The Pennsylvania State University

The Graduate School

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**THE RELATIONSHIP BETWEEN MATERNAL EDUCATION AND CHILDREN'S**

**ACADEMIC ACHIEVEMENT IN HONG KONG**

A Thesis in

Educational Theory and Policy

by

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**ABSTRACT**

This study explores trends in the relationship between maternal education and academic achievement of students in Hong Kong, using data from the most recent four cycles (i.e., 1999, 2003, 2007 and 2011) of Trends of International Mathematics and Science Study (TIMSS). Using fixed-effects models, I found students of mother with a higher level of education perform better than students of mother with a lower level of education in math and science in Hong Kong. Moreover, I found that the achievement gaps between students whose mother had middle school education or less and students whose mother had a bachelor's degree increased between 1999 and 2011. Increased segregation between schools may explain an increase in the association between maternal education and children's academic outcomes. Policy implications and future research directions are discussed.

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## Chapter 1

## INTRODUCTION

**Maternal Education**

Family characteristics, such as socioeconomic status (SES), family structure, and family size, are closely related with children's academic performance (Bradley and Davis-Kean, 2005; Mayoa and Siraj, 2015; Verna, Campbell, and Beasley,1997). As an essential component of family SES, maternal educational status has become an attractive topic to scholars who study children's cognitive achievement (Lareau, 2003). Researchers also found evidence that maternal educational attainment is associated with the formation of various types of capital (e.g., human, social, and cultural capital) (Bodovski, 2010; Harding, Mrris & Hughes, 2015). In addition, a higher level of maternal education is found to promote children's educational outcomes (Parveen & Alam, 2008).

In recent years, scholarly interests in the role of maternal education in children's academic outcomes have grown throughout the whole world. By using various analytic strategies, researchers address the role of maternal education in children's educational outcomes in a comparative perspective. However, due to limited data resources, few studies have examined the relationship between maternal education and children's academic performance in China. Likewise, as a relatively developed region of China, Hong Kong has also only been tested in very few studies regarding the maternal level of education. As a result, little is known about the relation between mother's education status and children's educational outcomes in Hong Kong.

**The Hong Kong Context**

Hong Kong, one of the two Special Administrative Regions (SAR) of China, was colonized by Britain for over 150 years until 1997. Since its return, Chinese government has employed a

special policy in Hong Kong, namely, "one country, two systems," which claims the sovereignty over Hong Kong but allows it to remain the major previous society form, governmental structure and economy mode. As reported by OECD (Organisation for Economic Co-operation and Development) in 2011, Hong Kong had around 7 million people living in a very small area of 1000 square kilometers, yet the high GDP growth rate had helped her to become one of the richest economies (Zhu & Lueng, 2012).

However, despite the highly developed economy and the excellent performance of Hong Kong students, gender educational inequality in Hong Kong is diminishing but still exists in a significant degree (Post, 2004). Although the introduction of nine years of universal basic education in Hong Kong in the 1970's, women in Hong Kong appeared to have lower level of education attainment than men. In 1986, for example, there were 21.4% of female residents who had hardly any schooling, and the proportion dropped dramatically since then but 7.1% of the female residents remained uneducated in 2011 (Census and Statistics Department of Hong Kong, 2012). By contrast, the counterpart of men was 5.3% in 1986 and 2.7% in 2011(Census and Statistics Department of Hong Kong, 2012). By contrast, the average literacy rate of women in all developed countries, reached 97.5% in 2010, as United Nations Educational, Scientific and Cultural Organization (UNESCO) reported. Accordingly, women in Hong Kong still exhibit a disadvantageous educational level.

**Purpose of Study**

Previous research on the relationship between maternal education and children's academic outcomes examined many countries including the United States. However, limited studies examined East Asian societies, particularly China. Moreover, there are few studies that have

tried to reveal trends of the association between maternal education and children's academic achievement based on longitudinal data. Building on previous research, this study examines how the relationship between maternal education and children's academic achievement changed over time in Hong Kong during the past decade, using data from the most recent four cycles of TIMSS (i.e., 1999, 2003, 2007 and 2011). Results from this study not only provide implications for policy makers in Hong Kong, but also offer important insights into the role of maternal education in children's academic achievement in China.

**Organization of the Thesis**

The thesis is organized as follows: Chapter 2 reviews relevant literature on the role of maternal education. Chapter 3 introduces data, measures, and analytic strategies that will be used. Chapter 4 presents results from two regression models predicting children's academic achievement in 1999, 2003, 2007 and 2011. Chapter 5 and Chapter 6 respectively discuss the findings and make conclusion, with further discussion of policy implications, limitation of the study, and directions for future research.

## Chapter 2

## LITERATURE REVIEW

**Maternal education status and cultural capital**

From the perspective of educationists and sociologists, maternal education is one of the components of family SES which is often measured by parental education, family income and parental occupation, is regarded as contributing to inequality in educational outcomes (Duncan & Magnuson, 2003; Bradley & Davis-Kean, 2005; Mayoa & Siraj, 2015; Verna, Campbell, & Beasley,1997). In other words, together with income and occupation of parents, maternal educational status has a significant impact on students' school performance.

According to a recent study by Harding, Morris and Hughes (2015), maternal education impacts children's academic outcomes through human, cultural and social capital. To be specific, maternal human capital is reflected in language use and quality of cognitively stimulating parenting practice, while maternal social capital is considered more a collection of educational information for children. Among these three forms of capitals, maternal cultural capital is the most illuminating part because maternal education influences children's academic outcomes directly by transmission of cultural capital. In other words, only cultural capital can be reproduced from mothers to their children by certain activities.

Since cultural capital is often described as an individual's cultural knowledge, educational credentials and school-related information (Bourdieu, 1986; Bourdieu & Passerson, 1977), instead of only being seen as a component of family SES, maternal education status is also considered a crucial part of cultural capital with increasing significance. Bourdieu (1977) developed the concept of cultural capital in the context of his educational research, and he argued that the level of education is associated with "legitimate" activities such as cinema attendance

and book reading. Hence, by reproducing the level of education, a knowledge of cultural and social class is likely to be transmitted to a next generation. In addition, Bourdieu pointed out that cultural reproduction had impacted individuals through cultural actions. On the other hand, many other researchers defined cultural capital by adding an important part, educational credentials (Robinson & Garnier, 1985). Also during last several decades in 20th century, researchers linked academic achievement with parents' cultural capital through cultural activities (Aschaffenburg & Maas, 1996; Ganzeboom, De Graaf & Robert, 1990; Kalmijin & Kraaykamp, 1996; Lareau, 2003).

Based on cultural capital theory from Bourdieu, maternal education becomes an essential factor of cultural capital reproduction in many studies, even more significant than fathers' education attainment (Wamala, Kizito, & Jjmba, 2013). Mother's education status related to increased levels of parental practices and promotes mothers' involvement in school, which influences students' cognitive outcomes. Researchers conclude that there is a positive correlation between mothers' level of education and students' academic outcomes (Augustine, Cavanagh & Crosnoe, 2009; Magnuson, 2007). For instance, children whose mothers have relatively higher levels of education are more likely to perform higher in both math and reading than children whose mother have lower levels of education (Roksa & Potter, 2011). In summary, most research indicates that maternal education plays a positive role in children's academic success in almost all contexts. Conversely, no education or a low level of maternal education is associated with a disadvantaged condition to children.

**Previous studies in global context**

For a long period, researchers have used maternal education status to measure SES. For example, Verna, Campbell, and Beasley (1999) addressed that family SES was a major

contributing force for the family process and offered a positive connection with child's self-concept and academic achievement. Bradley and Corwyn (2002) examined the extent to which differences in parenting practices mediated the relation between SES and child development. Likewise, a study on Peruvian children suggests that SES is positively related to child academic achievement through parenting behavior (Millones, Ghesquière, & Leeuwen, 2014). The evidence in SES-related cognitive research indicates that parents' years of schooling or maternal education indirectly affects child achievement (Devis-Kean, 2005; Duncan & Magnuson, 2012), while other evidence shows that the direct effect of family SES is greater than the indirect one (Stull, 2013). However, literature focused more on the influence of family income and parental occupations on children when taking family SES into consideration.

Despite a focus on SES, maternal education drew growing scholarly attention in the fields of education and sociology especially in the Western context. For example, using data from an American longitudinal survey, Magnuson (2007) found that an increase in mothers' educational attainment was associated with better school outcomes of children. Furthermore, another longitudinal study focusing on foreign-born Latinas in the United States found that the degree of concerted cultivation behaviors varied by different levels of maternal education (Ansari, Purtell, & Wu, 2016). In Canada, research shows that early childhood home environments mediate to a certain degree the association between maternal education and children's achievement (Zadeh, Farnia, & Ungerleider, 2010).

Similar results have been reported by scholars in many other countries. For example, scholars in Pakistan found that a mother with some education spends more time helping their children with school work so that those children have higher score by 0.23-0.35 standard deviations (Andrabi, Das, & Khwaja, 2012). In China, evidence shows that maternal education is one of the

most important determinants of students' educational outcomes, and the type of school could mediate the effect of mother's education (Pong, Xu, Lin, &Ren, 2013). In addition, Xiao (2013) found that mothers in rural China educate their children primarily with three resources: financial resources, emotional resources, and arrangement of time. Mothers who have higher levels of education tend to save more money for their children's education, communicate more on the academic issues, and arrange children doing homework or private tutoring after school or during vacation instead of farming (Xiao, 2013). As results, children whose mothers have higher levels of education occupied the advantaged position in school (Xiao, 2013).

In summary, most studies reviewed above used a quantitative approach with a variety of statistical models and different variables. Regardless of different methods used, evidence is generally consistent: Maternal education has a significant effect on children's educational outcomes. However, there are still relatively limited studies especially in Asia. Also, few studies examined the role of schools in the relationship between family and students' educational outcomes. Moreover, most research concentrates on the indirect impact of family such as parenting practice or parental expectation than the direct effects of one or more factors or school mediation effects.

**The Hong Kong Context**

Hong Kong's educational system reflect its unique history. Hong Kong followed the 6-5-2-3 British system of education (six-year elementary school, five-year secondary school, two-year pre-university and three-year university) until 2004, and changed to 6-3-3-4 system (six-year elementary school, three-year lower secondary school, three-year upper secondary school and four-year university), which is same as mainland China now (Sun, Bradley, & Akers, 2012). Compulsory Education Policy launched since 1978 in Hong Kong, which guaranteed free

education for nine years for all children from 6 to 15 years old (Dowson, Bodycott, Walker, & Coniam, 2000; Lee & Ye, 2004).

Although free compulsory education decreased the effect of family resources and gender on the educational opportunity for children in Hong Kong, family background still relates to quality of children's education (Pong, 1994). The school system in Hong Kong consists of traditional public schools (TPS) and international schools, local private schools and newly emerging Direct Subsidy Scheme (DSS) schools. Huge tuition gaps among those schools influence the school choice of children. The traditional schools are sponsored by the government and all students are free for charge, while in other schools, annual fee ranges from HK$30,000 to HK$183,000 per year for tuition (Zhou, Cai, & Wang, 2016).

Meanwhile, a large influx of immigrant children from mainland after 1997 increased the degree of diversity in the Hong Kong society (Zhang, Law, & Ting, 2011). Education for New Chinese Immigrant Children (NCIC) has faced a great challenge in many ways, such as social identity and language proficiency (Gu, 2016; Zhang, Law, & Ting, 2011). However, research suggests that achievement of immigrants' s children from mainland China is higher than that of native students on math and science (Pong, 2009).

Yet, very limited work examined the role of maternal education in children's school achievement in Hong Kong, leaving a huge gap in this field. One of the few studies found that students from higher SES family take more extra lessons in Hong Kong (Zhou &Wang, 2015). Another study used multilevel modelling approach to investigate factors impacting Science achievement for secondary school students in Hong Kong with PISA data, which only blends parental effects on science into a composite variable of student characteristics (Sun, Bradley, & Akers, 2012). In addition, Tam (2009) found that Chinese mothers of school-age children in

Hong Kong are more efficacious in promoting children's academic performance, and boys benefit more than girls from maternal education. However, none of them examined the relationship between maternal education and children's academic performance.

In conclusion, to fill the research gap in Hong Kong, this study examines the effect of maternal education on children's academic achievement. In addition, this study examines whether and how the effect of maternal education on children's academic achievement changed over time in the past decade, given social and political changes in Hong Kong since 1997. Finally, the current study investigates how schools mediate the relationship between maternal education and children's academic achievement.

**Conceptual Framework**

Building on prior research, the current study uses the following conceptual framework to examine the role of maternal education in children's academic achievement:
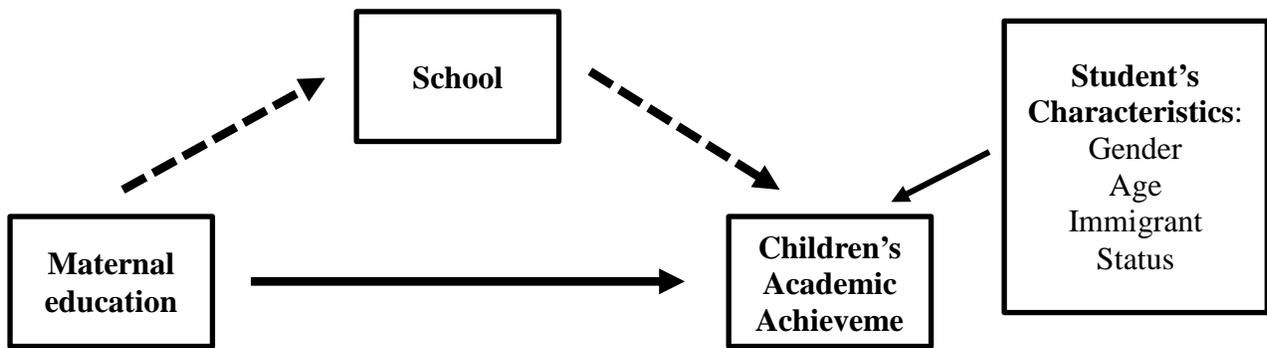


Figure 1. Conceptual Framework

The solid arrow indicates a direct influence of maternal education on students' academic achievement, while the dotted arrow means the mediating role of school factors. Student's characteristics that are associated with their academic achievement are also taken into account in the framework.

**Research Questions and Hypotheses**

Guided by prior literature and the conceptual framework, the current study addresses the following research questions:

Q1: What is the relation between maternal education and children's academic achievement in Hong Kong?

Q2: How did the relation change over time during the past decade ?

Q3: Do school factors mediate the relationship between maternal education and children's academic achievement in Hong Kong?

## Chapter 3

## METHODOLOGY

**Data and sample**

The current study draws on data from TIMSS administered by International Association for the Evaluation of Education Achievement (IEA). TIMSS is an international assessment of mathematics and science for the fourth and eighth grades students, which aims to improve the teaching and learning of mathematics and science as well as the certain educational policy. Since 1995, TIMSS has continued every four years (e.g., 1999, 2003, 2007, and 2011). Also, TIMSS uses the curriculum, broadly defined, as the major organizing concept in considering how educational opportunities are provided to students, and the factors that influence how students use these opportunities (TIMSS, 2015). Family background questionnaires in TIMSS can be examined in relation to achievement to explore factors that contribute to academic success.

TIMSS has two target populations each time: fourth- and eighth-grade students. It uses a two-stage stratified luster sample design, in which at the first stage consists of randomly selected schools and at the second stage includes one or more classrooms from target grade in sampled schools. This study focus on eighth-grade students in Hong Kong data because of the following reasons. The first and most important reason is that information about maternal education is collected only for eighth-grade students. Besides, eighth-grade students are in the almost final stage of nine-year compulsory education so that the outcomes for eighth grade students, to some extent, represent the achievement of compulsory education in Hong Kong. There are totally 4 samples in current study. The sample sizes are, in order, 4097, 4159, 2816 and 2851.

**Measures**

**Outcome variable.** The outcome variable of this study was academic achievement. In the TIMSS student questionnaire, the average scores of mathematics and science based on 5 plausible results of mathematics and science items for each year. This study used the average score for each subject as the dependent variable.

**Independent variable.** The independent variable of interest was maternal education. Each cycle, TIMSS asked "What is the highest level of education completed by your mother (or stepmother or female guardian)?" Although options that were given slightly different across cycles, they included the following scale of the International Standard Classification of Education (ISCED): 1 = Pre-primary education, 2 = Lower secondary education, 3 = Upper secondary education, 4 = Post-secondary non-tertiary education, 5 = Short-cycle tertiary education, 6 = Bachelor's or equivalent level, 7 = Master's or equivalent level, and 8 = Doctoral or equivalent level. I grouped these levels of education into three groups: (1) high school or less; (2) some college (including mothers who attended university but never graduate from one and graduated from a vocational school); (3) University or above (bachelor's degree or above).

**Control variables.** This study included (1) age, (2) gender, (3) Immigrant situation as control variables. Age was based on students' self-report of their age, ranging from 12 to 17. Gender based on students' self-report of their sex and was coded as follows: female =1 and male = 0. Immigrant situation was based on students' self-report and was coded as follows: immigrant students = 1, native students = 0. I also included a series of dummy variables for schools to control for heterogeneity associated with schools. Including school dummies would help to understand how schools mediate the relationship between maternal educational and children's academic achievement. Table 1 provides the summary of these variables included in analyses.

*Table 1 Variable Definitions table*

| variable name | Variable Definition |
|---|---|
| *Outcome Variable* | |
| **Math Achievement** **Science Achievement** | Mean of five plausible scores of math/science for each eighth grade student based on the results on math/science items of TIMSS |
| *Independent Variable* | |
| **maternal education:** **No H.S. Degree(reference)** **Some College** **University or above** | Dummy Variables derived from eighth grade student questionnaire of TIMSS. The variable label is "Parents' Highest Education Level", which used ISCED level as indicator. In this study, maternal education is recoded into three groups: No high school degree=0; some college=1 ; university or above=2 |
| *Control Variables* | |
| **Gender:** **Male(reference)** **Female** | Dichotomous variables derived and recoded from eighth grade student questionnaire of TIMSS: Whether the student's gender is female( Yes=1; No=0) |
| **Age:** **9 to 13(reference)** **14 to 15** **16 to 19** | Dummy Variables derived and recoded from eighth grade student questionnaire of TIMSS( 9~13=0; 14~15=1; 16~19=2) |
| **Immigrant status:** **Native students(reference)** **Immigrant students** | Dichotomous variable derived and recoded from eighth grade student questionnaire of TIMSS: Whether the student born in this country( Yes=0; No=1) |
| **School ID Dummy** | Dummy variable derived from TIMSS original variable of school ID for eighth grade students in Hong Kong |

**N(Mean)=** 3476

**Analytic Strategies**

I used regression models to examine whether maternal education status influenced the

students' academic achievement. I estimated two models. First, in order to address the first

research question about the relation between maternal education and children's academic achievement, I estimated the following equation:

$$Y_{achievement} = \alpha + \beta_1 X_{maternal\ edu} + \sum \beta_n X_{control} + \varepsilon$$

where $Y_{achievement}$ represents academic achievement, $X_{maternal\ edu}$ maternal education, and $X_{control}$ each of three control variables. $\varepsilon$ means error or residual.

Next, I added a series of dummy variables to address the second research question. By controlling for the effects of schools, I could examine the extent to which school factors explained the effect of maternal education status on children's outcomes. This model was estimated with the following equations:

$$Y_{achievement} = \alpha + \beta_1 X_{maternal\ edu} + \sum \beta_n X_{control} + \beta_i X_{schoolIDfixed} + \varepsilon$$

where $X_{schoolIDfixed}$ stands for schools for sample of students, and $\beta_i$ is the regression coefficient of School ID. The other symbols remain the same as in model 1.

Note that in order to examine the how the relation between maternal education and children's academic achievement changed between 1999 and 2011, I replicated the aforementioned regression models for each cycle.

# Chapter 4

## RESULTS AND FINDINGS

**Descriptive Findings**

Table 2 presents descriptive statistics for each variable and each cycle. In 1999, the mean score of math was 590.66 for eighth grade students in Hong Kong, while the mean score of science was 544.79. Approximately 90% of students had mothers who did not have a high school diploma in 1999. For the proportion of gender, compare to around 49% of male students, the proportion of female students was slightly higher. Also, about 17% were immigrant students.

In 2003, the mean score of mathematic (592.83) was similar to that in 1999, but the mean score for science (560.87) increased by over 15 points. Both proportions of mothers who got some college (8.94%) and who finished university (6.71%) increased by over 2%. Gender distribution was about the same as before. However, the age distribution was more concentrated in the 14-15 year-old group (54.15%) and immigrant students group (26.47%) increased by approximately 10%.

In 2007, both mathematics (582.39) and science (537.89) mean scores dropped to a large degree compared to previous years. The level of education for mothers also changed. To be more specific, the percent of students having mothers who had no high school degrees reduced to 79.65%. The distributions for gender, age and immigrant status remained almost same.

Finally, for 2011, the most significant change was observed for the proportion for mothers who completed higher education. Specifically, the proportion rose from 8.59% to 19.15%. However, the majority of students had mothers who did not have a high school diploma. Meanwhile, there were few changes observed values for other variables.

*Table 2 Descriptive Statistics Table for all variables through 1999 to 2011*

| | 1999 | | | | 2003 | | | | 2007 | | | | 2011 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| variable name | Mean | Percent | SD | N | Mean | Percent | SD | N | Mean | Percent | SD | N | Mean | Percent | SD | N |
| *Outcome Variable* | | | | | | | | | | | | | | | | |
| Math Achievement | 590.66 | | 65.11 | 4079 | 592.83 | | 65.56 | 4159 | 582.39 | | 86.19 | 2816 | 594.82 | | 77.96 | 2851 |
| Science Achievement | 537.26 | | 58.87 | 4079 | 560.87 | | 58.87 | 4159 | 537.89 | | 73.88 | 2816 | 543.12 | | 67.28 | 2851 |
| *Independent Variable* | | | | | | | | | | | | | | | | |
| maternal education: | 0.15 | | 0.46 | | 0.22 | | 0.55 | | 0.29 | | 0.61 | | 0.44 | | 0.79 | |
| No H.S. Degree(reference) | | 89.61 | | 3655 | | 84.35 | | 3508 | | 79.65 | | 2243 | | 74.96 | | 2137 |
| Some College | | 6.08 | | 248 | | 8.94 | | 372 | | 11.75 | | 331 | | 5.89 | | 168 |
| University or above | | 4.31 | | 176 | | 6.71 | | 279 | | 8.59 | | 242 | | 19.15 | | 546 |
| *Control Variables* | | | | | | | | | | | | | | | | |
| Gender: | 0.51 | | 0.50 | | 0.52 | | 0.50 | | 0.52 | | 0.50 | | 0.53 | | 0.50 | |
| Male(reference) | | 48.86 | | 1993 | | 47.75 | | 1986 | | 48.08 | | 1354 | | 46.97 | | 1339 |
| Female | | 51.14 | | 2086 | | 52.25 | | 2173 | | 51.92 | | 1462 | | 53.03 | | 1512 |
| Age: | 14.22 | | 0.82 | | 14.38 | | 0.90 | | 14.36 | | 0.77 | | 14.31 | | 0.69 | |
| 9 to 13(reference) | | 46.02 | | 1877 | | 37.89 | | 1576 | | 34.16 | | 962 | | 40.58 | | 1157 |
| 14 to 15 | | 48.49 | | 1978 | | 54.15 | | 2252 | | 60.37 | | 1700 | | 56.51 | | 1611 |
| 16 to 19 | | 5.49 | | 224 | | 7.96 | | 331 | | 5.47 | | 154 | | 2.91 | | 83 |
| Immigrant status: | 0.17 | | 0.38 | | 0.26 | | 0.44 | | 0.25 | | 0.43 | | 0.24 | | 0.43 | |
| Native students(reference) | | 82.42 | | 4220 | | 73.53 | | 3058 | | 74.89 | | 2019 | | 76.25 | | 2174 |
| Immigrant students | | 17.07 | | 874 | | 26.47 | | 1101 | | 25.11 | | 707 | | 23.75 | | 677 |
| School ID Dummy | | | | 137 | | | | 125 | | | | 120 | | | | 117 |
| N | | | | 4079 | | | | 4159 | | | | 2816 | | | | 2851 |

**Maternal Education Status and Children's Academic Achievement**

    **Mathematics Achievement.** Table 3 presents the results from regression models predicting the relationship between maternal educational level and students' mathematics performance. As mentioned above, Model 1 included the maternal education variable and student characteristics variables. Results showed that all regression coefficients were positive and statistically significant at the 99% confidence level, indicating that compared to students whose mother had high school education or less, students whose mother had some college or university education had higher mathematics scores. For instance, in 2007, students whose mother had a bachelor's degree or above had 33.68 points higher than students whose mother had high school diploma or less.

    For control variables, there was no gender differences in math performance except for 2007. Age was significantly related to math performance such that the older the students are, the worse scores they had on mathematics. Finally, compared to native students, immigrant students had low math scores.

    **Science Achievement.** Table 4 shows the results from regression models predicting science achievement. Results were similar to those for mathematics achievement. In other words, at the higher level of educational mothers had, the higher science achievement their children had. However, the magnitudes of the effect of maternal education were found to be somewhat different between math and science. For example, the achievement gap between students whose mother had university education or higher and students whose mother had high school education or less was 46.48 for mathematics achievement, while it was 39.36 for science achievement.

    In terms of control variables, for 1999 and 2003, there was significant gender differences in science achievement favoring boys. However, there was no significant gender difference since

*Table 3 Relationship between maternal education and children's mathematics achievement (8 grade)*

| VARIABLES | 1999 | | 2003 | | 2007 | | 2011 | |
|---|---|---|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| **Some College** | 19.83*** | 2.428 | 16.04*** | -1.369 | 26.13*** | 5.429* | 11.95** | -4.658 |
| | (4.259) | (2.725) | (3.540) | (2.404) | (4.997) | (2.935) | (6.034) | (3.816) |
| **University or above** | 22.58*** | 1.120 | 23.75*** | -8.481*** | 33.68*** | -2.891 | 46.48*** | 1.204 |
| | (5.013) | (3.277) | (4.033) | (2.887) | (5.751) | (3.624) | (3.621) | (2.587) |
| **Control** | | | | | | | | |
| **female** | -2.237 | -10.79*** | 1.797 | -11.50*** | 8.119** | -18.24*** | 0.664 | -22.65*** |
| | (2.032) | (1.508) | (2.011) | (1.540) | (3.201) | (2.074) | (2.820) | (2.023) |
| **Age** | | | | | | | | |
| **14 ～15** | -4.132** | -0.486 | -4.232** | -2.462** | -6.326** | -0.529 | -12.05*** | -5.277*** |
| | (1.850) | (1.177) | (1.806) | (1.215) | (3.023) | (1.764) | (2.662) | (1.694) |
| **16～19** | -9.787* | 2.158 | -14.84*** | -1.837 | -16.82** | 3.608 | -48.12*** | -14.58** |
| | (5.265) | (3.379) | (4.430) | (2.979) | (8.045) | (4.997) | (8.837) | (5.691) |
| **immigrant** | 0.114 | 6.492*** | -12.61*** | 1.306 | -19.19*** | 3.365 | -13.36*** | 8.761*** |
| | (2.945) | (1.942) | (2.489) | (1.699) | (3.901) | (2.333) | (3.393) | (2.178) |
| **IDSCHOOL Dummy** | | Fixed | | Fixed | | Fixed | | Fixed |
| **Constant** | 596.2*** | 502.5*** | 599.4*** | 619.8*** | 587.9*** | 560.0*** | 607.6*** | 430.1*** |
| | (3.230) | (7.807) | (3.281) | (7.536) | (5.623) | (10.22) | (4.899) | (11.22) |
| | | | | | | | | |
| **Observations** | 4,079 | 4,079 | 4,159 | 4,159 | 2,816 | 2,816 | 2,851 | 2,851 |
| **R-squared** | 0.012 | 0.639 | 0.025 | 0.591 | 0.036 | 0.597 | 0.076 | 0.668 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

*Table 4 Relationship between maternal education and children's science achievement (8 grade)*

| VARIABLES | 1999 Model 1 | 1999 Model 2 | 2003 Model 1 | 2003 Model 2 | 2007 Model 1 | 2007 Model 2 | 2011 Model 1 | 2011 Model 2 |
|---|---|---|---|---|---|---|---|---|
| **Some College** | 12.72*** | 0.525 | 9.440*** | -1.128 | 17.15*** | 5.429* | 7.520 | -3.630 |
| | (3.807) | (2.887) | (3.184) | (2.408) | (4.321) | (2.935) | (5.232) | (3.863) |
| **University or above** | 20.64*** | 4.230 | 20.58*** | 1.992 | 21.13*** | -2.891 | 39.36*** | 6.223** |
| | (4.482) | (3.471) | (3.627) | (2.891) | (4.973) | (3.624) | (3.139) | (2.619) |
| **Control** | | | | | | | | |
| **female** | -18.29*** | -20.41*** | -8.882*** | -20.39*** | 2.671 | -18.24*** | -3.312 | -20.81*** |
| | (1.817) | (1.598) | (1.809) | (1.542) | (2.768) | (2.074) | (2.445) | (2.048) |
| **Age** | | | | | | | | |
| **14 ～15** | -3.444** | -0.487 | -4.114** | -2.868** | -5.599** | -0.529 | -10.07*** | -4.675*** |
| | (1.654) | (1.247) | (1.624) | (1.216) | (2.614) | (1.764) | (2.308) | (1.715) |
| **16～19** | -12.36*** | -3.613 | -17.54*** | -8.410*** | -17.47** | -2.030 | -43.05*** | -18.02*** |
| | (4.706) | (3.580) | (3.979) | (2.984) | (6.955) | (4.708) | (7.659) | (5.759) |
| **immigrant** | 5.320** | 7.857*** | -7.147*** | 3.627** | -10.25*** | 3.365 | -6.932** | 9.584*** |
| | (2.633) | (2.057) | (2.239) | (1.702) | (3.373) | (2.333) | (2.941) | (2.205) |
| **IDSCHOOL Dummy** | | Fixed | | Fixed | | Fixed | | Fixed |
| **Constant** | 549.5*** | 484.3*** | 572.2*** | 596.3*** | 544.8*** | 560.0*** | 554.9*** | 406.9*** |
| | (2.888) | (8.270) | (2.951) | (7.547) | (4.862) | (10.22) | (4.248) | (11.36) |
| | | | | | | | | |
| **Observations** | 4,079 | 4,079 | 4,159 | 4,159 | 2,816 | 2,816 | 2,851 | 2,851 |
| **R-squared** | 0.034 | 0.505 | 0.022 | 0.491 | 0.019 | 0.597 | 0.067 | 0.544 |

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

2007. For age, results were similar to those for mathematics: the older students were, the lower scores their science achievement was. Immigrant students outperformed native students on science only in 1999.

**The Role of Schools in Mediating the Relationship between Maternal Education and Children's Academic Achievement.**

Based on both table 3 and table 4, almost all coefficients of maternal education lost their statistical significance for mathematics and science achievement when school dummies were added in model 2. For example, in table 3, the coefficient for "Some college" was 19.83 in 1999. However, when taking school variables into consideration, the coefficient became 2.428 and it was not statistically significant. Note that $R^2$ dramatically increased from model 1 to model 2 for both subjects across different cycles. In 2011, $R^2$ of Model 1 was 0.076 for mathematics but it increased to 0.668 in Model 2. Together, these results suggested that schools played an important mediating role in linking maternal education to children's academic achievement.

**Trends in 12 years**

Results in Tables 3 and 4 also suggested that the gaps in mathematics achievement between students of mother who never graduated from a high school and students of mother who had higher education increased, for example, from 22.58 in 1999 to 46.48 in 2007. The similar trend was observed for the gaps in science achievement. Yet, when controlling for school fixed effects, the achievement gaps who never graduated from a high school and students of mother who had higher education attenuated or disappeared.

## Chapter 5

## DISCUSSION

**Summary of Main Findings**

The current study examined the relationship between maternal education and children's academic achievement. The results highlighted a positive association between maternal education status and students' academic achievement. That is, the higher level of education mothers have, the higher score their children had on math and science. Further, I found that the achievement gap between students whose mother had high school education or less and students whose mother had a bachelor's degree or higher increased from 1999 to 2011.

In terms of school mediating effects, almost all coefficients of maternal education lost their statistically significance when taking school effects into account. A possible explanation of this finding would be that highly educated mothers may choose better resourced schools for their children. For example, highly educated mothers may be more likely to send their children to international, private, or Direct Subsidy Scheme schools.

**Implications for policy making process**

The current study has important policy implications for Hong Kong and elsewhere. First of all, given the significance of maternal education in children's educational outcomes and the growing achievement among students with different educational level mothers, more attention should be given to education for women. Although the proportion of highly educated mother increased over these 12 years, there are still a certain proportion of women who are uneducated and the proportion of women who have higher education was only 19.15% in 2011, educational policymakers should put forward corresponding policy and suggestions. On the other hand, based on the statistical results, mothers who have lowest educational level diminishes by only

5% over 12 years. Hence, in order to improve the children's educational outcomes, it is necessary raise the women's basic education or compulsory education.

In addition, given the possible role of schools in mediating the link between maternal education and children's academic achievement, educational policymakers should consider reducing school segregation and ensure equality of education for all children regardless family background and citizenship.

**Limitation of This Study**

Because there is a lack of information about family income and parental occupation in TIMSS, the measure of family SES was limited. In addition, the current study looked at the role of schools as a whole, rather than teasing out specific mechanism by which schools play a role in mediating the effect of maternal education on children's academic achievement. Thus, it remains to be investigated what aspects of school mediate the relationship between maternal educational and children's academic achievement.

**Conclusion**

The current study extends literature on the relationship between maternal education and children's academic achievement. Documenting the increasing impact of maternal education on children's educational outcomes and the mediating role of schools is important for both policies reform in Hong Kong and mainland China.

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*Table 5 Correlation table of variable*

| variables | maternal edu | Math | Science | age | female | immigrant | IDSCHOOL |
|---|---|---|---|---|---|---|---|
| **Maternal edu** | 1 | | | | | | |
| **Math** | 0.0977 | 1 | | | | | |
| **Science** | 0.0939 | 0.8124 | 1 | | | | |
| **age** | -0.0637 | -0.0447 | -0.0198 | 1 | | | |
| **female** | -0.0393 | -0.0191 | -0.1576 | -0.0461 | 1 | | |
| **immigrant** | 0.0075 | -0.0155 | 0.0226 | 0.4047 | -0.0176 | 1 | |
| **IDSCHOOL** | 0.0393 | 0.1065 | 0.0848 | -0.0088 | -0.0205 | -0.0069 | 1 |