

Cumulative probabilities make the last category (i.e. 3 = almost everyday in this study) reference point (Hox, 2010).

The ordinal outcomes commonly use cumulative probabilities. The cumulative probability formulation below, indicates the probability of a response being at or above the particular c category (Heck et al., 2012).

$$P\,(Y > c) = 1 - P\,(Y \leq c) \qquad \text{Eq. 3.8}$$

Level-1 or student-level link function links the expected values or mean of the outcome Y to the predicted values η. $\eta = f\,(\mu)$ (Hox, 2010). Link function in ordinal outcomes links the expected values of the cumulative probabilities (π_c) to the transformed predicted values of η_c. One of the common link functions in categorical outcomes is logit link (O'Connell, Goldstein, Rogers, & Peng, 2008). The common approach for ordered categorical responses for logit link function is cumulative logit function as follows (O'Connell, Goldstein, Rogers, & Peng, 2008). Logit link function is the natural logarithm (abbreviated as log below in the equation) of the odds or likelihood of πc (probability of students' response being at or below) versus 1 – πc.

$$\eta ic = \log\left[\frac{P\,(Y \leq c)}{P\,(Y > c)}\right] = \log\left[\frac{\pi c}{1 - \pi c}\right] \qquad \text{Eq. 3.9}$$

The structural model produces a transformed predictor η of the outcome variable Y to a set of predictors. This equation shows that each threshold (θ_c) separates the ordered responses of the outcome and thresholds begin with the second threshold (c = 2) (Heck et al., 2012). The structural model at multilevel ordinal model at student-level is

$$\eta ic = \log\left[\frac{\pi ijc}{1 - \pi ijc}\right] = \beta 0j + \sum_{q=1}^{Q} \beta qj\, Xqij + \sum_{C=2}^{C} \theta$$

Eq. 3.10

where η_{cij} is a cumulative log odd for each ordinal response c for *i*th student in the *j*th school. Log is the abbreviation for the natural logarithm. π_{ijc} is the probability of being at or below the *c*th category for *i*th student in the *j*th school.

$1-\pi_{ijc}$ is the probability of being at or *above* the *c*th category for *i*th student in the *j*th school. β_{0j} is the first threshold, $\beta_{qj}X_{qij}$ is the within-school (student) predictor.

Hox (2010) indicated that as specified with the subscript *j*, β_{0j} can be varied across school and this is the same as the lowest threshold. However, other thresholds (in this study, θ_2 and θ_3) are fixed in order to maintain measurement invariance across schools since there is no subscript *j*.

The school-level model is

$$\beta_{0j} = \gamma_{00} + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j} \qquad \text{Eq. 3.11}$$

where β_{0j} is the school intercept. γ_{00} is the school grand mean and u_{0j} is school residuals related to the intercept. β_{1j} is the school slope, γ_{10} is maternal education slope, and u_{1j} is school residuals related to the maternal slope. Since there were no school-level predictors in this study, they were not included here.

The second part of this study was to investigate research questions 4 and 5 using two-level multilevel ordinal regression with the proportional odds (PO) models using full-penalized quasi-likelihood (PQL) estimation with unit-specific estimates was employed. Full PQL was only available with a sample weight in HLM. Quasi-likelihood approach is the common estimate for multilevel ordinal models and it estimates the non-linear link functions by a nearly linear transformation (Heck et al., 2012). Unit-specific estimates mean school-specific estimates in this study. Ordinal

models can be estimated by PQL and it is the common and accurate approach to estimate regression coefficients (Hox, 2010; O'Connell, Goldstein, Rogers, & Peng, 2008).

Unit-specific estimates were chosen for a few reasons. Unit-specific estimates means that there is an expected change in the outcome in regression coefficients with a one-unit increase in the explanatory variable, holding other variables constant and all random effects in the model (Hox, 2010). The results are interpreted like the results of regular multilevel analysis models (Hox, 2010). Unit-specific approach is appropriate when research focuses are to explain how individual and group-level predictors affect the behavior and to examine the variation of individuals' behavior within groups (Hox, 2010). Unit-specific model is also available in the HLM software.

Proportional odds model (PO) assumes that the influence of parental level of education in relation to shadow education or slope coefficients (β_q) are constant regardless of students' response outcomes (Heck et al., 2012). The assumption of PO is also same as the parallel regression lines (Heck et al., 2012).

The research questions were conducted by HLM software. The results of model comparisons, centering, and sample weights for this model are also discussed in the results section. Like multilevel analysis, the results of ML with missing values are listed in the footnote after the references section. [2]

Models

In multilevel ordinal analysis, Model 1 was created as a null model and this model was not designed for any research questions. Models 2 and 3 were investigated the

research questions 5 and 6 respectively. The first model was a null model with no-predictors. The second model included random intercepts with maternal and paternal level of education as student characteristics. The last model incorporated varying random slopes with parental educational attainments. Figure 3.3 indicates the proposed final two-level multilevel ordinal model. This model examines how parental education would affect Japanese students' odds of participation in shadow education.

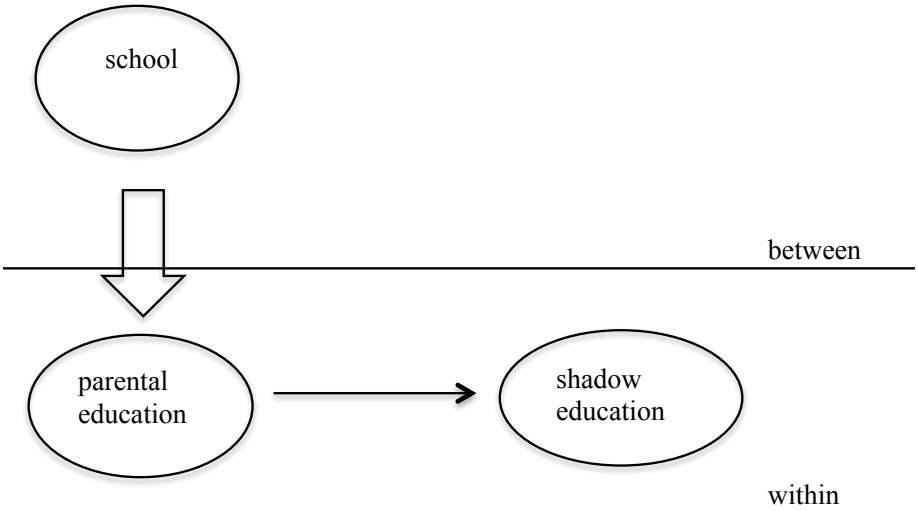

Figure 3.3. The Proposed Final Two-Level Multilevel Ordinal Model

Sample Weights

A sampling weight for student was added to all the models.

Centering

With regard to centering, same centering methods were applied in the multilevel ordinal model. Both mother and fathers' educational backgrounds were group-mean centered. School predictors were not specified since they were not included in the equations.

Model Comparisons

Since the models in this study were not nested, Akaike Information Criteria (AIC) for each model was also used for model comparisons (McCoach & Black, 2008). This model comparison is useful for choosing the best model that describes the SES phenomena in relation to Japanese student math achievement. The smaller AIC value is the best model (McCoach & Black, 2008). The results of each AIC are presented in the results section.

The University's Internal Review Board (IRB) approved this study as exempt from federal regulations relating to the protection of human research subjects.

In summary of the method section, participants, questionnaires, and variables were described. In addition, missing value issues, multiple imputation, models, sample weights, centering, and model comparisons were also discussed with multilevel analysis and multilevel ordinal models respectively. The generalized linear models in relation to multilevel ordinal models were also explained. In the next result section, findings and the interpretations of the findings are illustrated.

CHAPTER 4

RESULTS

This chapter presents results of two-level multilevel analysis models and multilevel ordinal models. Preliminary results include the correlation matrices of the variables and descriptive statistics for multilevel analysis models. In study one, primary analysis included multilevel models consisted of four models; Model 1 was a null model without any predictors, Model 2 included students' SES variables, Model 3 included both student and school SES variables, and Model 4 included the interaction terms between student and school SES variables.

In study two, the response variable or outcome variable was extra math lessons. Preliminary analyses include the descriptive statistics for extra math lessons. In the primary analysis, multilevel ordinal regression consisted of three models; Model 1 was a null model without any predictors, Model 2 included paternal and maternal levels of education with random intercepts, and Model 3 included maternal education with random slopes. The participants were Japanese eighth graders.

Study One: Preliminary Results

Before primary analyses, correlations between the explanatory variables were examined. Correlations between the explanatory variables for both levels 1 and 2 were checked with the final data sets (see Table 4.1). This procedure examined whether both student and school predictors were highly correlated to each other. If explanatory variables are highly correlated to each other, the effectiveness of the explanatory variables in relation to math achievement is unsure. The result displayed

that all correlations were either low or moderate; thus, there were no signs of collinearity. Due to the nature of imputed data sets, p-values were not available.

Table 4.1 Correlations between the Predictors

Variable	books	computers	extra math	maternal edu	paternal edu	school loc	sch disadv
books	1.00	–	–	–	–	–	–
computers	0.28	1.00	–	–	–	–	–
extra math	0.17	0.17	1.00	–	–	–	–
maternal edu	0.03	0.02	0.07	1.00	–	–	–
paternal edu	0.25	0.24	0.17	0.07	1.00	–	–
school loc	0.32	0.24	0.22	0.06	0.55	1.00	–
sch disadv	−0.11	−0.06	–0.08	–0.06	−0.12	−0.15	1.00

Table 4.2 presents the descriptive statistics on levels 1 and 2 units using the imputed data sets. The final data set includes 4,785 Japanese eighth graders from 146 middle schools in Japan. Skewness and kurtosis were calculated based on the average of all imputed data. Skewness and kurtosis were within the normality as seen in Table 4 (skewness +/-2 and kurtosis +/-7) (Curran, West, & Finch, 1996). Some categorical variables (i.e. books, maternal and paternal education, location of schools) can be treated as continuous variables (Agresti, 2013).

Table 4.2 Descriptive Statistics for Level-1 and Level-2

Level 1	N	Mean	SD	Skewness	Kurtosis
Variables					
scores	4785	569.39	76.46	-0.17	0.06
books	4785	3.02	1.26	0.07	-0.93
computers	4785	0.82	0.38	-1.66	0.75
extra math	4785	1.76	0.91	0.65	-1.07
maternal edu	4785	1.70	1.29	0.24	-0.63
paternal edu	4785	1.93	1.57	-0.04	-0.96

Level 2	N	Mean	SD	Skewness	Kurtosis
Variables					
school loc	146	1.30	1.30	0.63	-0.66
sch disadv	146	0.59	0.59	1.79	3.05

Primary Results

Multilevel Analysis Models

This section presents the first part of this study. As the readers see, Table 4.3 presents a series of two-level multilevel analysis models comparing the four models with the fixed effects, variance components, variance reduction, and AIC. Please note that the variance reduction was not calculated for Model 4 since this model was not nested.

Table 4.3. Fixed Effects, Variance Components, Variance Reduction, and AIC for Two-Level Multilevel Models

Parameter	Model 1 (baseline)	Model 2 (students with random intercepts)	Model 3 (stud and sch with random intercepts)	Model 4 (stud and sch with cross-level interactions)
Fixed Effects				
intercept	566.79***(2.95)	560.68***(3.54)	563.57***(3.48)	562.67***(3.92)
books	–	10.73***(0.85)	10.73***(0.85)	–
computers	–	7.59***(2.53)	7.44***(2.52)	–
extra math lessons	–	–0.23(1.11)	–	–
maternal edu	–	4.27**(1.54)	4.26**(1.54)	–
paternal edu	–	12.58***(1.40)	12.58***(1.40)	–
sch location	–	–	−8.75***(1.94)	–5.41(2.75)
sch disadv	–	–	−14.78***(5.14)	–12.57(6.94)
sch loc*books	–	–	–	−0.41(0.64)
sch disadv*books	–	–	–	−1.45(1.62)
sch loc*computers	–	–	–	−3.82(2.19)
sch disadv*computers	–	–	–	−2.69(5.28)
sch loc*maternal edu	–	–	–	1.84(1.28)
sch disadv*maternal edu	–	–	–	–0.21(3.10)
sch loc*paternal edu	–	–	–	−1.13(1.16)
sch disadv*paternal edu	–	–	–	−2.28(2.39)
Variance Components				
level-1 residual	4682.19*** (68.43)	4161.06***(64.51)	4160.19***(64.50)	4074.43***(63.83)
level-2 intercept variance	1113.19***(33.36)	1097.54***(33.13)	936.24***(30.60)	1262.13***(35.53)
book slope variance	–	–	–	8.81(2.97)
computer slope variance	–	–	–	349.81(15.81)**
paternal edu slope variance	–	–	–	15.16(3.89)
maternal edu slope variance	–	–	–	16.20(4.02)
extra math slope variance	–	–	–	–
Variance Reduction				
level 1	–	0.10	0.02	N/A
level 2	–	0.03	0.13	N/A
Parameters	3	8	9	31
AIC	54526.15	53943.63	53932.79	53927.73

Note. Standard errors and SD are in parentheses. Variance reduction was not calculated for the last model since the model was not nested.
**p<.05, ***p<.001

Model 1: Null Model

Model 1, a baseline model without any predictor, was used to calculate intraclass correlation coefficients (ICC) to find out whether there was enough variability between Japanese middle schools. Model 1 was created as a baseline model and this did not examine any research question. Within school variability (σ^2) and between school variability (τ_{00}) in the null model were 19%. Nineteen percent of variance lay between schools and 81% of variance lay within schools. This means that Japanese students tended to be homogeneous across schools and the difference lay largely within-schools rather than between-schools. This result is reasonable since more than 90% of Japanese middle school students go to public middle schools in their districts. Unlike stratified Japanese high schools where students attend based on their academic capabilities, the majority of Japanese students attend public middle schools regardless of their academic abilities. Japanese middle schools tend to maintain high math standards. The school intercept or school grand mean for all 146 schools was 566.79, indicating that Japanese students scored high grades in math and placed fifth in TIMSS.

The random intercept parameter indicated that the school intercepts varied significantly across schools, meaning that math achievement varied across schools ($\tau_{00} = 1113.19$, $p < .001$). There was also significant variance to be explained at the student level ($\sigma^2 = 4682.19$, $p < .001$). Thus, the next model included student predictors to explain within-student variability.

Model 2: Student SES Variables (Research Question 1)

In Model 2, all five SES student predictors (i.e. books, computers, paternal education, maternal education, and extra math lessons) were included. Model 2 was to test reseearch question 1, which was to examine whether student random intercepts would vary across schools. All student-level predictors, except extra math lessons (books, computers, maternal, and paternal education) were statistically significant. More specifically, the number of books made a difference in student math achievement. The number of books variable was treated as a continous variable as described in the preliminary analysis section (i.e. coded 0 as 10 or fewer books to 4 as more than 200 books). The coefficient therefore suggested that one unit increase in books was related to 10.73 points increase in Japanese student achievement, holding other variables constant. Students who had computers were more advantaged than those who did not have computers. As the computer variable was coded yes (1) and no (0), on average, students who possessed computers were likely to score 7.59 points higher than those who did not have computers, controlling for the influence of other vaiables. Maternal and paternal levels of education also made differences in student achievement. Mother and fathers' education variables were interpreted as continous variables (i.e. both variables coded middle school graduates = 0 to having graduate school degrees = 4), a unit increase in mothers' education was related to an average 4.27 point increase in student achievement, holding other variables constant.
The same interpretation can be applied to paternal education. A unit increase in fathers' education was related to a 12.57 point increase in student math scores, holding other variables constant. Since mother and fathers' education had the same

scales, paternal eduction was more influential than maternal education to student achievement. Extra math lessons variable was not a useful predictor.

Compared to the previous model, the variance component result in Model 2 suggested that the addition of the student predictors reduced the residual or within-group variability from 4682.19 (Model 1) to 4161.06 (Model 2). Since the models were random intercept models, the proportional reduction of prediction error was calculated to get total variance reduction estimations for levels 1 and 2 rather than parameter specific variance estimates. This method is also interpreted as estimating the proportional reduction in variance or variance explained. The estimate in proportional reduction of prediction error, like the proportion of variance, explains changes in the amount of residual variance that were produced from one model compared to a comparison model (McCoach & Black, 2008).

Adding student-level predictors reduced residual variance compared to Model 1 with no predictors. At the student level, there was a substantial reduction in student variance once student SES predictors were added to the model. The student variance was 4682.19 in Model 1 and was reduced to 4161.06 in Model 2. Student SES predictors accounted for about 10% of the within-school variability in student math scores. The between-group variance or school variance in Model 2 was modest, at 3%, compared to Model 1. As expected, by the addition of student-level SES predictors, a small reduction in between-group variance was accounted for.
The introduction of student-variables can result in decreasing residual variance at school-level. However, it is not uncommon for the addition of student-level variables to increase the variance at school-level, depending on whether student-level

predictors have some unexpected variability between groups (Raudenbush & Bryk, 2002).

The variance component also suggested that there was still variability to be explained between schools (τ_{00} = 1097.54, p <.001). The results of Akaike Information Criterion (AIC) indicated that AIC on Model 2 was smaller than AIC on Model 1. This indicates that adding the student SES predictors (i.e. maternal education, paternal education, books, computers, and extra math) were more useful than Model 1 that did not have any predictors. In the next model, school variables were added to explain this variability in addition to student variables.

Model 3: Student and School SES Variables (Research Question 2)

Model 3 incorporated both school SES predictors (i.e. location of schools and disadvantaged schools) and the remaining significant student-level predictors (i.e. computers, books, maternal, and paternal education). Model 3 was utilized to examine research question 2. It was created to determine whether random intercept models for student and school SES would vary across schools. Based on the non-significant results from the previous analysis, extra math lessons variable was removed from this analysis.

Results from examinging Model 3 indicated that both location of schools (less populate schools) and schools with economic backgrounds were negatively related to student math achievement. This disadvantaged school variable cannot be treated as a continuous variable, as it had only four scales even though it was normally distributed (coded 0 = less than 10% disadvantaged students to 3 = 50% or more disadvantaged students). The results suggested that, on average a one-unit increase in proportion of

disadvantaged students in the schools would result in an average of decrease of 14.78 points in school math scores, holding other variables constant. In other words, Japanese students who go to non-economically affluent schools tended to have considerably lower math scores compared to their peers who attend more economically affluent schools.

The location of schools also influenced student performance. This location of school variable were treated as a continuous variable (coded 0 = more than 500, 000 people or metropolitan area to 5 = less than 3,000 people or rural area). The results indicated that as one population category is decreased in terms of the location of school, on average Japanese students were likely to decrease 8.75 points in math achievement, holding other variables constant. From this result it can also be interpreted that students who attended less populated schools (e.g. rural area) were more disadvantaged than those who attend more populated schools (e.g. metropolitan area).

Compared to models 2 and 3, because only school variables (i.e. school location and disadvantaged schools) were added to this model, there should not be expected reduction in student residual variance. More specifically, the student variance changed from 4161.06 (Model 2) to 4160.19 (Model 3). Student predictors accounted for about 2% of the within-school variability in student scores.

The addition of school variables reduced student variance from 1097.50 (Model 2) to 936.24 (Model 3) in school residual variance. This means that adding the school SES predictors reduced the student variability. About 13% of the between-school variance in math scores is explained. The inclusions of school SES predictors seem

to weaken the influence of student SES predictors. In other words, school-SES association was stronger than student-SES association in relation to student math achievement.

Comparing AIC in Model 3 to Model 2, AIC was smaller in Model 3. This suggests that adding the school SES predictors (i.e. school locations and disadvantaged schools) was useful to the model that did not have any school SES predictors.

Model 4: Interactions between Student and School Variables (Research Question 3)

Model 4 had the same student and school variables and, in addition, cross-level interaction terms were added to the previous model. Model 4 was designed to investigate research question 4, which was how school-level variables would influence student-level variables. Location of schools and disadvantaged schools were still useful predictors for student math achievement. However, none of the cross-level interactions were significant (see Table 4.3). This means that none of the school SES predictors neither diminished nor enhanced student SES-math achievement relationships. This may suggest that Japanese middle schools seem to provide effective and equitable education for students from SES perspectives.

The random effects in Table 4.3 show only that the significant student-level slope was for having a computer at home. This means that the relationships between the size of the effect for having a computer on math achievement varied from school to school (Heck et al., 2014). In other words, the impact of utilizing a computer in math learning is stronger (or weaker) in some schools (Raudenbush & Bryk, 2002).

The student slopes (books, maternal, and paternal education) or the relationships between books-math scores, maternal-math scores, and paternal-math scores were non-significant. This means that the relationship between maternal eduation and math scores, the relatonship between paternal educaiton and math scores, and the relationship between number of books and math scores did not vary across schools.

With regard to proportion of reduction in prediction error, variance reduction was not calculated because Model 4 was not nested in the previous model (i.e. Model 3 was a random intercept with student and school SES predictors), whereas Model 4 was a cross-level interaction model with several random student-level slopes.

To summarize study one, at the student-level, maternal, paternal, computers, and books were related to math achievement. The extra math lessons variable was not influential on Japanese student achievement. At the school-level, school location and schools with disadvantaged students were negatively related to math achievement. The interaction terms between student SES and school SES in relation to student achievement were not significant. The results of multilevel ordinal models are discussed in the next section.

Study Two: Preliminary Results

In the second part of analysis, multilevel ordinal models were conducted. The outcome was ordinal response of the participation of extra math lessons and the explanatory variables were maternal and paternal level of education. Table 4.4 demonstrates the descriptive statistics on extra math lessons. About half of Japanese students have never participated in extra math lessons (shadow education), whereas the other half have experienced in shadow education. This result was based on the

original data set with listwise deletion since a multiple imputation was not conducted on this variable. Although some father and mothers' descriptive information are shown in the Table 4.2, other information, such as the percentage of each value was not available due to the imputed data sets in neither Mplus nor HLM software.

Table 4.4 Descriptive Statistics for Extra Math Lessons

Extra math	Value	Frequency	Percentage	Cumulative Percentage
	0=never or almost never	2584	53.2	53.5
	1=sometimes	901	18.6	72.1
	2=once or twice a week	1249	25.7	98.0
	3=every or almost everyday	98	2.0	100

Multilevel Ordinal Models

Primary Results

Table 4.5 presents fixed effects, variance components, and AIC for two-level multilevel ordinal proportional odds models by comparing the three models.

Table 4.5 Fixed Effects, Variance Components, and AIC for Two-Level Ordinal Models of Eighth Graders' Participation in Extra Math Lessons

Paremeter	Model 1		Model 2		Model 3	
	(baseline)		(patental edu with random intercepts)		(maternal edu with random slopes)	
		Odds Ratio		Odds Ratio		Odds Ratio
Fixed Effects						
intercept	0.16(0.05)	1.17**	0.14(0.04)	1.15**	0.14(0.04)	1.15**
maternal edu	–	–	−0.13(0.04)	0.88**	−0.15(0.04)	0.87**
paternal edu	–	–	–0.03(0.04)	0.98	–	–
For thresholds						
δ_2	0.89(0.03)	2.44***	0.84(0.03)	2.33***	0.84(0.03)	2.33***
δ_3	3.91(0.11)	49.90***	3.80(0.10)	44.69***	3.80(0.10)	44.70***
Variance Components						
level-2 intercept variance	0.16***(0.40)	–	0.14***(0.37)	–	0.14*(0.38)	–
maternal edu slope variance	–	–	–	–	0.00(0.06)	–
Parameters	2		4		4	
AIC	10249.50		10232.27		10233.76	

Note. Standard errors are in parentheses.
**p<.05, ***p<.001

Model 1: Null Model

Model 1, the baseline model, did not have any predictors. This was not designed to examine any research question. This model was created just to calculate intraclass correlation coefficients (ICC). Variance components indicated that there was an amount of variation in the level-2 intercepts even though it was not large (τ_{00} =.16). ICC for the multilevel ordinal model was calculated using Model 1. Only about 5%

variation lay between schools and 95% variation lay within schools. Small variability in participation in extra math lessons lay between schools. This means that the math achievements of Japanese students attending extra math lessons tend to be similar between middle schools. Although the between-school variability in level 2 was small, ordinal analyses were conducted due to the importance of parental influence.

Before presenting the influence of parental education in the next model, cumulative probabilities for each threshold are presented. Although thresholds or intercepts are usually not the focus of one's studies because thresholds are not influenced by the levels of predictors (Heck et al., 2012), brief descriptions of cumulative probabilities for each threshold are follows: The associated estimated probabilities for thresholds 1-3 was 53.5%, 73%, and 98%, respectively. Because 1 – C category or the total numbers of categories determines the number of the thresholds, there were three thresholds here.

Model 2: Paternal and Maternal Education (Research Question 4)

In Model 2, both mother and fathers' levels of education were added to the previous Model 1. This model examined research question 2, which was whether both parents' education would influence the likelihood of Japanese students' participation in extra math lessons. The negative cumulative logit coefficient indicates that the odds or the likelihood of being in higher categories increase (O'Connell et al., 2008). The result should be compared to the highest category versus the remaining lower categories because ordinal responses commonly use this cumulative odds model. The last response category is treated as the reference point in

the cumulative odds model, which is opposite to regular regression models (Hox, 2010).

The result indicated that when a unit increases in maternal education, the likelihood of being in the higher category (i.e. almost everyday) versus remaining in lower categories (i.e. once or twice a week, sometimes, almost never) increases. More specifically, with a one-unit increase in maternal education (i.e. one higher education level), Japanese students' odds of participation in extra math lessons everyday versus the lower categories were increased by 12% (100% – 88%).

Random effect of intercept on the participation of shadow education was significant ($\tau_{00} = 0.14$, $p < .001$), meaning that the odds of participation of shadow education varied across Japanese middle schools.

Regarding the proportional reduction of variance in error, the between school variance in this model (0.14, Model 2) was reduced slightly as compared with the null-model (0.16, Model 1). This result indicates that the inclusions of maternal and paternal education were not helpful in reducing the variability nor in explaining most of the variability at the student-level.

AIC was also calculated to compare Model 1 and 2. Model 2 (10232.27) was slightly better than Model 1 (10249.50), however, there was not much difference between the models. This suggests that the parental education variables did not improve the previous model very much.

Model 3: Random Slope Model with Maternal Education (Research Question 5)

Model 3 incorporated only maternal level of education with varied random slopes (i.e. whether relationships between mothers' education-math achievement would vary

across schools). Adding the random slopes would examine whether maternal education-students' likelihood of participation in extra math lessons would vary across middle schools. Since fathers' level of education was not significant, the variable was removed from this analysis in study two. To differentiate this result from study one, fathers' education was investigated in relation to math achievement. However, the results suggested that paternal education was not a useful predictor for Japanese students' likelihood of participation in shadow education. The results were almost the same as the previous model (see Table 4.5). The random effect indicated that the maternal slope did not vary across schools ($\tau_{10} = 0.00$, p = n.s.). This result indicated that the relationship between maternal education and students' likelihood of participation was not different from school to school.

AIC was conducted again to compare which model was the most parsimonious model among the models (McCoach & Black, 2008; see Table 4.5). Although AIC was better in Model 2 (10232. 27) compared to Model 3 (10233.76), there was not much difference between the models. This can be interpreted such that adding random slope of maternal education did not improve the previous model.

To summarize study two, Japanese students with more educated mothers were more likely to participate in shadow education relative to those with less educated mothers. Maternal level of education influenced Japanese students' predicted odds of participating in extra math lessons after school or shadow education. However, the impact of fathers' educational backgrounds was non-significant. The next chapter encompasses the discussion of this dissertation.

CHAPTER 5

DISCUSSION

This chapter will introduce a summary of the findings for each research question, detailed interpretations of the results, and comparisons of the previous findings to the findings in this study. The thoretical implication in relation to the study finings was also discussed. Future directions, contributions, and conclusions were also presented at the end of this chapter.

This study had a twofold focus on: a) Japanese eighth graders and Japanese middle school SES simultaneous influence on student math achievement and b) parental education influence on Japanese eighth graders' likelihood of participation in shadow education by utilizing the secondary data sets from Japan. The theoretical framework was Bronfenbrenner's bioecological theory (Bronfenbrenner & Morris, 1998).

The Relationship between Student and School SES

Before presenting the results of each research question, the relationship between student SES and school SES is discussed. It is noted that the p-values on the correlation matrixes between student and school SES in relation to math achievement were unknown due to the imputed data sets. Thus, the correlation between the variables were unknown, however, possible influence of these results are discussed based on the assumptions of possible results.

If student SES and school SES variables were negatively correlated, school SES might have accelerated or intensified the relationship between student SES and math achievement negatively. If student SES and school SES were positively correlated, school SES might have dimished the negative influence of the student SES-math

relationship. On the contrary, if student and school SES were not correlated, school SES might have either diminished or enhanced student-math achievement.

Study One: The Findings

Research Question 1

There were five research questions in study one. The results of the first research question partially confirmed that Japanese students' level of math achievement, influenced by their SES, varied across schools.

Although students' math scores varied across schools, Japanese middle school students maintained a high level of math scores. Student SES predictors (i.e. paternal education, maternal education, computers, and number of books) were related to math achievement.

Home resources were measured by number of books and the possession of computers at home in this study. The home resources were also indicators of parental wealth in the definition of SES in this study. This study found that home resources matter for Japanese students in math achievement; students who possessed computers and more books tended to be more advantaged than those who did not have computers and had less books. This suggests that students who have wealthier family backgrounds are more likely to outperform those who have less fortunate family background.

There are also regional differences for home resources. For example, possession of computers is different from metropolitan and rural areas. A data showed that 75.8% possessed computers in metropolitan area, while 67.7% possessed computers in rural area (Benesse Educational Research and Developmental Institute, 2014).

With regard to home resources, these findings were consistent with other Japanese and international research (Hojo, 2011; Liu et al., 2006; Oshio; 2010; Yoshino, 2012); however, inconsistent with Hamano (2009a)'s finding on number of books. This may be due to the structure of the questionnaire in his study, which asked the respondents whether they had many books or not. The definition of "many" might have been unclear for the respondents and this might have been the reason for his finding.

The possession of computers was also influential in math achievement. This result may indicate that access to computers and the Internet may be related. Japanese middle school students use a variety of methods to study online. According to Benesse Educational Research and Developmental Institute (2014), these methods include watching complementary and paid YouTube, downloading free test questions, checking effective ways of studying certain subjects, posting questions onsite, and using chat room to ask friends. These new methods of study are highly related to the existence of computers and the Internet. Japanese students may find computers and the Internet useful and helpful for their learning math. Utilizing computers for learning math is a trend for Japanese middle students in addition to traditional study.

Both parental educational backgrounds were influential to their children's achievement. These findings were consistent with the overall results of cross-national studies (Marks, 2008). For example, they were consistent with studies in Turkey (Tomul & Savasci, 2012), the Canary Islands (Sanchez, Montesinos, Rodriguez, 2013), the US, and Taiwan (Liu et al., 2006). In Marks' study (2008), the impacts of maternal and paternal education were significantly related to student achievement in more than 30 countries. The impact of parental education seems to be evident cross-

nationally. This current study also found the positive impacts of father and mothers' education on their children's math achievement.

Further, this study found that paternal educational background was more influential than maternal educational background and this study's finding was congruent with others' findings (Fujita, 2007; Hojo, 2011; Kaneko, 2004; Marks, 2008; Mimizuka, 2007; Oshio, 2011; Yoshino, 2012). This finding indicates two interpretations. First, fathers' educational attainments tend to be more important than mothers' in the male-dominated society. In such a society, it is rare for mothers to become a breadwinner of the house, while fathers take care of children at home. The government statistics showed that 40% of wives were staying at home in 2014 (The Japan Institute for Labour Policy and Training, 2015). This high percentage of housewives indicates that fathers tend to provide the main income for families. Men also tend to earn higher income than women in Japan by 41% (Ministry of Health, Labour and Welfare, 2013). Income is also related to educational level, hence, fathers' levels of education and income may become more important than those of mothers'.

Second, the impact of paternal education may be contextual. Marks (2008) found that paternal education tended to be more influential in math compared to maternal education in cross-national studies. He also found that maternal education had a stronger impact on reading than paternal education. If the dependent variable were a different subject, such as reading, maternal influence could have been stronger than paternal influence in this study. Parental educational influence on school subjects may be one of the key dependent variables to examine.

This study also found that Japanese students with more educated fathers scored higher than those with less educated fathers. This finding may indicate that as Kaneko (2004) suggested, when Japanese students with college graduate fathers study math, they may use less effort compared to those with non-college graduate fathers. Thus, students with more educated fathers tend to do well in math compared to those with less educated fathers.

In contrast with this study's finding, other research findings supported that mothers' education was more influential than fathers' (Hamano, 2009a; Ohio, 2011, Marks, 2008). This may be because of the contextual influence on academic achievement of math (Marks, 2008). However, Oshio (2011) used the TIMSS 2007 data sets and found that maternal education was stronger than paternal education in math. He did not explain why maternal education was more influential than paternal education. These inconsistent findings between these previous findings from this study's may be due to multiple imputation. This study applied multiple imputation to fill in the missingness and "I don't know" responses in parents' education. This study also applied multilevel analysis by using the hierarchical nature of the TIMSS data sets. Such differences as these might have produced different findings.

Number of books was also positively related to student math achievement. This may indicate that having many books at home may relate to better reading skills, which is necessary for reading math questions. However, this was not within the scope of this study; this study was not able to confirm this speculation. Number of books also may indicate that students who possess many books may be interested in learning in general. It is also important to note that even though the number of books

was positively related to student achievement, this does not mean that just possessing many books is likely to improve student achievement. Having books requires reading them in order to have any impact on achievement.

Extra math lessons were unrelated to math achievement. This means that Japanese students who did not utilize shadow education were not necessary underprivileged unlike Kariya (2008) suggested. This study result was inconsistent with others' findings (Hamano, 2009a; Hamano, 2009b; Hiragi, 2008; Kariya, 2004; Kariya, 2008; Liu et al., 2006; Makino & Mimizuka, 2004; Tomul & Savasci, 2012; Yamamoto & Brinton; 2010). Even though Liu and her colleagues, with the same data set as this study, found extra math lessons useful, this may be due to the difference between their selection of variables and this study's variables, which might have influenced such a result.

Four possible reasons are considered for this result. First, this finding may be due to the grade influence. When Japanese students enter ninth grade, their participation in shadow education increases (Kariya, 2008) in order to prepare for the competitive high school exams. When students reach ninth grade, about 60% of students participate in shadow education (Benesse Educational Research and Developmental Institute Corporation, 2005). Ninth graders usually spend less than one year studying for high school entrance exams. This implies that shadow education becomes prominent for Japanese ninth graders' preparing for high school exams.
Thus, shadow education might have been less influential for eighth graders. It may be also noteworthy that the participation in shadow education does not always increase in high school. The data shows that the participation in shadow education

was 16.5% for 10th and 19.7% for 11th graders (Benesse Educational Research and Developmental Institute, 2005). The sharp decline in high schools may imply that academically competent schools play roles of shadow education (Benesse Educational Research and Developmental Institute, 2005). Although the data did not include 12th graders' participation in shadow education, the participation rate was expected to rise due to the preparation of competitive university entrance exams.

Second, geographic locations might have had an impact on shadow education in some areas. In other words, geographic locations might have made shadow education less influential. Hamano (2009a) reported that shadow education made a difference in arithmetic for elementary school students from urban areas, while shadow education did not make any contribution for students from suburban areas. Some unexplainable factors, such as completing homework at home, might have made a difference in test scores for students in suburban areas. His findings suggested that Japanese students in suburban and urban areas used different strategies to study. Further, availability of shadow education resources from metropolitan and rural areas may make a difference for students. Sudo (2008) explained that more "juku" offer advanced school subjects in metropolitan areas. Hence, students who reside in such areas are able to find the right "juku" in which they want to participate, whereas students who do not reside such areas may not find appropriate "juku" in which they want to participate. This means that even though students may want to participate in shadow education, they are unable to participate in shadow education in some rural regions. These resource differences may differentiate the impact of shadow education on achievement.

Third, the types of extra math lessons may have made a difference in student math performance. Japanese students participate in shadow education for different reasons. Some utilize it for advancement and others utilize it for remedial purposes. If more students had utilized extra lessons, as remedial classes versus advanced classes, the overall impact of extra math lessons might not been positive. Thus, Japanese students who participated in shadow education as a remedial class might have diminished the positive impact of shadow education.

It is also noteworthy that even though this study found student SES impact, the proportional reduction in prediction error was small. The interpretations of such results were explained in detail in research question three.

Research Question 2

The findings of the second research question confirmed that school locations and disadvantaged Japanese middle schools negatively influenced student math achievement after controlling for the student SES variables.

With regard to school locations, the result in this study is congruent with other findings in Japan and in international studies (Hamano, 2009; Mimizuka, 2007; Mohanmmadpour & Ghafar, 2014; Owoeye & Yara, 2011); however, it is incongruent with some findings in Japan, the US, and other countries (Hojo, 2011; Oshio, 2011; Tayyaba, 2010; Thirunarayanan, 2004). The results are consistent with Hamano (2009) and Mimizuka (2007) in that Japanese students in metropolitan areas were more advantaged than those in rural area because fathers are more likely to have higher educational attainments in metropolitan areas (Kariya & Ando, 2008).

In addition, there are more private middle schools in metropolitan areas than in rural areas (Mimizuka, 2007); thus, these regional differences might have contributed to student differential academic performance. In other words, having access to different resources in metropolitan areas or in rural areas, may explain the differences in academic performance. Consequently, Japanese students in metropolitan areas did better in math than Japanese students in rural areas.

The study's findings were inconsistent with Hojo's (2011), and Oshio's (2011) findings. Both of them had four different categories of school locations instead of just one category in this study. There were also differences in statistical analyses and in handling of the missing values. In this study, multiple imputation was conducted on missing values for school locations and disadvantaged schools. These differences might have been the reasons for the different findings. Compared to the incongruent finding in the US by Thirunarayanan (2004), utilizing nationwide test results, students in urban areas are exposed to some unique issues, such as high unemployment rate and crime rate (Thirunarayanan, 2004). These urban related issues seem to negatively relate to student poor performance in the US.

The regional differences also indicate that even though the Japanese government recognized the negative impact of regional differences about 60 years ago and made efforts, such as standardizing the curriculum, to narrow the gaps between rural and metropolitan areas, students who go to schools in rural areas are still disadvantaged. However, reasons for the location differences may be due to individual differences instead of school differences. For example, as Shimizu and Sudo (2008) suggested, individual differences, such as student aspiration, student SES, and the existence of

private middle schools may be related to regional differences. If the school locations reflect these individual differences, public services, such as complementary tutoring on a regular basis may be relevant for educating economically disadvantaged Japanese students.

With regard to school economic status, this study's findings matched those of Condon et al. (2012) and Liu et al. (2006) about the US findings. Liu et al. (2006) also found the negative impact of schools with economically disadvantaged in Korea and Taiwan on test scores. Japanese students who go to disadvantaged middle schools are more disadvantaged compared to students who go to economically affluent schools. This result is consistent with the findings in Japan and cross-cultural studies (Ando, 2008; Condon et al., 2012; Liu et al., 2006; Shimizu & Sudo, 2008). This is probably due to the fact that economically disadvantaged schools are made up of students with lower SES backgrounds. The findings in this current study seem to be reasonable.

However, it is inconsistent with other studies using TIMSS Japan data sets (Liu et al., 2006). In Liu and her colleagues' study, they included both economically affluent and disadvantage schools and these variables were inconsistent relative to each other. If they had chosen only one of them, they would have drawn the same finding since the data sets were the same. Another reason may be how the missing values in school location were handled. In Liu's study (2006), the missing values on schools with economically disadvantaged students were deleted, while the missing values on the same variable were imputed multiple times in this study.

Although this current study supported the location of schools (less populated schools) and the school economic status influence on student math achievement, the proportional variance in prediction error was small. The result indicates that non-school SES variables may be more influential for Japanese students' math achievement than that of school SES variables.

Research Question 3

The findings of research question 3 did not support that the interactions between students and schools were related to math achievement. To clarify research questions 2 and 3, research question 2 focused on the main effect or main influence of student and school SES predictors respectively in terms of student achievement. Research question 3 emphasized the influence of school SES from higher levels in relation to school SES from lower levels on student SES-math achievement. The findings indicated that Japanese school SES neither moderated nor diminished Japanese student SES and math achievement relationships. Since this type of research question had rarely been examined in the context of SES in studies in Japan, the results in this study cannot be compared with others[2]. This result indicates that Japanese school SES did not have any impacts on student SES-math achievement relationships. This may suggest that Japanese middle schools provide effective and equitable education for students from SES perspectives. OECD (2012) reported that Japan provided equitable learning opportunities, good learning environments, equitable student-teacher ratio, and school autonomy, compared to other OECD countries. However, the school impacts on student composition differences should be considered (Raudenbush & Bryk, 2002). High variability in individual differences

within schools may explain for the high-test scores in TIMSS. Since this study did not include non-SES variables to confirm the overall school influences since this was not the focus of this study.

The location of schools did not make any difference in the paternal education-math achievement relationship. Please note that this finding is different from the finding in research question 2. In research question 2, the main effects of fathers' educational attainments were related to math achievement. However, this research question 3 examined how the location of schools would moderate parental-math achievement relationship. This result was unable to compare with others' since this question was not commonly tested. This finding suggests that there are no differences between metropolitan schools and suburban schools in terms of paternal education-math relations.

Regarding the random effects, only the computer slope (i.e. relationship between computer and student math achievement) had a significant variation among schools. This finding may imply that some students in some schools tend to use computers more often in their learning math than those in other schools. In the first research question, the possession of computers was significantly related to math achievement. This result in the third research question further expanded the result in the first research question.

The models indicated that the proportional reduction of prediction errors explained by student and school SES variables were small. This means that most of the variability in math achievement was unexplained. There are several interpretations of these findings. First, in the literature, researchers (e.g. Sudo, 2009) acknowledged the

negative impact of low student SES, however, the variance explained by student SES were not clear (e.g. Mimizuka, 2007). Although Mimizuka (2007) pointed out that the full model was problematic, student SES still may not have much impact on their achievement. Alternatively, non-SES variables, such as prior knowledge, may explain student residual variance better than student SES.

The school SES variables neither explain school residual variance well. This may indicate that non-student and school SES influences may be stronger on student achievement relative to the SES influence.

One significant difference between US and Japanese public middle schools is how public schools are funded. In the US, public schools are funded from government, and mostly from state and local governments. More specifically, about 93% funds are from state and local levels and 7% are from the government. Sales and income taxes are generally the source of state founds ("How do we fund", September 5, 2008). On a local level, these funds are based on property taxes, which creates gaps between economically affluent and economically disadvantaged schools ("How do we fund", September 5, 2008). While in Japan, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) distribute funds to prefectures and municipal governments (Kariya, 2006). Public schools are funded from the government, prefectures, and municipal authorities like the US. However, the fund distributions are different for these countries. About 30% of the funds come from the government and 70% is from prefectures and municipal authorities (MEXT, n.d.). It seems that the allocation difference on public school funding between the Japanese government (30%) and the US government (7%) create economically disadvantaged school

statues differently. As a consequence, economically disadvantaged school status significantly influences students' socioeconomic status in Japan, while it negatively influences students' socioeconomic as well as inequitable local funding in the US. In other words, it is likely that students in the US are more affected by SES than those in Japan. This may explain the low SES school residual variance accounted for by math achievement in this study.

The stratification of Japanese public middle schools also may be the reason for this finding. In Japan, more than 90% of students attend nearby public middle schools (MEXT, 2010) assigned by locational educational administrations. This means that Japanese students attend public middle schools regardless of their academic achievement. Such school stratification creates a large variation within schools and small variation across schools, which means that Japanese students tend to be homogenous between schools. This assumption also matches the ICC (intra coefficient correlation) in this study. The public middle school stratification dramatically changes when Japanese students reach 10th grade. Most students nationwide are required to take competitive high school exams and to attend high schools based on their academic abilities unless they attend a high school attached to their middle school. As a result, student academic achievement in high schools tends to be more similar within schools and their academic achievement widens across schools compared to public middle schools. Thus, the small SES school residual variance in math achievement is due to the Japanese middle school stratification.

Second, the reason for this finding may be grade influence. There are incongruent findings in this area. As Shimizu and Sudo (2008) suggested, negative SES influence may be weaker for middle school students compared to elementary students. White (1982) also supported that the impact of student SES diminished with student age as schools provide equalizing opportunities for students. OCED (2013) also confirmed that schools provide equal opportunities for high school students in Japan.

On the contrary, the research findings showed that SES impacts did not weaken with age, but rather intensified with school systems. High school tracking systems maintained and intensified inequality in terms of taking supplemental education and the length of study hours (Matsuoka, 2012). Since the Japanese high schools are stratified according to student academic capability, his findings seem to be reasonable.

Another possible interpretation is that SES impacts both increases and decreases depending on the grade. Based on Shimizu and Sudo (2008) and Matsuoka (2012), SES influence is stronger in elementary schools and is reduced at middle schools, but is increased again because of academically stratified high schools. The combination of grade level and the unique Japanese school systems influence need to be further investigated to assess the influence of student and school SES.

Third, simply using the variables in the TIMSS data sets may not accurately assess the impact of SES. These existing variables, especially the student SES variables used for this study may be an issue. The selection of the variables were drawn from the extant literature review. Even though these predictors were part of student SES indicators, they may not necessary capture the whole scope of student SES.

The limitations of the variables in the TIMSS data sets are further described in the limitation of this study.

Study Two: The Findings

Research Question 4

There were two research questions in study two. The results of the fourth research question were partially supported in maternal, but not in paternal level of education, which influenced Japanese students' likelihood of participation in extra math lessons. This may suggest that since mothers, more than fathers, tend to be the primary care takers of their children, mothers are more likely to be influential in their children's participation in shadow education. A few researchers explained that maternal education is a key and influential factor for their children to decide numerous choices in life (Kikkawa, 2009) and maternal aspiration was also related to their children's educational attainment (Hamashima & Takeuchi, 2002). This maternal educational aspiration might have influenced their children's attendance in shadow education.

The result also showed that higher maternal education, more likely Japanese students participation in shadow education. More educated mothers may be more concerned about their children's educational achievement. There are possible reasons why educated mothers positively related to their children's participation in shadow education relative to less educated mothers as follows (Reay, 2004): More educated mothers are more familiar with educational knowledge and systems and they have more confidence in intervening in their children's educational trajectory. Highly educated mothers also have a range of strategies to direct their children's schooling.

On the contrary, less educated mothers are less familiar with educational matters and systems, they feel incompetence and their lack of confidence may influence their desire not to be involved with their children's academic trajectory (Reay, 2004). Her interpretations seem to be reasonable. Mothers' familiarity with educational matters and their confidence seem to be related to their involvement in their children's shadow education.

Since both studies one and two included parental education, the results of parental education in studies one and two should be compared for clarification. In study one, both father and mothers' education were related to Japanese student math achievement. Especially, fathers' education was more influential than those of mothers since both of them used the same scale in study one. In study two, only maternal education was influential to Japanese students' likelihood of participation in extra math lessons (shadow education), while fathers' education had little influence on shadow education. Even though fathers' education was not significant, this does not conclude the weak influence of fathers' education. Since research findings on paternal education are incongruent in the literature, more research is needed to conclude the impact of paternal levels of education.

In summary, the results indicate that both maternal and paternal education influenced Japanese students in academic achievement and their likelihood of participation in shadow education in the two studies. Especially, mothers tend to be more influential in their children's academic arena. Kikkawa (2009) explained that mothers tend to be influential for their children throughout their life course. In other

words, maternal influence tends to be unavoidable in their children for different aspects in their lives. However, of course, paternal influence should not be ignored.

Research Question 5

The findings of the last research question were not confirmed. Maternal education-shadow education relationships did not vary across schools.
This suggests that the influence of mothers' education did not make any difference between schools. Please note that this result is not the same as the one in research question 4. Research question 4 examined how mother and fathers' levels of education would affect Japanese students' likelihood of participation in shadow education. While research question 5 examined whether the relationship between maternal education and math achievement would vary across schools. Since this result is not commonly investigated among researchers, this finding is not comparable with others.

The Theoretical Implication

Theoretical applications were discussed in the results of the first part instead of the second part of this study. This is because the first part of this study included both school and student variables. The first part of this study investigated the three interrelated relationships between contexts, person, and proximal processes.
There were home microsystems (student SES) and school microsystems (school SES) as context, person (Japanese eighth graders), proximal processes (extra math lessons), and students' developmental outcome (math achievement). Since the proximal process is the core engine of Bronfenbrenner's bioecological theory, several implications related to proximal processes were mainly discussed.

This study did not find any significant role of proximal processes as discussed in the literature. Japanese eighth graders did not utilize shadow education as proximal processes in their outcome development. This also matches the descriptive statistics that Japanese eighth graders participated at least once, however, they did not frequently participate in shadow education. This may be because the nature of proximal processes varies as a function of individuals, contexts, and time (Bronfenbrenner & Morris, 1998). Proximal processes may become prominent for Japanese ninth graders who prepare for high stakes high school entrance exams. Since the frequent and constant participation for extended periods of time in immediate contexts was required for effective proximal processes (Bronfenbrenner & Morris, 1998), ninth graders would be more likely to utilize proximal processes than eighth graders.

Proximal processes might have been a different variable, maybe a non-SES variable. For example, interactions between schoolteacher and student might have been proximal processes since such interactions occur everyday at school. However, this sort of variable was unavailable in the data sets.

Another implication is that even though person-symbols interactions and studying are part of proximal processes (Bronfenbrenner & Morris, 1998; Bronfenbrenner & Morris, 2006), these interactions may be weaker as proximal processes and hence, person-symbols interactions and studying may not be an ideal candidate for proximal processes. These interactions may be also more difficult to assess methodologically because reciprocal interactions are hard to detect relative to person-person interactions.

Bronfenbrenner and Morris (1998) indicated that when proximal processes emphasized interactions with only symbols, the person's disposition and resources would become more important in the direction and power of proximal processes rather than interaction with other persons. This suggests that Japanese students' non-SES indicators, disposition (e.g. motivation) and resources (e.g. prior knowledge), may have played more significant roles in person-symbols interactions.

Two contexts of home and school were related to Japanese students' developmental outcomes or academic achievement. Especially, students with more educated fathers were more advantaged than those with less educated fathers. The contextual influence on school and family was confirmed in relation to math achievement, but not on proximal processes.

The theory stated that effective proximal processes flourish in stable and predictable family environment; whereas, effective processes weaken in unstable and unpredictable family situations (Bronfenbrenner, 1995; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 1998). Since the influence of proximal processes was not confirmed in this study, the influence of home and school microsystems as contexts in relation to proximal processes was unable to be confirmed in relation to the theory.

It is also noteworthy that even though this study did not incorporate macro-time (or the chronosystem in the ecological theory by Bronfenbrenner, 1994), it may affect this study's finding since one's developmental processes are likely to be affected by the historical events (Tudge et al., 2009). Macro-time may involve the recent economic hardship in Japan where Japan placed sixth in OECD countries (OECD,

2013a). Economic distress will likely influence Japanese student performance negatively, especially for low-SES students. Economic hardship is likely to influence student achievement directly, such as reducing the participation in shadow education and parental income. Economic hardship is also likely to influence indirectly student academic performance. For example, when parents suffer from economic distress, this may affect their mood. As a result, parents may become more impatient toward their children and parents' attitudes may indirectly affect their children's achievement. On the contrary, economic depression is less likely to affect high-SES Japanese student achievement.

In summary, although this study did not find any effective role of proximal processes, this may be because proximal processes vary depending on the context, personal characteristics, and time as the literature suggested. In different home and school microsystems and different grades, proximal processes may be more significant.

Implications for Educational Policy

Since both student and school SES impacts on student achievement were confirmed in this study, a few suggestions are made for educational policy to reduce the negative impacts on SES at school and student-levels.

For the negative influence of disadvantaged schools and the location of less populated areas on student academic achievement, an educational policy is suggested to alleviate such negative school impacts. The government research agency found that teaching student math according to differential academic abilities helped low-math achieving students to accomplish better scores (NIER, 2009b).

Differential academic teaching method was related to math achievement, after holding other variables (i.e. class size, regional differences, and disadvantaged schools) constant (NIER, 2009b). More specifically, they found that the result was favorable when teachers used 75% of their class hours for teaching methods compared to less than 75% of class hours.

In fact, teaching students according to their academic abilities is becoming common in Japan. Teachers teach math according to students' academic abilities at 50% of public middle schools (NIER, 2009b). However, about 50% of teachers and parents expressed concerns in a national survey in 2003 that such teaching pedagogy was likely to create superiority for high-achievers and inferiority for low-achievers (NIER, 2009b). Despite the concerns, low math-achievers were in favor of the pedagogy (NIER, 2009b). Although more studies should be conducted in this area before it becomes a public policy, teaching students according to their academic abilities may reduce the negative school impacts.

Another suggestion is related to reducing negative student SES. Mori (2008) concluded that it tends to be effective for Japanese ninth graders, who do not participate in shadow education, to complete homework and to review class subjects after school in order to do well in school. Her findings should be used with caution because her analyses were based on one metropolitan area. Hamano (2009b) also confirmed the Mori (2008) findings that completing homework was a significant predictor for Japanese elementary students who live in small towns and rural areas. These findings were not tailored for low SES students, but completing homework and reviewing class materials may be helpful for low SES students. However, how can

low SES students accomplish these tasks since low-SES students tend to have low motivation and aspiration as explained in the introduction of this study?

One approach is to utilize the community's supplemental tutoring lessons. Currently, only 40% of supplemental education was utilized for low SES families in one prefecture (Uchida, 2014), this supplemental education should be more utilized and tailored to low-SES families. For example, tutors can help students accomplish schoolwork. By applying proximal processes from the bioecological theory, ideally, a tutor and a student have mutual respect and positive regard. A tutor can create joint activities for producing effective proximal processes with a student. This is not only helpful for improving student achievement but also helpful for increasing a student's motivation and aspiration.

The Issues of TIMSS 2003 Data Sets

Regarding the usage of TIMSS 2003 data sets, it is important to note the usage of the older data sets rather than the current data sets. This study utilized 2003 data sets due to the availability of the shadow education (extra math lessons) variable. Some readers may express concerns about the usage of decade old data sets and the data sets may not reflect the current social changes. In order to justify the usage of 2003 data, the most recent TIMSS 2011 and the 2003 data sets were compared using standard deviation. The standard deviations (SD) were used to check whether the variability within the variables between 2003 and 2011 had increased or decreased. The variability in changes may indicate whether the two data sets were similar. If the two data sets were similar, this indicates that the usage of 2003 is likely to present the current Japanese society.

The six variables used for comparisons were student math scores, possession of computers, economically disadvantaged schools, numbers of books, father and mothers' levels of education. The school location was not compared because the variable was not available in the 2011 data sets.

The noticeable changes were student math scores, possession of computers, and economically disadvantaged schools. The SDs were increased from 76 to 82 in math achievement and from .58 to .75 in economically disadvantaged schools.
This suggests that there are wider achievement gaps and that the numbers of economically disadvantaged schools were increased. However, the standard deviations for possession of computers were narrowed from .39 to .30, meaning that more students had computers at home when compared from 2003 to 2011.

On the contrary, there are no changes or slight changes in the standard deviations for the number of books (from 1.3 to 1.3), and in paternal (from 1.6 to 1.5) and maternal educational backgrounds (from 1.3 to 1.2). This indicates that parents' education and amount of books were not significantly changed from 2003 to 2011.

To summarize, there are some changes in student math scores, computers, and schools with economically disadvantaged schools. On the contrary, there are no changes in the standard deviations in books and parents' education.
The reasons for the findings are not clear, however, despite some changes in the variability of the variables, parental levels of education have not been changed. Because parental education is unlikely to change and tends to be established in adolescent years (Sirin, 2005), this variable needs a major social change such as economic depression to change the variability within. Since there are no changes in

the variation of parents' education between 2003 and 2011, the TIMSS 2003 data should not suggest a misrepresentation of the current Japanese society. To wit, the findings in this study using TIMSS 2003 data sets should not be different from more recent TIMSS data sets.

Future Directions

There are three recommendations for future studies to further advance this study. First, the proportional reduction of prediction errors in both student and school SES was small in this study. Since the student and school residual variance did not capture math achievement very much, this study was unable to improve upon the previous studies in the area. As Mimizuka (2007) suggested, future research should improve this issue in order to determine the overall influence of SES in Japan. This small residual variance may be due to the variables in this study. In order to assess student SES more directly, utilization of such as student SES variables as parental education, occupation and income, would be helpful. However, TIMSS data sets do not have direct student SES indicators unlike the PISA data sets. Nationwide test results are also unavailable for most researchers. TIMSS data sets are the only publicly available data for assessing middle school impact. In order to assess student and middle school SES influence with TIMSS data sets, another statistical analysis, such as multilevel structural equation modeling may be considered for future research to understand direct and indirect effects of variables instead of proportion of variance.

Second, a future study can focus on parental level of education instead of overall SES impact. As previously described in the measurement of SES section in the literature review, SES definitions are diverse. However, researchers seem to agree on

the usage of parental education as the common and stable SES indicator (Sirin, 2005). This approach will solve the definition of SES. Rather than focusing on the overall influence of student SES, this approach is more reasonable. In study two in this study, parental education was the main focus of the study. Parental education variables were explanatory variables and Japanese students' participation in shadow education was a response outcome. Thus, this study two can be further developed by incorporating school SES variables, such as school location and disadvantaged schools in addition to parents' education.

Third, this study found that Japanese middle schools may provide equity education to students from SES perspectives; however, this may be due to the large individual differences within schools. Although the focus on this study was not the equity of Japanese middle school education, future studies should include both SES and non-SES school variables in order to investigate whether Japanese middle schools would provide equal education to students. If researchers attempt to investigate middle school equality in Japan, TIMSS data only are available. In this case, researchers can consider including a variety of school variables, such as disadvantaged schools, student-teacher ratio, school enrollment size, and school locations (Ma, Ma, & Bradley, 2008). Student variables can be gender, SES, family structure, and home resources. In addition, interaction terms of school and student can be added to analyses (Ma, Ma, & Bradley, 2008).

Limitations

There are four limitations in this study. Since this study employed secondary data sets, the availability of particular variables is limited. Although this study included

some common SES indicators, such as parental level of education, the inclusion of some variables, such as home possessions, has not been agreed upon among researchers even though home possessions were widely used by researchers in the U.S. and in Japan. The direct individual SES indicators, such as the percentage of income from social welfare, would be necessary in the future data sets.

The second limitation is also related to the nature of the data sets in terms of investigating the bioecological theory fully. Bronfenbrenner (2005) stated that among the PPCT model, time has a special importance in assessing one's developmental process. This study was able to test three components (i.e. proximal process, person, and contexts), however, was unable to test a time component due to the lack of variables from the data sets. Time elements could have been examined, for example, math achievement in eighth grade and ninth grade as two points in measurements could be compared to assess how preparing for high school exams (a time component) would influence Japanese student math achievement. The transition from eighth to ninth grade will be a significant event for Japanese middle school students who study for high school entrance exams. This sort of time component will uniquely examine the bioecological theory in Japanese cultural context and this approach would be helpful for examining the theory more fully.

The third limitation is also associated with the application of the theoretical framework. In the second part of this study, home-microsystems (i.e. parental education), personal characteristics (i.e. Japanese eighth graders) and developmental outcomes (i.e. math scores) were examined; however, proximal processes were not employed. Since the proximal processes are the heart of one's developmental process

(Bronfenbrenner & Morris, 1998), the omission of the variable is not testing the key element of the theory. The nature of the research questions in part two study did not require the presence of the proximal processes even though the proximal processes are the heart of the theory. This suggests that the theory may not be useful for some areas, such as study two in this study.

The last limitation is within the usage of home resources (i.e. books and computers), which was intended to present wealth. The combination of these variables was not enough to measure wealth as one of the aspects of SES definitions in this study because they are ubiquitous items in homes today. The TIMSS data sets did not have stronger variables to measure wealth and therefore it is a limitation in this study. In order to measure wealth in SES, more direct indicators such as a variety of home possessions (e.g. possession of number of cars) would be more direct indicators of wealth.

Contributions

Despite the limitations, this study has contributed to the studies of SES in Japan and has attempted to overcome the four challenges stated in the introduction. These four challenges were statement of problems in this study. First, most of the extant studies had single-level analyses with student or school levels. This study utilized advanced statistical analyses to analyze student and school SES influence simultaneously. This study also clarified the parental influence on their children's likelihood of participation in shadow education. Second, the numbers of SES studies, especially research on location of schools, are still scarce. This study shed some light on this area and found out the impact of location of schools, favoring densely

populated schools. Third, the impact of school SES by utilizing large secondary data sets was not clear. This study clarified that Japanese middle school SES had impact in terms of student math achievement with large secondary data sets. Fourth, the previous findings did not isolate SES and non-SES impact on student achievement. This study isolated the impact of SES, including multiple indicators, a culturally relevant variable (i.e. shadow education), and a technology-related variable.

Conclusions

This study examined student and school SES impacts on Japanese eighth graders with Japan TIMSS data sets. This study presented evidence from multilevel analysis and multilevel ordinal models for student and school SES impacts in relation to student math achievement for Japanese middle school students. Japanese student math achievement was influenced by family background, such as parental education and home resources as measured by wealth.

Japanese student achievement was also affected by which schools they attended. School location and school economic status influenced Japanese student achievement. These uncontrollable environmental factors influence student math achievement.

Parental education influenced not only Japanese student math achievement but also students' participation in shadow education. Japanese students' likelihood of participation in shadow education was also influenced by their mothers' levels of education. When students' mothers were more educated, they were more likely to participate in shadow education.

From these findings, it is concluded that Japanese student math performance and their likelihood of participation in shadow education were influenced by several

uncontrollable parental and school factors in the academic arenas. These unavoidable SES factors tend to create inequality among Japanese students.

In order to alleviate unequal SES issues in Japanese society, educational policies, laws, and community support would be helpful. Government support and community involvement will be helpful for meeting the needs of low-SES families in order to reduce gaps between them and high-SES families.

References

Aoki, O. (2005). Hinkon・teisyotoku kazukuno kyoiku senryaku no genjitsukara naniga mieruka-kyoiku syakaigakuno kadai [What can we see from the realities of educational strategies among low income families?: A fundamental subject in the sociology of education]. *Hokkaidō Daigaku Daigakuin Kyoikugaku Kenkyuka Kiyo, 97,* 105-125.

Agresti, A. (2013). *Categorical data analysis (third edition).* NY: Routledge.

American Psychological Association (2013). Socioeconomic Status. Retrieved from http://www.apa.org/topics/socioeconomic-status/

Ando, S. (2008). Gakko gai yoin ga score ni ataeru eikyo [Outside of school influence on student test scores]. In T. Kariya (Ed.), *Heisei 19 nendo zenkoku gakuryoku gakushu jyokyō chōsa [Analysis report on nationwide survey on academic ability 2007]* (pp.21-30). Tokyo: College of Education, the University of Tokyo.

Beese, J., & Liang, V. (2010). Does resources matter? PISA science achievement comparisons between students in the United States, Canada and Finland. *Improving Schools, 13*(3), 266-279.

Benesse Educational Research and Developmental Institute (2005). Dai 1 kai kodomo seikatsu jittai kihon cyōsa hōkokusyo [Dai 1 kai kodomo seikatsu jittai kihon cyōsa hōkokusyo]. Retrieved from http://berd.benesse. jp/berd/data/dataclip/ clip0006/

Benesse Educational Research and Developmental Institute (2014). Chugaku 1nen~kokō 2 nensei 9,468 nin no cyokōsei taicyo ICT riyōjittai cyosa [Report on the usage of

IT from ninth graders to eleventh graders]. Retrieved from http://prtimes.jp/main/html/rd/p/000000446.000000120.html

Benesse Educational Research and Developmental Institute (2014). Kodomo no ICT riyō jittai cyosa [Report on children's possession of computers]. Retrieved from http://berd.benesse.jp/berd/center/open/report/ict_riyou/hon/hon2_1.html

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: University Press.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, *22*, 723-742.

Bronfenbrenner, U. (1994). Ecological models of human development. In *International Encyclopedia of Education, 3, 2nd. Ed.* Oxford: Elsevier. Reprinted in: M. Gauvain, & M. Cole (Eds)., Reading on the development of children, 2nd ed. (1993, pp. 37-43). NY: Freeman.

Bronfenbrenner, U. (1995). Developmental ecology through space and time: A future perspective. In P. Moen, G. H. Elder, Jr., & K. Luscher (Eds.), *Examining lives in context: Perspectives on the ecology of human development* 619-647. Washington, DC: American Psychological Association.

Bronfenbrenner, U. (1999). Environments in developmental perspective: Theoretical and operational models. In S. L. Friedman & T. D. Wachs (Eds.), *Measuring environment across the life span: Emerging methods and concepts* (pp. 3 - 28). Washington, DC: American Psychological Association.

Bronfenbrenner, U. (2005). The bioecological theory of human development. In U. Bronfenbrenner (Ed.), *Making human beings human: Bioecological perspectives*

on human development (pp. 3 - 15). Thousand Oaks, CA: Sage. (Original work published in 2001)

Bronfenbrenner, U., & Ceci, S. J. (1994). Nature-nurture reconceptualized in developmental perspective: A biological model. *Psychological Review*, *101*, 568-586.

Bronfenbrenner, U., & Evans, G. W. (2000). Developmental science in the 21st century: Emerging questions, theoretical models, research designs and empirical findings. *Social Development*, *9*, 115 - 125.

Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental process. In R. M. Lerner (Ed.), *Handbook of Child Psychology* (Vol. 1, pp. 993-1028). New York, NY: John Wiley & Sons.

Bronfenbrenner, U., & Morris, P. (2006). The ecology of developmental processes. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Theoretical models of human development Vol. 1.* (pp. 793-828). Hoboken, NJ: Wiley.

Buchmann, C., Condron, D. J., & Roscigno, V. J. (2010). Shadow education, American style: Test preparation, the SAT and college enrollment. *Social Forces, 89(2),* 435-461.

Bray, M., & Kwok, P. (2003). Demand for private supplementary tutoring: conceptual considerations, and socio-economic patterns in Hong Kong. *Economics of Education Review, 22*, 611-620.

Condon, C., Greenberg, A., Stephan, J., Williams, R., Gerdeman, R.D., Molefe, A., & van der Ploeg, A. (2012). Performance in science on the Minnesota Comprehensive Assessments-Series for students in grades 5 and 8 (Issues &

Answers Report, REL 2012-No. 138). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Midwest.

Curran, P.J., West, S. G., & Finch, J.F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. Psychological Methods, 1(1), 16-29.

Duncan, G. J., & Brooks-Gunn, J. (1997). Income effects across the life span: Integration and interpretation. In G. J. Duncan & J. Brooks-Gunn (Eds.), Consequences of growing up poor (pp 596-610). New York, NY: Russell Sage Foundation Press.

Enders, C. K. (2010). Applied missing data analysis. New York, NY: Guilford Press.

Ensminger, M. E. & Fothergill, K. E. (2003). A Decade of measuring SES: What it tells us and where to go from here. In Bornstein & Bradley (Eds.), Socioeconomic status, parenting, and child development (pp. 13-27), Mahwah, NJ: Lawrence Erlbaum Associates.

Entwisle, D. R. & Astone, N. M. (1994). Some practical guidelines for measuring youth's race/ethnicity and socioeconomic status. *Child Development, 65(6),*1521-1540.

Ferron, J. M., Hogarty, K. Y., Dedrick, R. F., Hess, M. R., Niles, J. D., & Kromrey, J. D. (2008). Evaluation of model fit and adequacy. In A. A. O'Connell & D. B. McCoach (Eds.), *Multilevel Modeling of Educational Data* (pp. 391-426). Charlotte, NC: Information age publication Inc.

Fujita, T. (2007). Gakuryoku kakusa no keinen henka-Tokyo S-ku no jirei [A cross-sectional study of student academic achievement: the example of "S" district in Tokyo]. *Kyōiku Keiei Kenyū, 13,* 79-88. Retrieved from

http://hdl.handle. Net/10613/1800

Hamashima, K., & Takeuchi, K. (2002). Kodomono shingaku aspiration no kiteiyōinni kansuru kenkyuū-toshi shōcyugakuseino 15 nen kanno henyo [A study of elementary and middle school students' 15 year changes in educational aspiration in the metropolitan areas], *Nihon Kyōiku Shakaigaku Gakkai*, 54, 1-10.

Hamano, T. (2009a). Katei deno kankyō seikatsu to kodomo no gakuryoku [Family environments and student academic achievement]. In Benesse Kyoiku Sougo Kenkyujo (Ed.), *Kyoiku kakusano hassei kaishōni kansuru chōsa kenshū hokokusho [Report on causes and termination of differential social class achievement in education]* (pp. 64-75). Tokyo: Benesse Kyoiku Sougo Kenkyujo.

Hamano, T. (2009b). Katei haikei to kodomo no gakuryokuto no kankei [Family environment and children's academic achievement]. *Heisei 19,20 nendo zenkoku gakuryoku gakusyu jyokyo chōsa tsuika bunseki hokokusho [Analysis report on a nationwide survey on academic ability 2007and 2008]*. In Ochanomizu Women's University (Ed.), Zenkoku chōsa no kettka niyoru shicyoson gakko no sampling syuho oyobi kyointoni taisuru hokantekina tsuikachōsawo jittshi katsuyosuru chōsa bunsekisyuhono chōsakenkyu(kokuritsu daigakuhojin ochanomizu joshi daigaku) [*Analysis report on nationwide survey on districts and schools sampling methods and additional analysis report on teachers sampling methods]* (pp. 148-161). Tokyo: Ministry of Education, Culture, Sports, Science and Technology.

Hauser, R. M. (1994). Measuring socioeconomic status in studies of child development. *Child Development,* 65, 1541-1545.

Hauser, R., & Warren, J. R. (1997). Socioeconomic indexes for occupations: a review, update, and critique. *Sociological Methodology, 27*, 177-298.

Heck, R. H., Thomas, S. L. & Tabata, L. N. (2012). *Multilevel modeling of categorical outcomes using IBM SPSS*. New York: Routledge.

Heck, R. H., Thomas, S. L. & Tabata, L. N. (2014). *Multilevel and longitudinal modeling with IBM SPSS (2nd edition)*. New York: Routledge.

Heck, R. H., & Thomas, S. L. (2015). *Introduction to multilevel modeling techniques: MLM and SEM approaches using Mplus (3rd edition)*. New York: Routledge.

Hiragi, K. (2008). Gakuryoku no chiiki kakusa to Chiba ken no itizuke [Regional differences in student academic achievement and Chiba prefecture's standing] In T. Kariya (Ed.), Heisei 19 nendo zenkoku gakuryoku gakushu jyokyo chōsa [Analysis report on nationwide survey on academic ability 2007] (pp. 8-20). Tokyo: College of Education, the University of Tokyo.

Hirao, K. (2003). Gakkōgai kyoiku riyoto hahaoya no syuro-shingakujuku tsujuku jikanwo chushini [Outside school educational activities and mothers' job situations]. In S. Ishikawa, K. Inoue, A. Ueeda, Y. Uzuki, T. Shinada, A. Nishino, K. Hirao, Y. Honda (Eds.), Joseino syugyoto oyako kankei-hahaoyatachino kaiso senryaku-oyako kankeihen [Women's job situations and parental relationships-Mothers' social strategies] (pp. 1-24). Tokyo: Sophia University Repository for Academic Resources.

Hoffman, L. W. (2003). Methodological issues in studies of SES, parenting, and child development. In Bornstein & Bradley (Eds.). Socioeconomic status, parenting, and child development (pp. 125-43), Mahwah, NJ: Lawrence Erlbaum Associates.

Hojo, M. (2011). Gakuryoku no kettei yoin-keizaigakuno shitenkara [*Factors in academic achievement from an economic point of view*]. *Nihon Rodo Kenkyū Zattshi, 614,* 16-27.

Hox, J. J. (2010). *Multilevel Analysis*: *techniques and applications (2nd Edition).* New York: Routledge.

International Association for the Evaluation of Educational Achievement. (2011a). *TIMSS 2011 User Guide for the International Database*. Boston, MA: TIMSS & PIRLS international Study Center, Boston College.

International Association for the Evaluation of Educational Achievement. (2011b). *TIMSS 2011 User Guide for the International Database Supplement 3: Variables Derived from Student, Teacher and School Questionnaires*. Boston, MA: TIMSS & PIRLS international Study Center, Boston College.

Kaneko, M. (2004). Gakuryokuno kitei yoin-katei haikeito kojinno doryokuha do eikyo suruka [Factors in academic achievement-how do family background and student efforts influence student academic achievement?]. In K. Shimizu & T. Kariya, (Eds.) Gakuryoku no shakaigaku : chōsa ga shimesu gakuryoku no henka to gakushū no kadai [Academic achievement in sociology: The changes in academic achievement and issues]. (pp. 153-172). Tokyo: Iwanami Shoten.

Kariya, T. (1995). Taisyū syakaino ikue-gakurekisyugi to gyodoshinwa no sengoshi [The direction of society-educational attainment and myth of equality after the war]. Tokyo: Cyūo Kōron Sha.

Kariya, T. (2004). Gakuryoku no kaisosa wa kakudaishitaka [Did the differential student academic achievement among different social classes expand?]. In T. Kariya & H.

Shimizu (Eds.), Gakuryoku no shakaigaku: chōsa ga shimesu gakuryoku no henka to gakushū no kadai [Academic achievement in sociology: The changes in academic achievement and issues]. (pp. 127- 151). Tokyo: Iwanami Shoten.

Kariya, T. (2006). Kyōiku to byōdō : taishū kyōiku shakai wa ikani seiseishita ka [Education and equality: How did society create equality?] Tokyo: Cyūo Kōuron Shinsyakan.

Kariya, T. (2008). Gakuryoku to kaisō: Kyoiku no hokorobi wo do shusei suruka [Academic achievement and social class: How do we fix the educational problems?]. Tokyo: Asahi Shimbun Shuppan.

Kariya, T. (2010). From credential society to learning capital society: a re-articulation of class formation in Japanese education and society. In H. Ishida, & D. H. Slater, (Eds.), Social class in contemporary Japan, London: Routledge: 87-113.

Kariya, T., & E, Rosenbaum. (2003) Stratified incentives and life course behaviours, In J. T. Mortimer & M. J. Shanahan (Eds.), Handbook of Life Course (pp 51-78). New York: Kluwer academic/Plenum Publishers.

Kawaguchi (2006). Kōukano aru gakkō wo sagasu [Research on effective schools]. *Ōsaka Daigaku Kyoikugaku Nenpō*. pp. 167-177.

Kawaguchi (2010).Nihonni okeru gakkō kyōikuno kouka ni kansuru kensyuno tenkai to kadai [Review of school effectiveness research in Japan]. *Ōsaka Daigaku Daigakuin Ningenkagaku Kenkyūka Kiyō 36,* 157-177.

Kawaguchi, T. (2011). Nihonno gakuryoku kenkyuno genjyoto kadai [A review of Japan's academic achievement]. *Nihon Rodo Kenkyu Zasshi, 614,* 6-15.

Kikkawa, T. (2009). Kyoiku kakusato hahaoya gakureki [Differentiation of schooling and mother's education], *Japanese Journal of Family Sociology, 21(1),* 61-64.

Lee, V. E., & Croninger, R. C. (1994). The relative importance of home and school in the development of literacy skills for middle-grade students. *American Journal of Education, 102, 3,* 286-329.

Lerner, R. (2005). Urie Bronfenbrenner: Career contribution of the consummate developmental scientist. In U. Bronfenbrenner (Ed.), *Making human beings human: Bioecological perspectives on human development*. Thousand Oaks, CA: Sage.

Liu, Y., Wu, A. D., & Zumbo, B. D. (2006). The relationship between outside of school factors and mathematics achievement: A cross-country study among the U.S. and five top-performing Asian countries. *Journal of Educational Research & Policy Studies*, *6*(1), 1-35.

Ma, X., Ma, L., & Bradley, K. D. (2008). Using multilevel model modeling to investigate school effects. In A. A. O'Connell & D. B. McCoach (Eds.), *Multilevel Modeling of Educational Data* (pp. 59-110). Charlotte, NC: Information age publication Inc.

Magnuson K, A., & Duncan, G, J. (2006). The role of family socioeconomic resources in the black-white test score gap among young children, *Developmental Review, 26,* 365-399.

Makino, K., & Mimizuka, H. (2004). Seisyoneki kara seijinki heno iko ni tsuiteno tsuisekiteki kenkyu: JELS dai 1 syū [Studies of human development from birth to

death: First report on JELS]. Tokyo: Ochanomizu University Global COE Program.

Marks, G. N. (2008). Are father's or mother's socioeconomic characteristics more important influences on student performance? Recent international evidence. *Social Indicators Research, 85*, 293-309. Retrieved from DOI 10.1007/s11205-007-9132-4

Matsuoka, R. (2012). Investigating the intersection of school academic position and student background on Japanese tenth graders' educational choices and study habits (Unpublished doctoral dissertation). University of Hawai'i at Mānoa, HI.

McCoach, D. B., & Black, A. C. (2008). Evaluation of model fit and adequacy. In A. A. O'Connell & D. B. McCoach (Eds.), *Multilevel Modeling of Educational Data* (pp. 245-272). Charlotte, NC: Information age publication Inc.

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American Psychologist, 53*, 185-204.

Mimizuka, H. (2007). Syogakuko gakuryoku kakusa ni idomu: Dare ga gakuryoku wo kakutoku suruka [Tracking academic achievement gaps among elementary schools: Who acquires academic achievement?]. *Kyōiku Syakaigaku Kenkyū, 80,* 23-39.

Ministry of Education, Culture, Sports, Science and Technology (n.d.). Gimu kyoikuhi kokko hutan seido ni tsuite [The systems for the government's expenses on mandatory education]. Retrieved from http://www.mext.go.jp/a_menu/shotou/gimukyoiku/outline/001.htm

Ministry of Education, Culture, Sports, Science and Technology (2012). Kōto gakko

kyoiku no genjō [Report on number of high school students]. Retrieved from http://www.mext.go.jp/a_menu/shotou/kaikaku/main8_a2.htm

Ministry of Education, Culture, Sports, Science and Technology (2010). Kōkōsei no hutokō chūto taigaku no genjyotō [High school students' absenteeism and attrition].
Retrieved from http://www.mext.go.jp/b_menu/shingi/chukyo/chukyo3/047/siryo/__icsFiles/afieldfile/2012/03/21/1318690_02.pdf

Ministry of Health, Labour and Welfare (n.d.). Danjo kan no chinzkin kakusa kaisyo ni mukete [Solutions to differential income between women and men].
Retrieved from http://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/koyoukintou/seisaku09/

Miwa, S. (2008). Kyōiku tattsei kateini mirareru syushin kaisono eikyō [The influence of social class on the process of educational achievement]. In I. Tanioka., M. Jinda., & N. Iwai (Eds.), Nihonjin no ishiki to kodo: Nihon-ban sogoteki shakai chōsa JGSS ni yoru bunseki, (pp. 225-236). Tokyo: Tokyō Daigaku Shūppan Kai.

Mohanmmadpour, E., & Ghafar, M. N. A. (2014). Math achievement as a function of within-and between-school differences. Scandinavian Journal of Educational Research, 58(2), 189-221. Retrieved from http://dx.doi.org/10.1080/00313831.2012.725097

Mori, I. (2008). Kojin no katsudo ya seikatsu syukanga gakuryokuni ataeru eikyō [The effects of students' lifestyles and outside of school activities]. In T. Kariya

(Ed.), *Heisei 19 nendo zenkoku gakuryoku gakushu jyokyo chōsa [Analysis report on nationwide survey on academic ability 2007*] (pp. 62-72). Tokyo: College of Education, the University of Tokyo.

Morota, Y. (2004). Gakuryōku titai to gakuryōku sokushin [Learning delay and learning speed]. In K. Shimizu & T. Kariya (Eds.), Gakuryōku no shakaigaku : chōsa ga shimesu gakuryoku no henka to gakushū no kadai [Academic achievement in sociology: The changes in academic achievement and issues]. (pp. 37-56). Tokyo: Iwanami Shōten.

Nakazawa, S. (2007). Genzaino wakamonosha hinkon [*Contemporary poverty in youth*]. *Shizuoka Kenritsu Daigaku Tankidaigakubu Kenkyū Kiyō*, 1-15.

Nakazawa, W. (2013). Shiteki gakkōgai kyoikuno motarasu kōkō shigaku heno kouka-keiko sukoa bunsekino ōyo. [*The educational effect of private tutoring on the progression to high schools: an application of propensity score analysis*]. Discussion paper series. University of Tokyo Institute of Social Science.

Namba, Y., & Hatanaka, M. (2012). Kyoiku kakusa no yoin to mondaiten. [*Causes and problems of educational inequality*]. *Hyogo Kyoiku Daigaku Kenkyū Kiyō 40,* 51-62.

Nara, K. (2010). OECD competency gainen no bunseki to ichimenteki PISA gata gakuryōku no mondai ten [Analysis on OECD competencies and problems on PISA style academic achievement]. *Wakō Daigaku Gendai Ningen Gakubu Kiyo Dai 3 Go,* 77-98.

National Center for Educational Statistics (2009). U.S. performance across international assessments of student achievement. U.S. Department of Education. Retrieved from http://nces. ed.gov

National Institute for Educational Policy Research. (2003). Kokusai sugaku rika kyoiku doko chōsa no 2011 nen chōsa (TIMSS 2011) kokusai chōsa kekka hokoku (gaiyō) [A summary of the TIMSS 2003]. Tokyo: Ministry of Education, Culture, Sports, Science and Technology.

National Institute for Educational Policy Research. (2009a). Jidō seito no seikatsu to syosokumento ni kansuru bunseki in [Analysis on children's life styles]. *Heisei 19,20 nendo zenkoku gakuryoku gakusyu jyokyo chōsa tsuika bunseki hokokusho [Analysis report on nationwide survey on academic ability 2007and 2008]*. Tokyo: Ministry of Education, Culture, Sports, Science and Technology.

National Institute for Educational Policy Research. (2009b). Syudokudo betsu shoninzū shidō ni tsuite: sono 1 [The findings on differential academic teaching methods: part one]. *Heisei 19,20 nendo zenkoku gakuryoku gakusyu jyokyo chōsa tsuika bunseki hokokusho [Analysis report on nationwide survey on academic ability 2007and 2008]*. Tokyo: Ministry of Education, Culture, Sports, Science and Technology.

National Institute for Educational Policy Research. (2009c). Syudokudo betsu shoninzū shidō ni tsuite: sono 2 [The findings on differential academic teaching methods: part two]. *Heisei 19,20 nendo zenkoku gakuryoku gakusyu jyokyo chōsa tsuika bunseki hokokusho [Analysis report on nationwide survey on academic ability 2007and 2008]*. Tokyo: Ministry of Education, Culture, Sports, Science and

Technology.

National Institute for Educational Policy Research. (2010). Chōsa kekka no gaiyo (syoto cyuto kyoikukikan, sensyu gakko, kakusyu gakko) [Summary of survey on elementary schools, technical schools, and various schools]. Retrieved from http://www.mext.go.jp/component/b_menu/houdou/__icsFiles/afieldfile/2013/08/07/1338338_02.pdf.

Nochi, G. (2008). Differential effect of poverty of Hawaii students' achievement in reading and mathematics (Unpublished doctoral dissertation). University of Hawai'i at Mānoa, HI.

Nonoyama-Tarumi, Y. (2008). Cross-national estimates of the effects of family background on student achievement: A Sensitivity Analysis. *International Review of Education 54*(1), 57-82.

Nukata, J., Sakaguchi, T., Fukuda, Y., Ochiai, Y., Arimoto, N., & Inoue, Y. (2008). Zenkoku gakkō syuhen johō ni kansu data base no sakusei to sono katsuyorei [A creation of a school environment information data base and an example of its utilization]. In T. Kariya (Ed.), *Heisei 19 nendo zenkoku gakuryoku gakushu jyokyo chōsa [Analysis report on nationwide survey on academic ability 2007]* (pp. 198-205). Tokyo: College of Education, the University of Tokyo.

O' Connell, A. A., & Goldstein, J., Rogers, H. J., & Peng, C. Y. J. (2008). Multilevel logistic model for dichotomous and ordinal data. In A. A. O'Connell, & D. B. McCoach (Eds.) *Multilevel Modeling of Educational Data* (pp. 199-242). Charlotte, NC: Information age publication Inc.

OECD (2012). *Japan,* OECD Publishing. *Programme for International Student*

Assessment (PISA) Results from PISA 2012: Japan, OECD Publishing.

OECD (2013a). *Programme for International Student Assessment (PISA) Results from PISA 2012: Japan,* OECD Publishing.

OECD (2013b). Tainichi shinsa hokokusho 2013 nen bam [*Economic report on Japan in 2013*]. OECD, Paris.

Orr, J. E. (2003). Black-white differences in achievement: the importance of wealth. *Sociology of education, 76(4),* pp. 281-304.

Oshio, T. (2011). Gakuryoku wo kimerunowa gakko ka kateika [Who decides student academic achievement: school or family?-A comparison between five Asian countries]. In Zaimu sogo seisaku kenkyujo (Ed.), Jinzaino ikusei katsuyoni kansuru kenyu hokokusho [*Report on developing human capabilities*] Tokyo: Zaimu Shō.

Owoeye, J. S., & Yara, P. O. (2011). School location and academic achievement of secondary school in Ekiti State, Nigeria. *Asian Social Science 7(5)*, 170-175.

Palardy, G. J. (2008). Differential school effects among low, middle, and high social class composition schools: A multilevel, multiple group latent growth curve analysis. *School Effectiveness and School Improvement, 19,* 21-49. Retrieved from DOI: 10.1080/0943450801936845

Peugh, J. L., & Enders, C. K. (2004). Missing data in educational research: A review of reporting practices and suggestions for improvement. *Review of Educational Research*, *74(4)*, 525-556.

Public broad casting (2008, September 5). How do we fund our schools? *Public Broad Casting*, Retrieved from

http://www.pbs.org/wnet/wherewestand/reports/finance/how-do-we-fund-our-schools/?p=197

Raudenbush, S. W., & Bryk, A. S. (2002). Hierarchical Linear Models: Applications and Data Analysis Methods. Thousand Oaks, CA: Sage Publications.

Sanchez, C. N. P., Montesinos, M. B., & Rodriguez, L. C. (2013). Family influences in academic achievement: A study of the Canary Islands. *International Journal of Sociology 71(1)*, 169-187.

Sato, M. (2005, July 28). Cram schools cash in on failure of public schools. *The Japan Times*, Retrieved from www.japanties.co.jp/.

Savasci, H. S., & Tomul, E. (2013). The relationship between educational resources of school and academic achievement. *International Education Studies 6(4)*, 114-123.

Schiller, K. S., Khmelkov, V. T., & Wang, X. (2002). Economic development and the effects of family characteristics on mathematics achievement, *Journal of Marriage and Family 64*, 730-742.

Shimizu, H. (2012). Kodomo tachino gakuryoku suijyunwo shitasasae shiteiru gakkōno tokuchoni kansuru cyosa kenkyu [A study on effective schools that support children's academic standards]. *Buraku Kaihō Kenkyū, 195,*82-92.

Shimizu, H., & Fujii, S. (2009). Furina kankyōni aru kodomo no gakuryoku no sokoageni seiko shiteiru gakkō no tokucyo-(kouka no aru gakko) kenkyuu syoho ni yoru bunseki-[Analysis of successful school characteristics of disadvantaged children]. In Unknown (Ed.), *Heisei 19,20 nendo zenkoku gakuryoku gakusyu jyokyo chōsa tsuika bunseki hokokusho [Analysis report on nationwide survey on academic ability 2007and 2008]* (pp162-179). Tokyo: Ministry of Education,

Culture, Sports, Science and Technology.

Shimizu, H., & Kariya, T., (2004). Gakuryoku no shakaigaku : chōsa ga shimesu gakuryoku no henka to gakushū no kadai [Academic achievement in sociology: The changes in student academic achievement and directions]. Tokyo: Iwanami Shoten.

Shimizu, M., & Sudo, Y., (2008). Gakuryoku no kiteiyoin no tiiki kan hikaku [A comparison of student academic achievement in different regions]. In T. Kariya (Ed.), *Heisei 19 nendo zenkoku gakuryoku gakushu jyokyo chōsa [Analysis report on nationwide survey on academic ability 2007*] (pp. 31-40). Tokyo: College of Education, the University of Tokyo.

Shinozaki, T. (2008). Hizaigaku, hisyugyo, hikyusyokucyuno jakunen mugyousya (neet) no tokucyo [Characteristics of young people on attendance in school, non-employment, and non-leave of absence]. In I. Tanioka, M. Jinda, & N. Iwai (Eds.), Nihonjinno ishikito kodo Nihonban sogo shakai chōsa JGSSni yoru bunseki [*Analysis on Japan General Social Survey*] (pp. 163-178). Tokyo: Tokyō Daigaku Shuppankai.

Singh, J. M. (2011). Long-term effects of Native Hawaiian students' early academic achievement under the no child left behind legislation: A multilevel cohort analysis. (Unpublished doctoral dissertation). University of Hawai‘i at Mānoa, HI.

Sirin, S. R. (2005). Socioeconomic Status and Academic Achievement: A meta-analytic review of research, *Review of Educational Research, 75(3),* 417-453.

Socioeconomic Status. (n. d.). In The American Heritage Dictionary Online (2014).

Stevenson, D. L., & D. P. Baker. (1992). Shadow education and allocation in formal schooling: transition to university in Japan. *American Journal of Sociology, 97,* 1639-1657.

Sudo, K. (2009). Gakuryoku no kaisosani kansuru jisshokenkyu no doko-nihonto America no hikaku wo toshite [*A review of the empirical studies of academic achievement disparity-through the comparison of US and Japan*]. *Tokyō Daigaku Daigakuin Kyoikugaku Kenkyuka Kiyō 49 Kan*. 53-61.

Sudo, K. (2008). Gakko kankyo to kyoiku katsudo ga gakuryokuni ataeru eikyo [The influence of school environment and educational activities on student achievement]. In T. Kariya (Ed.), *Heisei 19 nendo zenkoku gakuryoku gakushu jyokyo chōsa [Analysis report on nationwide survey on academic ability 2007*] (pp. 52-61). Tokyo: College of Education, the University of Tokyo.

Takata, N. (2012). Beikoku syogakko ni okeru hubo no sannkani kansuru ichikōsatsu: Michigan syu no aru syogakko no jirei yori [A paper on parental participation in a US elementary school: An example of elementary school in Michigan]. Hokaidō University Syakai kyoiku kenkyu, 63-71.

Tayyaba, S. (2010). Mathematics achievement in middle school level in Pakistan. *International Journal of Educational Management, 24(3)*, 221-249. Retrieved from http://dx.doi.org/10.1108/09513541011031583

The Japan Institute for Labour Policy and Training (2015). Sengyo shufu setaisū to tomobataraki sūno suii [The total number of non-working housewives and dual job families]. Retrieved from http://www.jil.go.jp/kokunai/statistics/qa/a07-1.html

The Ministry of Health, Labour and Welfare (2010). Heihei 22 nen kokumin seikatsu kiso chōsano gaikyo [*The result of Nation's life survey in 2010*]. Retrieved from http://www.mhlw.go.jp/toukei/saikin/hw/k-tyosa/k-tyosa10/4-1.html

The Ministry of Education, Culture, Sports, Science and Technology (2010). Gimu kyōikuhi kokko hutan seido nituite [About Act on National Treasury's Sharing of Compulsory Education Expenses]. Retrieved from http://www.mext.go.jp/amenu/shotou/gimukyoiku/outline/001.htm

Thirunarayanan, M. O. (2004). The "significant worse" phenomenon: A study of student achievement in different content areas by school location. *Education and Urban Society, 36(4)*, 467-481.

Thomas, S. L., & Heck, R. H. (2001). Analysis of large-scale secondary data in higher education research: potential perils associated with complex sampling designs. *Research in Higher Education 42(5),* 517-540.

Tomul, E., & Savasci, H. S. (2012). Socioeconomic determinants of academic achievement. *Educational Assessment, Evaluation and Accountability,* 24, 175-187. Retrieved from DOI 10.1007/s11092-012-9149-3

Tsumura, M. (2005). Katei no gakkō gai kyoikuhini eikyowo oyobosu yoinno hennka-SSM 1985.2005 deta ni yoru bunseki [The change in factors affecting education costs for activities outside school: Results of SSM-1985 and SSM-2005] (pp.109-125). Kaiso syakaino nakano kyoiku gensyo [Educational Phenomena in a Stratified Society]. In T. Nakamura, T (Ed.), 2005 nen SSM chōsa kenkyukai.

Tudge, J. R. H., Mokrova, I., Hatfield, B. E., & Karnik, R. B. (2009). Uses and misuses of Bronfenbrenner's bioecological theory of human development, *Journal of Family Theory and Review 1*, 198-210.

Uchida, M. (2014). Hinkonno rensawo tachikiru gakusyu no torikumi [Initiative for educational support to stop the chain of poverty]. *Yamaguchi Kenritsu Daigaku Syakai Fukushi Gakubu Kiyō 20 Kan.* 45-54.

White, K. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91,* 461-481.

Yamada, T. (2009). Kakusa wo syukusyo suru gakkyu kouka no tankyu: multilevel analysis wo mochiita bunseki [*A multilevel analysis of school classes to reduce class differentiation*]. Benesse Cooperation. 89-102.

Yamamoto, Y., & M. C. Brinton. (2010). Cultural capital in East Asian educational systems: the case of Japan. *Sociology of Education, 83,* 67-83.

Yi, J. (2013). Tiger moms and liberal elephants: Private, supplemental education among Korean-Americans. *Society 50(2),* 190-195.

Yoshino, A. (2012). The relationship between self-concept and achievement in TIMSS 2007: A comparison between American and Japanese students. *International Review of Education*, *58*, 199-219. Retrieved from DOI 10.1007/s11159-012-9283-7

Footnotes

Results of maximum likelihood (ML) with the final multilevel analysis models. [1]

Parameter	
Fixed Effects	
intercept	569.55***(6.20)
sch location	–9.31(4.92)
sch disadv	–15.18(9.20)
sch loc*books	0.00(1.23)
sch disadv*books	−0.98(2.23)
sch loc*computers	−2.16(4.00)
sch disadv*computers	−1.84(7.81)
sch loc*maternal edu	2.77(1.80)
sch disadv*maternal edu	0.72(3.15)
sch loc*paternal edu	−1.27(1.59)
sch disadv*paternal edu	−3.19(2.83)
Variance Components	
level-1 residual	4056.37***(63.69)
level-2 intercept variance	1474.66***(38.40)
book slope variance	9.75(3.12)
computer slope variance	270.01(16.43)
paternal edu slope variance	12.32(3.51)
maternal edu slope variance	2.78(1.67)

Note. Standard errors and SD are in parentheses.
***p<.001

Results of maximum likelihood (ML) with the final multilevel ordinal models. [2]

Parameter		Odds Ratio
Fixed Effects		
intercept	0.09(0.05)	1.09
maternal edu	−0.18(0.04)	0.84***
For thresholds		
δ_2	0.86(0.03)	2.37***
δ_3	3.74(0.12)	41.92***
Variance Components		
level-2 intercept variance	0.17***(0.40)	–

Note. Standard errors are in parentheses.
***p<.001