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Abstract

The purpose of this study is to examine the longitudinal effects of school, family, student, and demographic factors on students' academic achievement. A method of meta-analysis was used to estimate the magnitude of the effect size of various independent variables. The data was obtained from Taiwan Education Panel Survey (TEPS). The members of the tracked panel of 2868 high school students were selected as samples for this present research. The tracked panel received four waves of questionnaires and standard tests from 2001 to 2007. The results of the present analysis shows significant differences between the mean effect sizes of the factors associated with academic achievement, and that students' prior achievement had the largest effect size of 2.39, 1.45, and 1.90, respectively, based on the comprehensive ability score, the general analytic ability score, and the mathematic ability score. The demographic factor showed the second largest mean effect size (.65, .53, .59), larger than that of the family factor and students' engagement, which both showed small effect without significant differences from each other. And the school factor showed the least mean effect size. In addition, it was found that the mean effect of all the variables based on the comprehensive ability score (.43) was significantly larger than that based on the general analytic ability score and on the mathematic ability score, specifically. Practical implications and suggestions are given in the present research after the general discussion of the research findings.

Key words: academic achievement, high school students, Taiwan Education Panel Survey（TEPS）

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Chapter One　Preface

Among all the educational outcomes, students' academic achievement is often regarded as the primary criteria of defining successful education. Brown and Sakes claimed that the twentieth-century ideal of excellent and efficient schools emphasizes the greatest degree of individual cognitive development (as cited in Riordan, 2003). This concept matches most people's expectations for schooling in Taiwan. At a personal level, better academic achievement ensures higher diploma, which is positively related to their later occupation and income (Directorate-General of Budget, Accounting, and Statistics, 2008). On the other hand, success in transmitting knowledge and academic skills makes civilized, intelligent citizens and leads to the prosperous development of a country. Hence, the 'No Child Left Behind Act of 2001' (2002) was proposed by the United States Congress to remedy the large disparity of student academic achievement within the nation, and to "ensure that all students, including disadvantaged students, meet high academic standards". This program is an example of national concern in regard to upgrading student academic performance. Not surprisingly, promoting students' academic performance has also been a major goal in Taiwan for both individuals and the government.

Perhaps the emphasis on academic achievement in Taiwan is even too much. Due to the influence of the traditional Chinese concepts that "nothing is more prestigious than studying" and "studying brings the fortune", parents usually seek for their children to show an excellent academic performance, and they make efforts to assist children to generate high achievement in the hope that they will have a prosperous future. To help children attain this goal, schools offer intensive lessons and a great

volume of tests to examine whether students are proficient in what they have learned. Certain schools even group students into different classes according to their academic performance in order to provide efficient teaching for the top achievers. The underachievers are comparatively neglected. In addition to formal education, some students go to cram schools after formal classes to repeat lessons and take more tests. Students suffer from great pressure to get high grades in order to enter ideal senior high schools or colleges.

However, not every parent can afford the fees for extra lessons and materials; and not every child receives good upbringing and inspiration at home. The government should promise equal opportunities in schooling and resources to children without an advantageous background to help them develop their potential adequately. A democratic society like Taiwan must fulfill the promise of equity and justice in the provision of education.

In fact, people and the government are aware of the risks of the excessive competition and pressure in our educational system, and many educational reforms have been instituted in the past decade. For example, the Ministry of Education implemented new curriculum, which is more experience-oriented and student-centered with the aim to inspire potential and development in basic competencies (Ministry of Education, 2000). A new senior high school entrance exam, the “Basic Competence Test”, was also developed to test students on the application rather than the recitation of knowledge. Moreover, the number of senior high schools and colleges was quickly expanded to offer a choice of opportunities to the students seeking to promote to higher grade of schooling. Nevertheless, the pressure to achieve a high academic standing did not disappear because people still compete for limited

seats at a few prestigious schools, entry to which is believed to ensure the attendees a promising future. Thus, academic achievement is still the most important concern because only when one performs well enough in the entrance exam can one enter an ideal school.

Since the upgrading of academic achievement has always been a matter of great concern to parents, teachers and administrators, and that in seeking for excellence one should not sacrifice equity and justice in education, we must understand the factors that can improve academic standards fairly and efficiently. A large amount of educational research has focused on the factors associated with academic achievement. According to the past research (Chen, Kuo, & Lee, 2007; Hsieh, 2007; Lin & Wu, 2007; H. H. Ma, 2008; Rock, 1991), the factors related to student academic achievement are comprehensive and complex, but all of them are included within family, school, and individual domains.

In the report, Equality of educational opportunity, Coleman (1966) conducted an overall investigation to the characteristics of the American schools, students, and teachers. Among all the findings, the relation of achievement to school characteristics is the most noticeable part, in which Coleman found that when the socioeconomic background of the students were statistically controlled, differences between schools accounted for only a small fraction of differences in pupil achievement. This result suggested that schools had little effects and it was the socioeconomic factors that bore strong relation to academic achievement. Accordingly, the importance of the family background has always been a great concern of educational researches. Recently, researchers such as Yang (2003), Painter and Levine (2004), Tzeng (2006), Chou (2006), and Hango (2007) have also found that family atmosphere, parent-child

interaction, parent involvement, and parents' educational expectations of their children are related to students' academic achievement.

However, the abundant evidence on family effects has not led to a reduction in the exploration of school influence on student academic outcomes. Besides focusing on the tangible facilities or the school spending, Wenglinsky (1997) suggested that social environment of the school and other aspects of the learning process were important. He found that some type of school spending were associated with achievement while others were not, and that the impact of spending patterns seemed to be indirect, mediated by school social environment. Just like what Crosone, Johnson, and Elder (2004) found that the quality of the interaction between students and teachers had a positive effect on student academic achievement. In addition, local studies have revealed that school climate, teachers' background and relationship with students affected student academic achievement (Hsieh, 2007; Lin & Wu, 2007; Wu, 2005).

In addition to the continuing discussion as to the effects of family and school, personal factors such as students' educational expectations, engagement, and extracurricular learning activities have also been associated with academic achievement (Aksoy, 2000; Chiao, 2007; Lai, 2004; Park, 2005; Sirin & Rogers-Sirin, 2004).

After reviewing the past research, it is noticeable that many demographic factors are contained in family, school, and student categories**,** such as parents' education and occupation, family structure and income, the number of siblings, school size, school location, private/public supported, gender and ethics (Chen, 1994; Hsieh, 2007; Lin & Wu, 2007). However, Ma (2008) distinguished demographic factors from family, school, and student factors and examined the effect sizes of the three sub-categories of

demographic variable—family, school, and student. He found that ethnicity by educational expectation interaction had a large effect on student academic achievement. In addition, students' age, school type, and the type of community where the school was located had medium effect sizes. Other researchers also tested the effect of specific demographic factors, and found that they had a crucial influence on student academic achievement (L. C. Chen, 2005; DeBell, 2008; Heard, 2007; Lai, 2004; Marks, 2008a, 2008b; Painter & Levine, 2004; Reeves & Bylund, 2005). To clarify the effects of such variables as are hard change by individual efforts, this research separated demographic factors from the others and classified all the related dependent variables into four categories, the family, school, student, and demographic factor.

As for the data resources, many US researches, which estimated factors associated with academic achievement, obtained their data from a few national studies, such as the National Educational Longitudinal Survey of 1988 (NELS88) (Aksoy & Link, 2000; Carbonaro, 2005; Downey & Yuan, 2005; Dumais, 2009; Painter & Levine, 2004), the National Longitudinal Study of Adolescent Health (Add Health) (Crosnoe , Johnson, & Edler, 2004; Heard, 2007) , and the National Longitudinal Survey of Youth (NLSY79) (Orr, 2003; Shaff, Wolfinger, Kowaleski-Jones, & Smith, 2008). Unlike the United States, Taiwan did not conduct any extensive national representative educational survey until recent years. The only one the data of which have been completely released is the Taiwan Education Panel Survey (TEPS). The survey of junior high school cohort started at the base year of 2001, and there were three follow-up surveys for the revisited participants in 2003, 2005, and 2007. TEPS is designed to provide trend data about the critical transitions experienced by young

people as they progress through high school. It is a multifaceted study with questionnaires for students, teachers, parents, the schools, as well as standard cognitive tests for students. Some researchers have applied the data collected in 2001 and 2003 from the first and second release of the data of the survey in their analyses of the impacts of various factors on student academic achievement (Kuan & Lee, 2008; Kuan & Yang, 2007; Lee & Yu, 2005; Lin & Huang, 2008; Lin & Wu, 2007; Liu,2006). However, little research has completely included data from the first to the last follow-up survey, which was just released in 2008. In order to examine the longitudinal influence of the factors associated with academic achievement, the present research includes data from all four waves of data of the junior high school cohort collected from 2001 to 2007.

This study contributes to an extensive understanding of the factors in the family, school, student, and demographic domains that affect student academic achievement, and also the nature of their effects. Moreover, this study compares the outcomes of the statistical analysis with prior research results and with a few important theories, trying to give a thorough explanation for the factors of student academic achievement and to imply the potential direction of further detailed studies. It also provides suggestions to parents, teachers, and the administrators on educational practice in the future.

Following the introduction, the research purposes of the present study are:

1. To investigate the magnitude of effect sizes of various variables associated with high school student academic achievement.
2. To investigate the mean effects of variables which are classified into four factors: family, school, student, and demographics.
3. To compare the mean effects among the family, school, student, demographic

factor and among the sub-categorical factors on the three kinds of student academic achievement respectively: the comprehensive ability score, the general analytic ability score, and the mathematic ability score.

The research questions are:

1. Do familial, school, student and demographic variables affect high school student academic achievement?
2. Are there any differences among the mean effects of family, school, student, and demographic factor on high school student academic achievement?
3. Are there any differences among the mean effects of sub-categorical factors on high school student academic achievement.
4. Are there any differences among the mean effects of factors based on the three kinds of student academic achievement: the comprehensive ability score, the general analytic ability score, and the mathematic ability score?

Before proceeding to Chapter Two, the operational definitions of the dependent and independent variables are clarified as following:

1. High school students

   'High school students' refers to 2868 stratified randomly selected samples from the junior high school cohort of the Taiwan Education Panel Survey (TEPS). They were investigated in 2001 as 7^{th} graders in junior high schools and were revisited in 2003, 2005, and 2007; that is, when they were in the 9^{th}, 11^{th}, and 12^{th} grades.

2. Academic achievement

Academic achievement refers to the comprehensive analytic ability scores, the general analytic ability scores, and the mathematic ability scores, which were gauged from the results of the TEPS standard cognitive tests by using the 3-item parameter (3-PL for short) Item Response Model as the indicator of students' achievement. The content of the standard test included materials on literacy, mathematics, science and general analytic abilities. An integration of the results of all the test items served to create the comprehensive ability score. In addition, a group of items tested participants on their abilities of analyzing, applying**,** and creativity, of which the results constructed the general analytic ability score; and the results of the test items related to mathematics and numbers created the mathematic ability score.

3. The family factor

Family factor refers to efforts the family made to promote students' learning. Related variables were generated from the four waves of student and parent questionnaires. The sub-categories are parents' aspirations for their child's education, parental involvement in their child's learning, and family cultural capital.

4. The school factor

School factor refers to efforts the school made to promote students' learning. Related variables were generated from the four waves of student and teacher questionnaires. The sub-categories are teacher-student interaction, safety and order, teachers' highest degree, teachers' years of teaching experience, and teachers' teaching involvement.

5. The student factor

Student factor refers to efforts student made to meet ideal academic achievement. Variables were generated from the four waves of student questionnaires. The sub-categories are students' prior academic achievement, students' aspirations for their education, educational engagement during semester, behavioral problems in school, educational engagement during summer vacation, extracurricular activities and recreation.

6. The demographic factor

Demographic factor includes school demographics (school type, school community, school program), familial demographics (ethnicity, number of siblings, parents' education, parents' occupation, family income, family structure), and student demographics (gender).

Chapter Two Literature Review

In this chapter, variables related to student academic achievement are classified into four categories—family, school, student, and demographics. To provide a basis to the argument in the present research, this chapter provides a comparison and contrast of the results from various prior empirical studies which examined the effects of the four factors on student academic achievement.

The Effect of Family Factors on Student Academic Achievement

To discuss the family effect on student academic achievement, parents are crucial because usually they take the duty of nurturing their children. The most-examined categories in past research are parent's aspirations for their child's education, parental involvement in children's studies, and family cultural capital.

Parental Involvement

Trivette and Anderson (1995) conceptualized parental involvement as a complex construct with four dimensions—parental aspirations for children's education, parent-child communication about school, home environment (family rules about watching TV, doing homework, or maintaining a grade average), and parental participation in school-related activities. Instead of merely content analysis, Sui-Chu and Willms (1996), and Fan (2001) used factor analysis to produce empirical evidence and to define the dimensions of parental involvement operationally. Both studies used data obtained from the National Education Longitudinal Study (NELS) and generated a number of dimensions, including home discussion, school communication, home

supervision, school participation (Fan, 2001), communication, education aspiration, participation, supervision, TV rules, contact with school, and volunteer (Sui-Chu & Willms, 1996).

Although different researchers have named the components of parental involvement in different ways, it can be concluded that the content of parental involvement must include (1) parental aspirations for their child's education; (2) parent-child communication about school matters; (3) school-parent communication; (4) parental participation in school activities; and (5) parental supervision of their children at home. It is also noted that these aspects of parental practice are covered in the concept of 'social capital' in social theories.

Social capital, introduced by Loury in 1977, was defined as a set of resources that inhere in family relations and in community social organization, and are useful for the cognitive or social development of a child or young person (as cited in Coleman, 1988). Coleman (1988) further claimed that both social capitals within the family and outside it showed empirical evidence of considerable value in reducing the probability of dropping out of high school. And the components of parental involvement exactly fit the concept of 'within-family social capital', which Coleman (1988) said to be 'the relations between children and parents'. The following paragraphs give empirical evidences of the relationship between student academic achievement and several dimensions of social capital embodied in parents-child relations.

Trivette and Anderson (1995) examined four components of parental involvement on 8th graders' academic achievement and found that parental aspirations did have an effect. Likewise, Fan (2001) and Chou (2006) concluded that parental

aspirations for their children's education had a consistent and positive effect on high school students' academic growth. Lee (2007) also indicated that the educational expectation of aboriginal parents had influence on their 8th-grade children's academic achievement. Concerning the racial or ethnic background, Yan and Lin (2005) examined the relationship between parental involvement and 12th-grade students' mathematics achievement and found that parental aspirations for their child had the strongest positive effect on mathematics achievement regardless of racial or ethnic background. In addition, Cherian (1994) considered family structure and showed that parental aspirations had significant effects on adolescents' academic achievement no matter the children were from broken or intact homes. To sum up, during the adolescent years, parental aspirations make a crucial contribution to their child's academic performance.

In contrast with the consistent results in studies of the effects of parental aspirations, empirical studies have shown that the effects of parent-child communication about school matters, parental participation in school activities, and parental supervision of their children at home are disputable. Trivette and Anderson (1995) found that parent-child communication about school, the home environment (family rules about watching TV, doing homework, or maintaining a grade average), and parental participation in school activities did not have a direct, positive effect on 8th graders' achievement, while Sui-Chu and Willms's (1996) research revealed that the discussion of school-related activities at home had the strongest relationship with academic achievement, and that parental participation in school had a moderate effect on reading achievement, but a negligible effect on mathematics achievement. In addition, Astone and McLanahan (1991) and Fehrmann, Keith, and Reimers (1987)

found that parental supervision or monitoring after school was positively related to children's academic achievement.

Further, Sui-Chu & Willms's (1996) research revealed a small negative effect of parent-school communication on 8th graders' achievement. Fan (2001) also reported that 'more contact with school' had a negative effect on mathematic achievement growth. Although such results are puzzling at first glance, the items of both questionnaires provided possible answers. Because the "communication/contact" included both academic and social-behavioral aspects, it can be inferred that the negative effect stemmed from more communication with schools when their children were at risk of failing academically or manifested problem behavior.

After reviewing the related research, it can be concluded that part of the family factors associated with high school student academic achievement can be properly included under the concept of parental involvement. However the effects of various dimensions are different. Parental aspirations were found to have a consistently positive impact on child's academic achievement, while the effects of the other dimensions are controversial. Although it is not conclusive that the more that parents are involved in a child's learning, the better he/she performs academically, the present research hypothesizes that parental involvement has a positive effect on student academic achievement.

Cultural Capital

Bourdieu's theory of social reproduction and cultural capital posits that the culture of the dominant class is transmitted and rewarded by the educational system (as cited in Dumais, 2002) . Therefore those who are more familiar with culture of the dominant class are more likely to be accepted and loved by teachers, and they tend to

adjust better to school education, which also results in better academic performance. Accordingly, cultural capital means the degree one acquires the formal culture of the dominant class (Huang, 1996).

Here comes the question, what is the culture of the dominant class? In the past empirical studies, researchers hypothesized that going to concerts and exhibitions, watching dramas, visiting libraries or museums, more exposure to reading and classical music, or attending cultural-related lessons (art, music, dance, and the like) would establish the cultural capital, and in turn be helpful for one's academic performance (Chen & Cheng, 2000; Dumais, 2002; Lin & Wu, 2007; Roscigno & Ainsworth-Darnell, 1999; Sullivan, 2001; Wong, 1998) . Among them, Sullivan (2001) and Wong (1998) conclude that cultural capital have a significant effect on student academic performance; Chen & Cheng (2000) indicated that students who received more formal cultural of the dominant class were more possible to obtain more years of non-obligatory schooling; Dumais (2002) found that cultural capital has a positive, significant effect on the grades of female students. However, Lin and Wu (2007) and Wu (2005) found that the ‘’formal cultural' Bourdieu mentioned in his theory of cultural capital can explained little of the variation of student academic achievement, and they further suggested that the component of cultural capital needed to be modified in regard to the cultural difference between Taiwan and the European countries.

The Effects of School Factors on Students' Academic Achievement

Except for family, school is the place to which children are exposed most

frequently. Since Coleman (1966) concluded that schools had no differential effects on student achievement, a large number of studies have attempted to prove the efficiency of schools. The following paragraphs demonstrate research studied on social environment and teacher quality of schools.

Social Environment of Schools

A series of studies, known as "effective-schools research", identified schools in which students of low SES attained high levels of achievement. They found that such schools displayed a series of relatively uniform characteristics that are associated with high levels of achievement among low SES students including the social environment of the school, the relations between teachers, and principals, and teachers' morale (as cited in Wenglinsky, 1997). These researches implied that schools can indeed make a difference for students.

Specifically, Crosone, Johnson and Elder (2004) examined whether the nature of the student-teacher relationship could be used to predict student academic achievement. Their findings indicated that students who reported that they got along well with their teachers and who perceived their teachers to be caring and fair showed a higher academic achievement. Likewise, Burchinal, Peisner-Feinberg, Pianta and Howes (2002) found that a closer relationship with the teacher was positively related to better academic competence for elementary students. Actually, far early in Sewell, Haller, and Portes's (1969) research, it has been proved that significant others' influence, including parents', teachers', and friends', has direct effects on levels of educational and occupational aspiration, as well as educational (i.e., college) attainment, and the teacher's influence refers to whether or not direct teacher

encouragement for college was perceived by the student.

Other research has also shed light on the effects of characteristics relevant to school culture and climate. Lin (1995) found that a school's history, tradition, culture (academic climate), and school community are the strongest predictors of college entrance exam scores among all the other school characteristics examined. And the effect of school characteristics was even stronger than that of family characteristics. Still other research has associated a safe and ordered school environment with a higher student academic performance, in particular, at the lower grade levels (Levine, 1992; Stockard & Mayberry, 1992). Griffith (2000) also indicated that student consensus regarding Order and Discipline and its interaction with student evaluations of order and discipline were significant and positive predictors of school-level math and reading criterion-referenced test scores.

Teacher Quality

In addition to the social environment of schools, a growing body of research suggests that schools can make a difference to student academic achievement, and a substantial portion of that difference is attributable to teachers (Darling-Hammond, 2000; Ferguson, 1991). Students who are assigned to several ineffective teachers in a row show a significantly lower achievement and gains in achievement than those who are assigned to several highly effective teachers in sequence (Sanders & Rivers, 1996). Quantitative analyses also indicate that measures of teacher preparation and certification are the strongest correlates of student achievement in reading and mathematics (Darling-Hammond, 2000).

Teachers' contributions to promoting student academic achievement are

somewhat proven, but the nature of the points that exactly represents a teacher who is efficient in facilitating learning performance is controversial. Researchers who intended to demonstrate the effect of teachers' efforts on student academic achievement analyzed data from nationally conducted surveys such as High School and Beyond, and the Taiwan Education Panel Survey. They examined teachers' interest in their students, perceived quality of instruction (Lee, 1989), reform of teaching methods, working attitude, involvement, highest degree earned, years of teaching experience, interruptions in teaching and attendance on in-service training programs (Hsieh, 2007; Lin & Wu, 2007). Among these variables, Park (2005) found that a teacher's years of experience is not a significant predictor of a student's growth in mathematics achievement, while Hsieh (2007) concluded that a teachers' years of experience had a positive effect on student academic growth. On the other hand, while Hill (2003) found that for a teacher to hold a graduate degree in the field the student is studying has a significant effect on achievement tests in mathematics, reading, and science, Hsieh (2007) and Park (2005) later found that a teacher's highest degree earned had a negative or no effect on student academic growth. The effect of a teacher's in-service training programs is also disputed (Hsieh, 2007; Lin & Wu, 2007). Lin & Wu (2007) also indicated that teachers' degree, teaching years, reform of teaching methods, working attitude, and involvement are not significantly related to academic achievement.

The final part of the factors associated with student academic achievement are school background and composition including average school social class, percentage of minorities, average academic background, school community (city/suburb/country), and school type (public/private). Lin & Wu (2007) found that nearly 80% of the

variation in school level was explained by school mean SES, and the unique contribution of variables associated with school educational resources to students' academic achievement was found to be quite low (4% or thereabouts). Therefore, in order to determine the effects of school efforts as discussed before, all the background variables were categorized into demographic factors in the present research and will be discussed in later sections.

The Effect of Student Factors on Student Academic Achievement

The student factors can be divided into 'intelligence' and 'non-intelligence' aspects. Generally speaking, intelligence is closely related to student academic achievement. However, in social science research, it is hard to measure participants' intelligence objectively. Instead, academic achievement is usually measured as both independent and dependent variables. Burkam, Lee, and Smerdon (1997) found that scores on 8th grade achievement tests had a positive effect on 10th grade achievement. The results of Engerman and Bailey's (2006) research also indicated that having a low academic achievement in grade 10 was the most significant predictor in having a low academic achievement in grade 12, with family decision-making style, SES, and ethnicity as controlled variables in the regression equation. Reynolds and Walberg (1992) analyzed data from Longitudinal Study of America Youth and found that prior mathematic achievement influenced subsequent mathematic achievement powerfully. In addition, Ma (2008) demonstrated that the students' prior (or accumulated) achievement demonstrated a large mean effect size (0.94) and grew steadily from grade 8 to 12. Accordingly, students' prior academic achievement is positively related to their future academic performance.

On the other hand, Hsieh (2007) reviewed several related studies and indicated that the non-intelligence factors may include extensive mental variables such as learning attitude, motivation, self concept, anxiety, physical and mental health, and other personal characteristics. However in the present study, the non-intelligence student factors focus merely on students' aspirations for their highest degree and their degree of engagement in their studies.

It has to be clarified first that in some studies, students' 'expectations' instead of 'aspirations' was used as the description of their desire of advanced schooling. The two terms are similar but not exactly the same given that aspiration is an ideal goal, more like a dream, while expectation is more realistic, with regard to one's ability. Although 'aspiration' is somewhat different from 'expectation', related research indicated that they are closely related and are often exchangeable (as cited in Hsieh & Chang, 2004). In the student questionnaires of TEPS, two questions were asked: ' What degree do you expect yourself to accomplish' and 'What degree do you think you can accomplish with regard to your own ability'. The former measurement was defined as students' aspirations for their highest degree in the present study in contrast with the later measurement of students' expectations.

The results of Sirin and Rogers-Sirin's (2004) research suggested that for African American middle-class adolescents, educational expectations, which was measurement of both concrete and abstract beliefs students might have about their educational future, and their engagement in school learning had the strongest relation to academic performance. Lin and Wu's (2007) research also supported the hypothesis that students' aspirations and expectations in regard to their highest academic achievement had a significant effect on junior high school students' academic growth.

In addition, Carbonaro (2005) analyzed data from the 8th- to 10th-grade cohort of the National Education Longitudinal Survey of 1988 (NELS:88) and found that students' effort, which is defined as the amount of time and energy that students expend in meeting formal academic requirements, is strongly related to students' learning. Likewise, Park (2005) demonstrated that students' engagement had positive effects on student academic growth per month in math after taking into account student variables such as gender, SES, and race. More specifically, the result of Aksoy and Link's (2000) study suggested that extra time spent on mathematics homework increased student test scores while extra hours per day of watching television had a negative impact on mathematics test scores.

When it comes to the impact of extra hours students spending on learning school materials, the wide-spreading situation of students' going to 'cram schools' and attending extra academic lessons after school has been noticeable in Taiwan. Several related local research was found. Wu (2005) indicated that taking extra academic lessons after school affected students' academic achievement positively. Liu (2006) analyzed the data of 2001 TEPS and came to a conclusion that the hours students spent on attending extra academic lessons after school have significant positive impact on academic achievement. And he also found that the total hours of around eight hours every week lead to the highest grades of the participants. However, Kuan and Lee's (2008) research using data from the 2001 and 2003 waves of the TEPS revealed that the average treatment effect of math cramming (attending private cram schools after school) on Taiwanese 9th graders' mathematic ability scores was positive but small.

In addition, Dumais (2009) indicated that school-sponsored activities were

associated with higher scores for all students, while television-watching and hanging out with friends were negatively associated with them. Likewise, Chen, Kuo, and Lee (2007) found that the time spent on study was positively related to scores on the Basic Competence Test in Taiwan, while the time spent on recreation had a negative relationship with the test scores.

In addition to the routine learning schedule during the school semester, students sometimes continue to be involved in learning activities during the summer vacation, in which students have two-months off from formal education in Taiwan. Entwisle and Alexander (1992) found the phenomenon of ‘summer loss’, which suggested that students from lower SES backgrounds lose ground in the summer ,when they are out of school, but do as well or better than better-off students in winter when school is in session. They also indicated that minority group shortfall in educational attainment might stem from the dearth of socialization resources to support children's out-of-school learning in relatively disadvantaged homes. The result of their study implies that students’ engagement during the summer vacation may enhance their progress in learning.

To sum up, it is obvious that students’ higher prior achievement, expectation for higher degree, more engagement during the semester and summer vacation, and lower time spending on recreation like watching TV are associated with better academic performance. The present research also aims to test the hypothesis that these variables have positive effects on student academic achievement.

The Effect of Demographic Factors on Students' Academic Achievement

According to Parsons, the trend of social evolution went like this : first focused on the 'ascribed' characteristics, which were those born to possess like family background, race, and sex; later turned to value the 'achieved' characteristics, which referred to those can be acquired by efforts, such as education and expertise (as cited in Huang and Chen, 2005).

In the past research which examined the effects of factors associated with student academic achievement, demographic variables, such as gender, parents' social economic background, family structure, school community, school average social economic status, were mostly included specifically within family, school, and individual categories. And the results of these researches demonstrated the critical influence of demographic variables (Chen, Kuo, & Lee, 2007; Hsieh, 2007; Lin & Wu, 2007). Therefore, the present research borrowed the concept of 'ascribed' versus 'achieved' characteristics and separates demographic variables from other factors in order to clarify the effects of family, school, and students' effort on academic achievement, and to show the pure effects of demographic variables which are hard for an individual to change by his or her own effort.

Family Demographic Variables

This subcategory comprises variables such as SES, family structure, siblings, and ethnicity. Among the abundant educational research exploring the factors associated with student academic achievement, family SES may be the most frequently examined. Parents from different social classes may live under different economic

conditions, and have different life styles, educational attitudes, and values, so that they affect children's academic achievement in different ways. Much research had found that the higher the family SES is, the better the academic achievement the children can accomplish (Hsieh, 2007; Li & Yu, 2005; Lin & Wu, 2007; Wu, 2005).

Generally, family SES is a synthetic measurement of either of both side of parents' education, occupation, family income, or family habitation. Various indicators have been developed to estimate family SES. However, some researchers have also examined the specific effects of father's or mother's education and occupation. With the growth of the rate of female accomplishment of higher education and of the rate of employment of mother's outside the family in recent times, the impact of mother's SES on student academic achievement has been noticed. Marks (2008a) found that father's occupational status had a greater impact on student achievement than mother's occupational status whereas the impact of mother's education was usually greater or comparable to that of father's education. In addition, Tzeng (2006) also concluded that the effect of mother's education was greater than father's.

On the other hand, Tzeng (2006) indicated that family income has no direct effect on academic achievement, and that parent-child interaction must be the intervening variable that affects children's academic achievement. This indirect effect is smaller than the effect created by parents' education levels. In addition, the intervening effect of parent-child interaction was also found in the relationship between father's education and student academic achievement.

Family structure is also related to student academic achievement in addition to family SES. Generally, it is clear that intact families provide the best environment for

children's educational achievement while children in step families suffer a disadvantage (Kuan & Yang, 2007). Shaff, Wolfinger, Kowaleski-Jones, and Smith (2008) found that children remaining in single-parent families resulting from divorce or non-marital births have lower achievement scores than children from married families. Wu (2005) also found that higher socioeconomic status and a more intact family structure are beneficial to student achievement, however more male siblings could decrease achievement through dilution of the educational resources in a family. And the disadvantages of less-intact family structure even have long-term influence. Amato & Keith (1991) examined the consequences of parental divorce for later well-being in adulthood through a meta-analysis involving over 81000 individuals. They found that adults who experienced parental divorce exhibited lower levels of well-being than did adults whose parents were continuously married, and one of the strongest estimated effects occurred in educational attainment.

The results of X. Ma's (2005) research also indicated that students with lower family SES and more family siblings will perform worse in math achievement. In addition, Li and Yu (2005) verified that siblings dilute household education resources and play a mediating role between household education resources and educational achievement. On the other hand, Downey (1995) found that parental resources explained most or all of the inverse relationship between sibling size and educational outcomes.

It is also noticeable that ethnicity/race made a difference in student academic achievement. Orr (2003) found that even when parents' education, occupation, and income were controlled, blacks still performed worse than whites in academic achievement. A local research (Sun & Huang, 1996) also revealed that mainlanders

achieved significantly higher educational attainment than Minnan people, Hakka people and aboriginals. And among them, aboriginals attained the least years of education.

After reviewing the related research, it is found that family SES composed by parents' education, occupation, and family income is related to student academic achievement positively, however the magnitude of the total effect or specific effect of each variable is disputable. At the same time, a more intact family structure and fewer siblings are associated with higher academic achievement.

School Demographic Variables

The school demographic variables related to student academic achievement comprise school average SES, school ethnic composition, school size, school community, and school type (public/private). Lin and Wu's (2006) analysis on multilevel data revealed that among the school factors related to student academic achievement, nearly 80% of the school level variation was explained by school mean SES, and it was positively related to student academic achievement. However Caldas (1999) found that the percentage of students from one-parent families is a much stronger predictor than racial composition and poverty level for average school achievement. School size also had an impact on students' achievement. Students' scores in larger schools were higher than those in smaller ones (Zigarelli, 1996). The results of Lee and Smith's research (1997) suggested that the ideal high school, defined in terms of students' achievement growth in reading and mathematics, enrolled between 600 and 900 students. In schools smaller than this, students learn less, and those in large high schools (especially over 2,100) learn considerably less.

The community in which a school is located, and whether the school is public or private, are also important factors associated with student academic achievement. Brunsma & Rockquemore (1998) found that the achievement of suburban students was higher than that of rural students; and the achievement of students in Catholic, non-religious private, and religious private schools was higher than that of students in public schools. However, the situation is somewhat different in Taiwan. A researcher in Taiwan (L. C. Chen, 2005) found that at senior high school level, students' academic achievement in public schools was better than that in private ones; students' academic achievement in urban schools was better than that of rural ones; and academic achievement in large-sized schools is better than that in medium and small-size ones. Nevertheless, rural school students' mean annual gains in school performance equal or better than those of their urban counterparts (Reeves & Bylund, 2005).

Student Demographic Variables

Past research on gender differences in school performance has highlighted boys' modest advantage on standardized mathematics tests (Downey & Yuan, 2005). After reviewing several related studies, Downey and Yuan (2005) further indicated that gender differences in mathematics test scores are typically small or nonexistent during elementary and middle school but increase during the high school years. The results of Burkam, Lee, and Smerdon's (1997) research also suggested that gender differences in science achievement depended on subject; there was a moderate male advantage in 10th-grade physical science achievement but no discernible differences in life science. However, girls outperformed boys in other subjects, as in Hedges and

Nowell's (1995) reference to girls' large advantage in writing ability as tested in the National Assessment of Educational Progress (NAEP). As for the local studies, Lin and Wu (2007) found that when some critical variables, such as negative cultural capital, learning attitude, and family educational resources, were statistically controlled, boys' performance on the comprehensive ability test of the TEPS were better than girls'. Given that the present research will include not only the comprehensive ability score, but also the general analytic ability score and the mathematic ability score as the dependent variables, the outcome of the present analysis will further explain the sex difference on specific domain of student academic achievement.

According to the purposes of the present research and the findings from the literature review, the following research hypotheses are proposed:

1. There are significant differences between the family, school, student, and demographic factor associated with student academic achievement.
2. There are significant differences among the sub-categories of the four factors.
   2-1. There are significant differences among parents' aspiration, father's involvement in children's learning, mother's involvement in children's learning, and family cultural capital within the family factors.
   2-2. There are significant differences among teacher-student interaction, school safety and order, teacher's highest degree, teacher's years of teaching experience, and teacher's teaching involvement within the school factors.
   2-3. There are significant differences among students' prior achievement, students' educational aspirations, students' educational engagement during the

semester, students' behavioral problems in school, and extracurricular activities and recreation within the student factors.

2-4. There are significant differences among family income, father's education, mother's education, father's occupation, mother's education, and ethnicity within familial demographics; there are significant differences among school type (private/public), school community (city/town/country), and school program within school demographics.

3. The effect sizes of the factors based on the comprehensive ability score, the general analytic ability score, and the mathematic ability score are significantly different from each other.

Chapter Three Method

Data

This research is based on data from the Taiwan Education Panel Survey (TEPS), a longitudinal and nationally representative survey of Taiwanese adolescents in grades 7-12. TEPS consists of four waves of survey, including the first one conducted in 2001, and the three more follow-ups in 2003, 2005, and 2007 specifically. It is a clustered multistage stratified probability sample, and the participants in the present research were obtained from the public release files of TEPS, in which 70% of the total visited students were included. The ultimate sample size of the present research is 2868.

In the first wave of TEPS in the fall of 2001, 20004 grade 7 students from 333 junior high schools completed the survey. The same panel was then revisited until they were 9th graders in 2003, which comprised the 2nd wave of the junior high panel in the TEPS. Afterwards, the 3rd and 4th waves of the survey were conducted on a proportion of the previous participants in 2005 and 2007, after they had gone on to Year Two (grade 11) and Year Three (grade 12) in senior high schools, senior vocational schools, or five-year junior college programs. Finally, 2939 students were included in the 4th wave of tracked panel in the 'public release file of the TEPS' (Chang, 2008) . However some cases that did not complete the 4th wave of standard test were excluded because the results of the standard test were necessary to construct the dependent variable. So the sample size used for the present research is 2868 from the tracked panel who participated in the longitudinal survey from Wave 1 to Wave 4 of the TEPS.

For each student in each wave of the survey, the TEPS conducted a standard test, which was designed to test students on their problem-solving ability instead of subject-oriented achievement. The content of the standard test included materials on reading, math, science and general analytic abilities. The ability scores were gauged from the test results by using Item Response Model as the indicator of students' learning achievement. According to the Psychometric Report for the Ability Tests of TEPS 2001(Yang, Tam, & Huang, 2003), three kinds of ability scores are available: (1) the comprehensive analytic ability scores were gauged from the performances of all the test items, including the curriculum-free analytical ability sub-test , the mathematic ability sub-test, the literacy sub-test, and the science ability sub-test. (2) the general analytic ability scores were gauged from the results of the curriculum-free analytical ability sub-test, which tested students on their ability of analyzing, applying, and creativity, (3) the mathematic ability scores were gauged from results of mathematic ability sub-test and of the items related to numbers in the curriculum-free analytical ability sub-test.

In addition, questionnaires were used to collect data from students as well as their parents, teachers (Chinese, math, English, and homeroom teachers), and the administrators of their schools. The questionnaires included questions on a variety of aspects, including students' family, school, daily life, personal characteristics; parent-child relationship, parents' expectations for their child; teachers' instruction, teachers' assessment of students; schools' finance, equipment, administration affairs, and all of the demographic items. In this research, the standard tests as well as students', parents', and teachers' questionnaires of Wave 1 to Wave 4 were used to generate the dependent and independent variables. The results of the students' and

parents' questionnaires were obtained from the 'public release file of TEPS'. And the results of teachers' questionnaires were obtained from the 'restricted release file of TEPS' in which only the teachers of the participants in 85% of the sampled schools and 70% of the sampled classes were included. Therefore it was incapable to get the information of every participant's teachers due to the limitation of the practice of partially releasing of the data.

Variables and Measurement

The dependent variable is students' academic achievement. The present research adopted three kinds of ability scores gauged from the 4th wave of standard test results of the TEPS by using the 3-item parameter (3-PL for short) Item Response Model, the comprehensive analytic ability, the general analytic ability, and the mathematic ability scores. They were obtained from the 4th wave of students' questionnaire, coded as 'w4all3p', 'w4cf3p', and 'w4m3p' individually.

The dependent variables were factors associated with student academic achievement. After reviewing the literatures, the present researcher identified items pertinent to the objectives of the present research from the four waves of responses to the student and parent questionnaires of the TEPS. Then the selected variables were grouped into four categories—family, school, student, and demographics, and some sub-categories were later constructed under the main classification of four factors based on the conceptual and operational similarity obtained from literature review. Some sub-categories were defined by single items (but were repeatedly surveyed in various waves), others are based on composites of several items. It is noted that a few variables were synthesized by several items with similar elements or by grouping the

categorical responses. For example, the variable ‘Having Chinese magazines, journals; foreign language newspapers, magazines, journals; or encyclopedias at home’ is combined from three specific questions, and the response item was synthesized as ‘Having none of them, having one of them, having two of them, and having all of them’. Another example is the variable ‘Living with parents’, which was generated from the original question: ‘Who lives with you?’ and the first two categorical responses ‘Father’ and ’Mother’. The synthesized response items are ‘Living with neither of them, living with father, living with mother, living with both of them’.

The following section illustrates the sub-categories and the number of variables within each factor.

- The family factor

  This category consists of parents’ aspirations for their children’s education, parent’s involvement in their children’s learning, and family cultural capital. Totally 26 variables were included.

- The school factor

  This category consists of positive teacher-student interaction, safety and order, teacher’s highest degree, teacher’s years of teaching experience, teacher’s teaching involvement. Totally 43 variables were included.

- The student factor

  This category consists of prior achievement, educational aspirations, educational engagement during semester, behavioral problems in school, educational engagement during summer vacation, and extracurricular activities and recreation. Totally 45 variables were included.

- The demographic factor

This category consists of family demographics (family income, parents' education, parents' occupation, living with parents, number of siblings, ethnicity), school demographics (private/public, school community, school program) and personal demographics (gender). Totally 22 variables were included.

These sub-categories consisted of variables measured in the different waves of the TEPS. The specific measurement and source of every variable are listed in Table 1. The source of each item can be identified by the coding from the original survey. Except for the variables from the standard test, almost all the variables were coded according to the following rules: (a) the first two letters stand for the survey wave, for example, w1 means the variable is from first wave data; (b) the third letter stands for the respondent of the item, for example, 'p' means the variable is from parents' questionnaires, 's' means the variable is from students' questionnaires, and 't' means the variable is from teachers' questionnaires; and (c) the remaining numbers stand for the sequence by which the item was arranged in the questionnaire. Few exceptions are demographic variables such as father's occupation, which was coded as 'w＊faocc' (＊could be 1 to 4), and school community, which was coded as 'w＊urban3' (＊could be 1 to 4).

Table 1

The variables and measurement

Factors	Measurement	
	Item Number	Description of Items
Dependent Variables		
Academic Achievement	w4all3p	The comprehensive analytic ability scores were gauged from the 4th wave test results by using the 3-PL Item Response Model as the indicator of students' learning achievement

	w4cf3p	The general analytic ability scores were gauged from the 4th wave test results by using the 3-PL Item Response Model as the indicator of students' learning achievement	
	w4m3p	The mathematic analytic ability scores were gauged from the 4th wave test results by using the 3-PL Item Response Model as the indicator of students' learning achievement	
Independent Variables			
Classification		Original Coding	Description of Items	Reference Category
The Family Factor	Parents' aspirations for their child's education	w1p510a w2p213	What degree do you (or your spouse) expect him/ her to accomplish?	Senior high school/ senior vocational school=0
		w3 father's aspirations	A synthesis of w3parent: The identity of the respondent w3spouse: The identity of the spouse w3p512: What degree do you expect him/ her to accomplish? w3p709: (spouse) What degree do you expect him/ her to accomplish?	Senior high school, senior vocational school, or five-year junior college programs =0
		w3 mother's aspirations		
	Parent's involve-ment in child's learning	w1 , w3 father	w1s219, w3s313: Your father talks with you about advanced schooling and obtaining employment in the future.	Never=0
			w1s221, w3s315: Your father checks your homework or test sheets to know the status of your learning.	Never=0
			w1s222: Does your father take part in school activities, or serve as a parent committee member or volunteer?	Never=0
			w3s316: Does your father take part in school activities, or serve as a parent committee member or volunteer?	Never=0
		w1,w3 mother	w1s223, w3s320: Your mother talks with you about advanced schooling and obtaining employment in the future.	Never=0
			w1s225, w3s322: Your mother checks your homework or test sheets to know the status of your learning.	Never=0

			w1s226, w3s323: Does your mother take part in school activities, or serve as a parent committee member or volunteer?	Never=0
	Cultural Capital	w3p301	Your spouse or you went to bookstores, book exhibitions, or other kinds of exhibitions with your child when he/she was at grade 7-9.	Never=0
		w4p217	How often do you (or your spouse) go to bookstores, book exhibitions, or other kinds of exhibitions with your child?	Never=0
		w3p302	Your spouse or you went to classical music concerts, or watch dancing and drama performances with your child when he/she was at grade 7-9.	Never=0
		w4p218	How often do you (or your spouse) go to classical music concerts, or watch dancing and drama performances with your child?	Never=0
		A synthesis of w1p134-w1p136	Having Chinese magazines, journals; foreign language newspapers, magazines, journals; or encyclopedias at home.	Having none of them=0
		A synthesis of w3p1111-w3p1113		
		w1p137, w3p1114	You have internet-access at home.	No=0
The School Factor	Positive teacher-student interaction	w1s327	How many teachers use various different ways to help you understand the content of the learning?	None of them do so=0
		w2s326 w4s323	How many teachers can explain the content of the learning clearly?	None=0
		w2s3274 w4s3245 *	Did your math teacher explain the content of the learning clearly?	No=0
		w2s328 w4s325	How many teachers interact well with your class?	None=0
		w2s3294 w4s3265 *	Did your math teacher interact well with your class?	No=0
	Safety and order	w1s307	You feel that your school is not safe.	Strongly agree=0

		A synthesis of w1332 to w1336	You have had something stolen, been robbed, threatened, subject to extortion, sexually-harassed, raped, or provided with illegal drugs since the semester started.	More than twice=0
		A synthesis of w3s115 -w3s119		
		w1s306	The rewards and punishments, and the grading are not fair in the school you are attending.	Strongly agree=0
		w3s112	The rewards and punishments are not fair in the school you are attending.	Strongly agree=0
		w3s113	The grading is not fair in the school you are attending.	Strongly agree=0
	Teacher's highest degree	Each coding represents three items obtained from Chinese, math, and English teachers' questionnaires	w1t201, w3t110, w4t403: What is the highest degree you've earned? The original items were synthesized as two categories: ● Junior college or university ● Master or Doctor	Junior college or university=0
	Teacher's years of teaching experience		w1t206: How many years have you served as a teacher? The original items were synthesized as two categories: ● Less than 10 years ● More than 10 years (including 10)	Less than 10 years=0
			w3t117, w4t118: How many years have you served as a teacher? The original items were synthesized as two categories: ● Less than 9 years ● More than 9 years (including 9)	Less than 9 years=0
	Teacher's teaching involve-ment		w1t113, w3t212, w4t111: How many hours do you spend on preparing lessons?	Less than 1 hour=0

The Student Factor	Prior achieve-ment	w1all3p w2all3p w3all3p w1cf3p w2cf3p w3cf3p w1m3p w2m3p w3m3p (from standard test)	The ability scores were gauged from the 1st, 2nd, 3rd wave tests results specifically by using the 3-PL Item Response Model as the indicator of students' learning achievement	
	Educa-tional aspirations	w1s553a w2s402a	What degree do you expect yourself to accomplish?	Senior high school/ senior vocational school=0
		w3s425 w4s409		Senior high school, senior vocational school, or five year junior college=0
	Educa-tional engage-ment during semester	w1s108a	How many hours do you spend taking in-school or out-of-school academic courses after school?	None=0
		w2s103 w3s126 w4s106	How many hours every week do you spend taking in-school academic courses after school?	None=0
		w2s109 w3s127 w4s107	How many hours every week do you spend taking out-of-school academic courses after school?	None=0
		w1s110 w2s120 w3s106	What is the average number of hours you spend every day on homework, studies, and preparing for tests except for the time taking courses in and out of school?	Less than one hour=0
	Less Problema-tic behaviors in school	w1s509 w2s125	Have you ever cut classes or avoided going to school since this semester started?	Often=0
		w3s447 w4s121	Have you ever avoided going to school since this semester started?	Often=0
		w3s448 w4s122	Have you ever cut classes since this semester started?	Often=0
		w1s510 w3s449 w4s123	Have you ever fought in school or had a conflict with the teacher since this semester started?	Often=0

Student Factors		w2s127	Have you ever fought or created a disturbance in school since this semester started?	Often=0
	Educa-tional engage-ment during summer vacation	w1s1131	Did you attend in-school or out-of-school academic courses during the summer vacation before 7th grade?	No=0
		w2s1211	Did you attend in-school academic courses during the summer vacation before 9th grade?	No=0
		w3s2182 w4s1322	Did you attend in-school academic courses or intern courses during the summer vacation before 9th grade?	No=0
		w2s1212 w3s2185 w4s1325	Did you attend out-of-school academic courses during the summer vacation before 9th grade?	No=0
	Extra-curricular activities and recreation	w1s409	How many hours every week do you spend on activities in school clubs? (excluding school teams)	None=0
		w3s129	How many hours every week do you spend in taking part in activities and training related to school clubs or school teams?	None=0
		w1s423	How many hours every day do you spend on sport, listening to music, watching TV or videos?	More than three hours=0
		w3s208	How many hours every day do you spend on watching TV or videos on average?	More than four hours=0
		w1s424 w3s214	How many hours every week do you spend on outside reading, such as literature, historical biographies, and philosophic, political, economic, or technological readings.	Hardly ever=0
		w1s427	How many hours every day do you spend on using the computer or surfing the internet?	More than three hours=0
		w2s106	How many hours every week do you spend on internet chatting rooms, BBS, using e-mail, or ICQ?	More than 20 hours=0
		w3s212	How many hours every week do you spend on internet chatting rooms, BBS, using e-mail, or using ICQ, MSN, or SKYPE etc.?	More than 20 hours=0
		w4s117	What is the average number of hours you spend every week on internet chatting rooms, BBS, using e-mail, or using MSN, Yahoo Messenger and SKYPE etc.?	More than 20 hours=0

		w2s107 w3s213 w4s118	What is the average number of hours you spend on playing on-line games every week?	More than 20 hours=0
The Demo-graphic Factor	Familial Demographics			
	Family income	Family Income: w1p515 w2p508 w3p602	What is the average monthly family income?	Less than $20,000NT dollars=0
	Parents' education	Father w1faedu Mother w1moedu	What is your educational degree?	Below junior high school degree=0
	Parents' occupation	Father w3faocc Mother w3moocc	What is your occupation?	'Forestry, fishery, husbandry, agriculture' and non-skilled (physical) labory'=0
	Living with parents	A synthesis of w1s2021 w1s2022 A synthesis of w3s2021 w3s2022	Original item is: Father lives with you. Mother lives with you. The two items were synthesized as four categories: ● Living with neither father nor mother ● Living with father ● Living with mother ● Living with both father and mother	Living with neither father nor mother=0
	Number of siblings	A synthesis of w1s203 w1s204 w1s205 w1s206	The original items are: How many older brothers do you have? How many younger brothers do you have? How many older sisters do you have? How many younger sisters do you have? These items were synthesized as five categories: ● None ● One ● Two ● Three ● More than four (including four)	More than four=0

	Ethnicity	w1faethn	What is your father's ethnicity?	Aboriginals=0
	School Demographics			
	School type	w1priv w2priv w3priv w4priv	Public/ private	Private=0
	School Communi-ty	w1urban3 w2urban3 w3urban3 w4urban3	City/ town/ country	Country=0
	School program	w3pgrm	Curricular track	Five year junior college=0
	Student Demographics			
	Gender	w1s502	What is your gender?	Female=0

*These items were used as dependent variables of the sub-category 'positive teacher-student interaction' in the analysis of factors related to mathematic ability.

Data Analysis

The present research computed the effect sizes of various variables associated with student academic achievement, and furthermore to test whether there are differences between the effects of the four factors—family, school, student, and demographics. It has to be clarified that in this study, the data was analyzed without statistical weighing.

The effect size, a value which reflects the magnitude of the treatment effect or (more generally) the strength of a relationship between two variables , is the unit of currency in a meta-analysis (Borenstein, Hedges, Higgins, & Rothstein, 2009, p.3). Although the present research is not a meta-analysis, it borrows the method of meta-analysis to deal with a great number of raw data in the TEPS. The effect size of each variable associated with academic achievement was computed first. Then the various effect sizes were synthesized in a meaningful and systematic way to generate

mean effects of the synthesized categories of factors.

To obtain a through view of the effects on different domains of student academic achievement, the present research adopted three kinds of ability scores as dependent variables: the comprehensive ability score, the general analytic ability score, and the mathematic ability score. Therefore each independent variable generated three effect sizes based on different kinds of dependent variables. Take the variable 'gender' as an example, the effects of gender on students' comprehensive ability score, the general analytic ability score, and the mathematic ability score were computed respectively, and so were the effects of other variables.

Formulas for converting raw data

Formulas converting data to Hedges's *g* was adopted from Cooper and Hedges (1994, p. 237), and the formula converting *r* to effect size was adopted from Hedges and Olkin (1985, p. 77).

$$es = \frac{M_e - M_c}{\sqrt{\frac{(n_e-1)SD_e{}^2+(n_c-1)SD_c{}^2}{n_e+n_c-2}}} \qquad \text{Formula (1)}$$

Formula (1) was used to calculate the effect size of all the variables except for 'students' prior achievement'. It is noted that 'es' means effect size; M_e and M_c are the means of the two to be compared categories, with M_c being the mean of reference category, which has the lower mean between the response items. SD_e is the standard deviation of the non-reference category, and SD_c is the standard deviation of the reference category. And n_e and n_c are the sample size of the two categories.

Effect size measures provide a standardized index of how much impact treatments actually have on the dependent variable (Murphy & Myors, 1998). By

expressing the difference in group means in standard deviation, the value can be used to compare effects of different variables, without having to keep track of the units of measurement used in different variables.

$$es = \sqrt{\frac{4(N-1)}{N}} \times \sqrt{\frac{r^2}{1-r^2}} \qquad \text{Formula (2)}$$

Formula (2) was used to calculate the effect size of the variable: students' prior achievement. Because the ability score obtained from standard test of the TEPS is a continuing variable, the correlation coefficient 'r' between students' prior achievement and the dependent variable was calculated. And N is the sample size.

Determination of reference categories

Before calculating the effect sizes, the reference category of each variable was determined by reviewing the relevant literature. Among the response items of every variable, the category believed to have the lowest mean was determined as reference category. Table 1 presents the reference categories of variables. When one category was shown as "=0", it means that in calculating the effect size of two compared categories, the mean of other category (M_e) minus this reference category (M_c) to produce an effect size. For example, it is believed that students from less-income families perform inferior to those from higher-income families, then the group with least family income, 'less than $ 20000NT' , would be determined as the reference category in calculating the effect size of 'family income'. And the mean of other groups such as '$20000-50000NT','$500000-100000NT','$100000-150000NT', '$150000-200000','more than $200000NT' were treated as M_e individually to minus the mean of this reference category (M_c). In this way, five effect sizes were generated

from the variable, ‘family income’, which has six response items. The results of calculation of effect size of ‘family income’ are illustrated in table 2.

Table 2

The illustration of the computation and the results of the effects of ‘w1: family income’ on the comprehensive ability scores.

	N	Mean	Std. Deviation	Std. Error	Effect Size
w1p515: Monthly family income					
Less than $ 20000 NT	199	1.46	1.46	0.10	
$ 20000~49999 NT	1038	1.73	1.34	0.04	0.20
$ 50000~99999 NT	1102	2.09	1.36	0.04	0.46
$ 100000~149999 NT	342	2.48	1.32	0.07	0.74
$ 150000~199999 NT	92	2.50	1.36	0.14	0.73
More than $ 200000 NT	72	2.37	1.52	0.18	0.62
Total	2845	1.98	1.39	0.03	0.55

To determine proper reference categories, the original response items of few variables need to be merged or excluded. For example, in the question of father’s and mother’s occupation in the 3rd wave of TEPS, 11 categories of occupations are originally listed as response items. However, to determine the reference category of parents’ occupation, the classification of occupation has to represent for stratification of social economic status more briefly, especially the lowest category, which would be adopted as the reference category. Therefore some groups were merged or excluded according to Huang’s (1998) five-scaled ranking of the social economic status of occupations. The two groups, ‘non-skilled labor and physical labor’ and ‘forestry, fishery, husbandry, and agriculture’, were merged as the reference category. The other two, ‘sales clerks or service staffs (such as a cook)’and ‘skilled labors,

assemblers, or operators (such as drivers)' were merged as the same group. And the group of 'soldiers' was excluded in the calculation because it is hard to compare with other groups under the concept of SES ranking, and because the size of this group is very small with only 30 fathers and 4 mothers in the investigation. Consequently 8 categories were adopted to calculate the effect size of father's and mother's occupation.

Computation of effect sizes

After deciding reference categories, the conversion formulas were written according to Formula (1) and (2) in EXCEL to generate the effect size of each non-reference category of the variables. The reference category can thus be identified as a group with an effect size of 0. And to determine the magnitude of effect size, Cohen's criterion was applied in the present research. According to Cohen's criterion, an effect size of 0.2 is small, 0.5 is medium, and 0.8 is large (Cohen, 1977).

It needs to be clarified that although the total sample size of the present research is 2868, the calculation of the effect size of every variable did not include the 2868 cases because each variable contained a few unreasonable or missing values. Therefore the cases with unreasonable or missing values of response were excluded before computing the mean of each category. In addition, the cases of variables associated with teachers' information were not completely available because the case number of teacher's questionnaires was intentionally reduced by the research committee of TEPS when releasing the data for the purpose of secrecy and safety. Therefore the case numbers of calculations associated with teachers' information are around 1600, and that of other calculations are mostly not less than 2700, with the

exception of the investigations of ‘parents’ occupation’, which reveled more missing values. The lowest case number was **2400** in the calculation of ‘w3: mother’s occupation’.

Testing differences between mean effect sizes

After the effect sizes of independent variables were calculated, and the grand mean effect size was obtained, the next step was to test whether the effect sizes of these grouped variables, no matter grouped by categories, sub-categories, or different periods, have significant differences. However, before applying statistics to analyze the data, three assumptions underlying parametric tests have to be considered: (a) that the residuals are independently distributed, (b) that the residuals are normally distributed, and (c) that the variance of the residuals are homogeneous (as cited in Ma, 2008). The normality of the distribution of the residuals is robust, but a violation of the assumptions of (a) and (c) will probably have an appreciable effect on the validity of a parametric statistical test (Ma, 2008). If any of the assumptions are violated, non-parametric statistics instead of parametric statistics should be used.

To test whether the residuals are independently distributed, the lag1 autocorrelation of residuals can be computed through SPSS. And to test whether the residuals are homogeneous, Levene’s Test can be computed through SPSS. If the results of the two tests appear to be significant, it suggests a violation of assumptions (a) and (c). Therefore nonparametric statistics will be used in the present research. Among several methods utilized in nonparametric statistics, it is appropriate to use the Kruskal-Wallis Analysis of Variance by ranks and Mann-Whitney U Test to examine the two research hypothesizes: (1) there are differences among the four categories of

factors and (2) there are differences among the several sub-categories of four factors.

Chapter Four Results

In the present research, three kinds of ability scores were adopted as dependent variables: the comprehensive ability score, the general analytic ability score, and the mathematic ability score. Therefore this chapter will report the effects of the family, school, student, and demographic factor on the three kinds of academic ability score.

In the analysis of the variables related to the comprehensive ability score and to the general analytic ability score, 399 effect sizes were computed from 128 variables for both kinds of score; and in the analysis of the variables related to the mathematic ability score, 338 effect sizes were computed from 110 variables. Why the number of variables related to the mathematic ability score is less is mainly because that only math teachers' information was included. In the analysis of variables related to the other two kinds of ability score, the information of not only math teachers but also Chinese teachers and English teachers was involved. The mean effect sizes of each variable and the specific sub-categories are presented in Appendix A. The following paragraphs highlight the effects of certain independent variables and the mean effect sizes of the sub-categorical factors relevant to the student academic achievement.

Parents' aspirations for their child's education

The average effect sizes of 'parents' aspirations for their child's education' based on the students' comprehensive ability score, general analytic ability score, and mathematic ability score were 1.13, 0.82, and 1.03, respectively. The values mean that the average sizes of effect were 1.13, 0.82, and 1.03 times, respectively, as large as the variability in the three kinds of academic outcomes that occurred in the case of students whose parents expected them to only get senior high school or senior

vocational school diplomas. Such results suggested that the effect of ‘parents’ aspirations’ is quite large.

Father’s involvement in child’s learning

The average effect sizes of ‘father’s involvement in child’s learning’ based on the three domains of academic ability scores of the students were .18, .12, and .16, respectively, showing few effects on academic achievement.

Mother’s involvement in child’s learning

The average effect sizes of ‘mother’s involvement in child’s learning’ based on the three domains of academic ability scores of the students were .27, .19, and .26 respectively, showing small effects on academic achievement.

Family cultural capital

The average effect sizes of ‘family cultural capital’ based on the three domains of academic ability scores of the students were .35, .28, and .31, respectively, showing small effects on academic achievement. Among the related items, ‘taking children to bookstores, or exhibitions’, ‘having magazines, journals, or newspapers at home’, and ‘having internet access at home’ obviously showed small effect, larger than ‘going to classical music concerts, or watching dancing and drama performances’, which had almost no effect or even a negative effect compared with the results for the group which never did so.

Positive teacher-student interaction

The average effect sizes of ‘Positive teacher-student interaction’ based on the three domains of academic ability scores of the students were 0.32, 0.21, and 0.44, respectively, indicating small effects on academic achievement with the value for

math scores slightly larger than the others. However it needs to be clarified that the value for comprehensive ability scores and the general analytic ability scores were based on the average effects of Chinese, English, and math teachers, while the value for mathematic ability scores was based on only the effects of math teachers.

Safety and order of campus

The average effect sizes of 'safety and order of campus' based on s the three domains of academic ability scores of the students were 0.25, 0.19, and 0.20, respectively, indicating only small effects on academic achievement.

Teacher's highest degree

The average effect sizes of 'teacher's highest degree' based on the three domains of academic ability scores of the students were 0.12, 0.11, and 0.06, respectively, indicating almost no effect on academic achievement.

Teacher's years of teaching experience

The average effect sizes of 'teacher's years of teaching experience' based on the three domains of academic ability scores of the students were 0.33, 0.30, and 0.25, respectively, indicating small effects on academic achievement.

Teacher's involvement in teaching

The average effect sizes of 'teacher's involvement in teaching' based on the three domains of academic ability scores of the students were 0.25, 0.16, and 0.05, respectively, indicating distinct degrees of effects on different domains of academic achievement. And it is notable that English teachers' involvement in the w3 and w4 periods (11^{th} and 12^{th} grades) showed small to medium effects on the comprehensive

and general analytic ability scores with the values ranging from .37 to .70.

Prior achievement

The average effect size of 'prior achievement' based on the correlation of w1-w4, w2-w4, and w3-w4 scores of students' comprehensive ability was 2.39,and the effect size based on the correlation of between-waves scores of general analytic ability and the mathematic ability were 1.45, 1.90 respectively. The average effect sizes indicated extremely large effects on student academic achievement.

Student's educational aspirations

The average effect sizes of 'student's educational aspirations' based on students' comprehensive ability score, general analytic ability score, and the mathematic ability score were 0.97, 0.74, 0.85 respectively, indicating large effects compared with the academic outcomes that occur with students who expected themselves only to get senior high school or senior vocational school degrees.

Student's educational engagement during semester

The average effect sizes of 'student's educational engagement during semester' based on the three domains of academic ability scores of the students were 0.41, 0.31, and 0.24, respectively, indicating small effects on academic achievement. However, it is notable that the effect size of 'hours spent on taking out-of-school academic lessons after school every week' in the w3 and w4 periods (11^{th} and 12^{th} grade) were 0.74 and 0.70 for the comprehensive ability scores, and 0.53 and 0.52 for the general analytic ability scores, compared with the academic outcomes of those who did not take any extra lessons. The values were much larger than those, around 0.10, in the W1 and W2 periods (7^{th} and 9^{th} grades). And for the mathematic ability scores, the effect sizes

of ‘hours spent on taking out-of-school academic lessons’ were equally low in every period with a value of around or even less than 0.10.

Student’s having less behavioral problems in school

The average effect sizes of ‘having less behavioral problems in school’ based on the three domains of academic ability scores of the students were 0.27, 0.21, and 0.19, respectively. The values mean that the children who reported that they never or occasionally having behavioral problems such as cutting classes, avoiding going to school , or fighting, had the mean effect sizes of 0.27, 0.21, and 0.19 times, respectively, as large as the variability in the three kinds of academic outcomes that occurred in the case of students who often did so.

Student’s educational engagement during summer vacation

The average effect sizes of ‘student’s educational engagement during summer vacation’ based on the three domains of academic ability scores of the students were 0.41, 0.32, and 0.37, respectively, indicating small effects on academic achievement. However, the effect sizes of ‘taking out-of-school academic courses during the summer vacation leading to 10^{th} grade’ were 0.78, 0.60, and 0.74, respectively, based on the three kinds of academic ability scores. And the effects of the same practice during the summer vacation leading to 12^{th} grade were 0.66, 0.47, and 0.63, respectively. The results indicate medium sizes of effect compared with the academic outcomes of those who didn’t do so.

Student’s extracurricular activities and recreation

The average effect sizes of ‘Student’s extracurricular activities and recreation’ based on the three domains of academic ability scores of the students were 0.28, 0.22,

and 0.22, respectively, indicating small effects on academic achievement. Among all the activities, the effect of 'the average hours spent on watching TV or videos every day' in the w3 period (11th grade)' was the largest with the value of 0.53, 0.46, and 0.44, respectively, based on the three kinds of academic ability scores, showing medium or nearly medium sizes of effect compared with those who watched TV or videos more than four hours every day.

Family Income

The average effect sizes of 'family Income' based on the three domains of academic ability scores of the students were 0.55, 0.48, and 0.50, respectively, indicating medium effect on academic achievement.

Parents' education

The average effect sizes of 'father's education ' based on the three domains of academic ability scores of the students were 0.91, 0.63, and 0.64, respectively, and those of mother's were 0.83, 0.83, and 0.74, respectively, indicating medium to large effects on academic achievement.

Parents' occupation

The average effect sizes of 'father's occupation ' the three domains of academic ability scores of the students were 0.67, 0.58, and 0.62, respectively, and those of mother's were 0.63, 0.59, and 0.57, respectively, indicating medium effects on academic achievement.

Living with parents

The average effect sizes of 'living with either or both side of parents' compared

with ‘living with no parents’ were 0.50, 0.33, and 0.53, respectively, based on the three domains of academic ability scores of the students. The results indicated small to medium sizes of effect on academic achievement.

Number of siblings

The average effect sizes of ‘number of siblings’ based on the three domains of academic ability scores of the students were 0.41, 0.27, and 0.35, respectively, compared with those who have more than four siblings. The results show that having fewer siblings holds small effects on student academic achievement.

Ethnicity

The average effect sizes of ‘ethnicity’ based on the three domains of academic ability scores of the students were 1.27, 1.02, and 1.23, respectively. The academic outcomes of the groups, mainlanders, Hakka, and Minnan, were compared with that of the reference groups, aboriginals. The result indicated quite large effects on academic achievement.

Type of school (public/private)

The average effect sizes of ‘type of school’ based on the three domains of academic ability scores of the students were 0.35, 0.31, and 0.30, respectively. However, the distribution of the academic outcomes in public and private schools is very different between the two stages of high school (junior years and senior years). The results revealed negative effect sizes (around -.30 to -.20) when the data collected in the w1 and w2 (7^{th} and 9^{th} grade) investigation was involved; however, large positive effect sizes (around .80 to 1.00) were found when the w3 and w4 (11^{th} and 12^{th} grade) data were involved.

School community

The average effect sizes of 'school community' based on the three domains of academic ability scores of the students were 0.67, 0.54, and 0.64, respectively, indicating medium effects compared with the reference category, 'country'. It is noticeable that the effect sizes of w3 and w4 (11^{th} and 12^{th} grade) school community were large, with values ranging from 0.74 to 0.93; however, the effect sizes of w1 and W2 (7^{th} and 9^{th} grade) school community were only small, with values ranging from 0.34 to 0.46.

School program

The average effect sizes of 'school program' based on the three domains of academic ability scores of the students were 0.71, 0.47, and 0.68, respectively, indicating medium effects compared with the reference category, 'studying in five-year junior college programs'. It needs to be clarified that the data were obtained from only wave 3 and wave 4 (11^{th} and 12^{th} grades) investigations because the school programs are not differentiated until the 10^{th} grade in Taiwan.

Gender

The average effect sizes of 'gender' based on the three domains of academic ability scores of the students were 0.10, 0.20, and 0.12, respectively. The reference category was 'female', which suggested a slight precedence of 'male' over 'female' on academic achievement.

The test results are divided into three parts according to the different dependent variables in the following paragraphs to present the differences among the mean effect sizes of four factors (family, school, student, and demographics) and among those of

the sub-categories. And it has to be clarified that during the process of calculating the effect sizes of related factors, it was found that the mean effect size of students' prior achievement was distinctly larger than that of the other sub-categories. Therefore students' prior achievement was separated from the 'student factor' as an independent factor to be compared with the other four categories of factors: family, school, student, and demographics.

Part One The Effects of Relevant Factors on Comprehensive Ability

The average size of effect was .43 (SD=.40). The following sections present the mean effects of factors and sub-categories and the results of the statistical tests in relation to the research questions.

The Mean Effect Size of Factors Relevant to Comprehensive Ability

The mean and mean ranks of the effect sizes of the five categories are presented in Table 3. The mean effect size of demographic factor (.65) was medium, larger than the effect sizes of family factor (.46), school factor (.27), and students' engagement (.38). The mean effect size of 2.39 of the students' prior achievement exhibited a prominently large effect size. The variable 'students' prior achievement' was obtained from the comprehensive ability scores gauged from the 1st, 2nd, and 3rd waves of the standard tests of the TEPS, and it reflects the accumulated abilities of a student.

Before applying statistical tests to examine whether there are significant differences between the five factors, it has to be confirmed that the residuals of the 399 effect sizes are independently distributed and that the variance of the residuals is

homogeneous. The lag1 autocorrelation of the residuals was found to be significant (r=.57, with a standard error of .05) , and Levene's Test for homogeneity of variance also showed that the residuals were not homogeneous ,$F(4,394) = 5.91$, $p < .001$, indicating a violation of the assumption of parametric tests. Therefore non-parametric statistics were used. The Kruskal-Wallis Test resulted in significance, $\chi^2(4, N=399) = 55.32$, $p < .001$, referring to differences between the mean ranks of the effect sizes of the five factors. The results of *post hoc* comparisons by means of the Mann-Whitney U Test are shown in Table 3.

Table 3

Mean and mean ranks of effect sizes of factors relevant to the comprehensive ability score

Factors	K	M	SD	Mr
1 Family	72	0.46	0.44	199
2 School	102	0.27	0.22	155
3 Student prior achievement	3	2.39	0.39	398
4 Students' engagement	152	0.38	0.32	192
5 Demographics	70	0.65	0.41	276
Total	399	0.43	0.40	
Kruskal-Wallis ANOVA by ranks	$\chi^2(4, N=409) = 54.66$, $p < .001$			
Mann-Whitney U Test	3 > 5 > (1,4) > 2 *			

Note. In all of the following tables in the present study, K=Number of effect size, M=Mean of effect sizes, SD=Standard deviation of effect sizes, Mr=Mean of ranks of effect sizes.

* Significant at least at p<.05.

The Mean Effect Sizes of Sub-Categories of Factors Relevant to Comprehensive Ability

The Mean Effect Sizes of Sub-Categories of the Family Factor

Seventy-two effect sizes were generated from the four sub-categories of the family factor. Parents' aspiration for child's education had a large size of effect (1.13),

while father's and mother's involvement in child's learning, and family cultural capital had only small effect sizes. The lag1 autocorrelation of the residuals of the 72 effect sizes was .75, with a standard error of .12, p < .001, and Levene's Test for homogeneity of the variance of the residuals also revealed significance, $F(3,68) = 12.07$, $p < .001$. Such results showed that the distribution of the residuals was not independently distributed, and that the variance of the residuals was not homogeneous. Therefore the Kruskal-Wallis Test was applied. The results demonstrated significance, $\chi^2(3, N=72) = 41.53$, $p < .001$. *Post hoc* comparisons by means of the Mann-Whitney U Test demonstrated that the mean rank of the effect size of parents' aspiration was significantly larger than that of father's involvement, mother's involvement, and cultural capital. And the mean rank of the effect size of father's involvement was significantly smaller than all the other sub-categories.

The Mean Effect Sizes of Sub-categories of the School Factor

One hundred and two effect sizes were generated from the five sub-categories of the school factor. The lag1 autocorrelation of the residuals of the 102 effect sizes was significant (.40, with a standard error of .10, $p < .001$), and Levene's Test for homogeneity of the variance of the residuals revealed significance, $F(4,97) = 4.49$, $p < .05$. Therefore the Kruskal-Wallis ANOVA by ranks was applied. The results of the test showed that the mean rank of the effect sizes of the five sub-categories had significant difference, $\chi^2(4, N=102) = 10.95$, $p < .05$. *Post hoc* comparisons by means of the Mann-Whitney U Test demonstrated that the mean ranks of the effect size of teacher-student positive interaction, safety and order, and teacher's years of teaching experience were significantly larger than that of teacher's highest degree.

The Mean Effect Sizes of Sub-Categories of the Student Factor

One hundred and fifty-five effect sizes were computed from the six sub-categories of the student factor. The lag1 autocorrelation of the residuals of the 155 effect sizes was .48 with a standard error of .08, $p<.001$, and Levene's Test for homogeneity of the variance of the residuals also revealed significance at $F(5,149) = 3.56$, $p < .001$. A Kruskal-Wallis test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(5, N=155) = 38.63$, $p < .001$. The sizes of mean effect of 'prior achievement'(2.39) and 'students' educational aspirations'(.97) are large (presented in Table 4), and the other sub-categories in sequence of their sizes of effect are educational engagement during semester (.43), educational engagement during summer vacation (.41), extracurricular activities and recreation (.28), and behavioral problems in school (.27). The results of the *post hoc* comparisons are shown in Table 4.

The Mean Effect Sizes of Sub-Categories of the Demographic Factor

The demographic factor was divided into familial, school, and student demographics. The mean and mean ranks of the effect sizes of the various demographic sub-categories are provided in Table 4. Fifty-one effect sizes were computed from the eight sub-categories of familial demographics. A Kruskal-Wallis Test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(7, N=51) = 14.76$, $p < .05$. Ethnicity had the largest effect size of 1.27, and both father's and mother's education also reached a large size of effect (.91, and .83). Other demographic sub-categories revealed medium or nearly medium effect size. In addition, three sub-categories were included in the school demographic and eighteen

effect sizes were computed. The Kruskal-Wallis Test resulted in no significance, χ^2(2, N=18) = .84, p > .05.

The mean effect size of familial and school demographics is compared in Table 5. The mean effect size of familial demographics (.67) is larger than that of school demographics (.61). Although the lag1 autocorrelation of the residuals revealed no significance (r=.21, with a standard error of .12, p >.05), the result of Levene's Test for homogeneity of variance of the residuals was significant, F(1,67) = .03, p < .05. Therefore the Mann-Whitney U Test was applied. However, the result revealed no significant difference between them, Z(N=69) = -.246, p > .05.

Table 4

Mean and mean rank of effect size of each sub-category of factors relevant to the comprehensive ability score

Sub-categories of factors	K	M	SD	Mr
Family				
1 Parents' aspirations	16	1.13	.43	64
2 Father's involvement in children's learning	18	.18	.13	20
3 Mother's involvement in children's learning	18	.27	.12	30
4 Cultural capital	20	.33	.18	36
Kruskal-Wallis ANOVA by ranks	72	χ^2(3, N=72) = 41.53, p < .001		
Mann-Whitney U Test		1 > (3,4) > 2 *		
School				
5 Teacher-student interaction	23	.36	.20	63
6 Safety and order	15	.24	.13	50
7 Teacher's highest degree	9	.12	.07	27
8 Teacher's years of teaching experience	9	.33	.22	62
9 Teacher's teaching involvement	45	.25	.26	49
Kruskal-Wallis ANOVA by ranks	102	χ^2 (4,N=102) = 10.95, p < .05		

Mann-Whitney U Test		(6,7,9) > 8 *		
Student				
10 Prior achievement	3	2.39	.39	154
11 Students' educational aspirations	12	.97	.44	132
12 Educational engagement during semester	45	.43	.25	88
13 Behavior problems in school	30	.27	.35	61
14 Engagement during summer vacation	7	.41	.25	84
15 Extracurricular activities and recreation	58	.28	.18	63
Kruskal-Wallis ANOVA by ranks	155	$\chi^2(5, N=155) = 38.63, p < .001$		
Mann-Whitney U Test		11 > 12 > (13,15) * 13 > (14,16) *		
Demographics				
Familial demographics				
16 Family income	15	.55	.24	23
17 Father's education	4	.91	.72	31
18 Mother's education	4	.83	.37	33
19 Father's occupation	7	.67	.28	28
20 Mother's occupation	7	.63	.26	26
21 Living with parents	6	.50	.19	18
22 Number of siblings	4	.41	.16	14
23 Ethnicity	4	1.27	.25	47
Kruskal-Wallis ANOVA by ranks	51	$\chi^2(7, N=51) = 14.76, p < .05$		
Mann-Whitney U Test		24 > (17,20,21,22,23) *		
School demographics				
24 School type (private/public)	4	.35	.77	8
25 School community	8	.67	.32	10
26 School program	6	.71	.60	10
Kruskal-Wallis ANOVA by ranks	18	$\chi^2(2, N=18) = .84, p > .05$		
Student demographics				
27 Gender	1	.10		

Note. * Significant at least at p<.05.

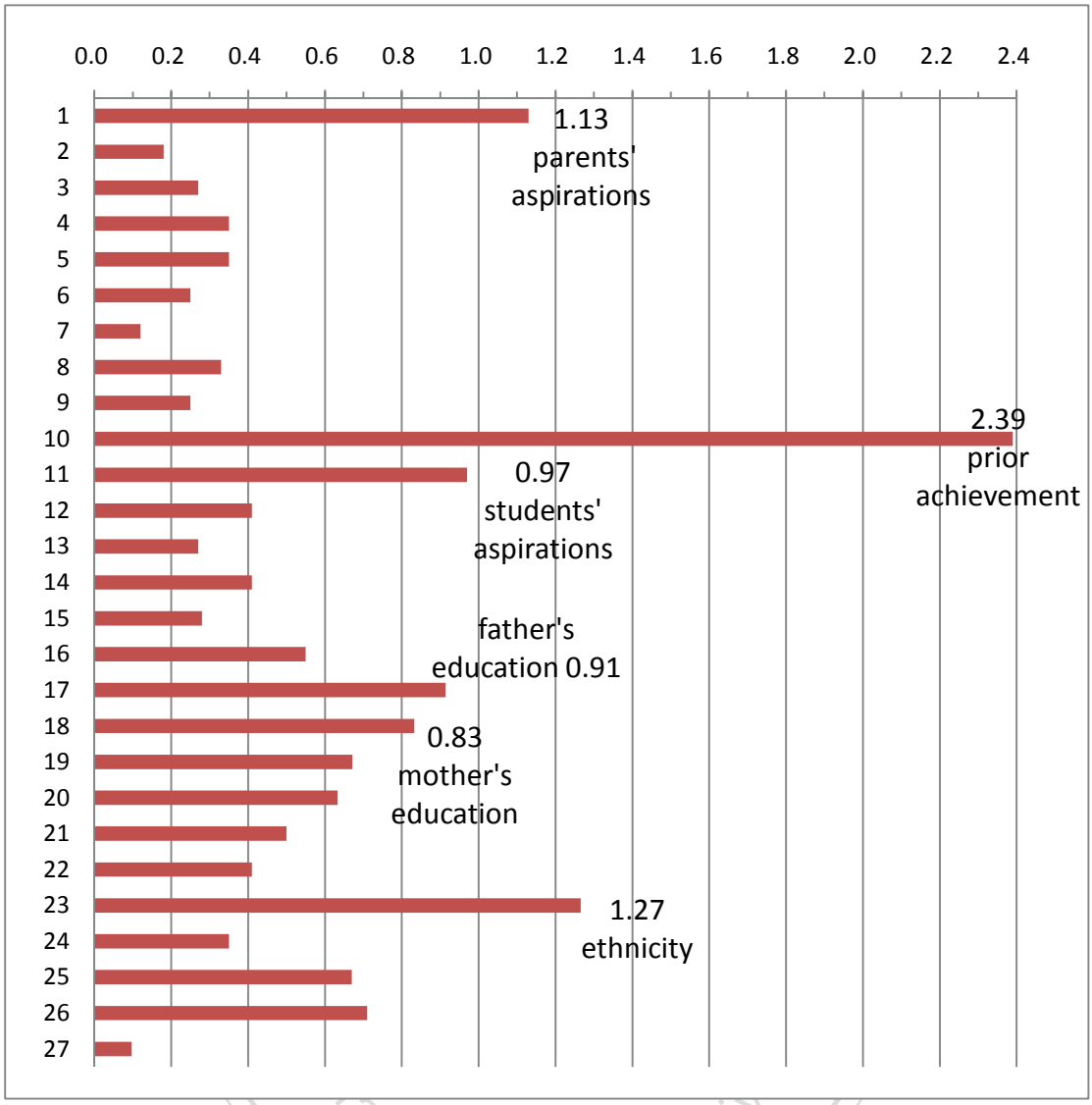

Figure 1 *The effect sizes of sub-categorical factors relevant to the comprehensive ability score*

Table 5

Mean and mean rank of effect size of familial and school demographics relevant to comprehensive ability scores

The demographic factor	K	M	SD	Mr
Familial demographics	85	.57	.37	50.60
School demographics	18	.69	.427	58.61
Mann-Whitney U Test	103	Z(N=103) = -1.03, p > .05.		

Part Two The Effects of Relevant Factors on General Analytic Ability

The average size of effect was .32 (SD=.31). The following sections present the mean effects of factors and sub-categories and the results of the statistical tests in relation to the research questions.

The Mean Effect Size of Factors Relevant to General Analytic Ability

The mean and mean ranks of the effect sizes of the five categories are presented in Table 6. The mean effect size of the demographic factor (.53) was medium, larger than the effect size of family (.33), school (.19), and students' engagement (.29). The mean effect size of 1.45 for the students' prior achievement exhibited a prominently large effect size. The variable 'students' prior achievement' was obtained from the general analytic ability scores gauged from the 1st, 2nd, and 3rd waves of the standard tests of the TEPS, and it reflects the accumulated abilities of a student.

Before applying statistical tests to examine whether there are significant differences between the five factors, it was confirmed that the lag1 autocorrelation of the residuals was significant (r=.57, with a standard error of .05) , and Levene's Test for homogeneity of variance also showed that the residuals were not homogeneous , $F(4,394) = 4.47$, $p < .05$, indicating violation of the assumptions of parametric tests. Therefore non-parametric statistics were applied. The Kruskal-Wallis Test resulted in significance, $\chi^2(4, N=399) = 60.65$, $p < .001$, referring to differences between the mean ranks of the effect sizes of the five factors. The results of post hoc comparisons by means of the Mann-Whitney U Test are shown in Table 6.

Table 6

Mean and mean ranks of effect sizes of factors relevant to the general analytic ability scores

Factors	K	M	SD	Mr
1 Family	72	0.33	0.33	196
2 School	102	0.19	0.21	149
3 Student prior achievement	3	1.45	0.20	397
4 Students' engagement	152	0.29	0.26	196
5 Demographics	70	0.53	0.32	278
Total	399	0.32	0.31	
Kruskal-Wallis ANOVA by ranks	$\chi^2(4, N=399) = 60.65, p < .001$			
Mann-Whitney U Test	3 > 5 > (1,4) >2 *			

Note. * Significant at least at $p<.05$.

The Mean Effect Sizes of Sub-Categories of Factors Relevant to General Analytic Ability

The Mean Effect Sizes of Sub-Categories of the Family Factor

Seventy-two effect sizes were generated from the four sub-categories of the family factor. Parents' aspiration for child's education had a large size of effect (.82); family cultural capital had a small effect size with the value of .26; however, father's and mother's involvement in child's learning had the effect sizes of only .12 and .19, respectively, showing little effect. The lag1 autocorrelation of the residuals of the 72 effect sizes was .74, with a standard error of .12, p < .001, and Levene's Test for homogeneity of variance of the residuals also revealed significance, $F(3,68) = 8.23$, $p < .001$. Such results show that the distribution of the residuals was not independently distributed, and the variance of the residuals was not homogeneous. Therefore the Kruskal-Wallis Test was applied. The results demonstrated significance, $\chi^2(3, N=72) = 41.62$, $p < .001$. *Post hoc* comparisons by means of the Mann-Whitney U Test are demonstrated in Table 7.

The Mean Effect Sizes of Sub-Categories of the School Factor

One hundred and two effect sizes were generated from the five sub-categories of the school factor. The lag1 autocorrelation of the residuals of the 102 effect sizes was significant (.43, with a standard error of .10, p <.001), and Levene's Test for homogeneity of the variance of the residuals revealed significance, $F(4,97) = 6.77$, $p < .001$. Therefore the Kruskal-Wallis ANOVA by ranks was applied. The results of the test showed that the mean rank of the effect sizes of the five sub-categories had no significant difference, $\chi^2(4, N=102) = 7.25$, $p > .05$.

The Mean Effect Size of Sub-Categories of the Student Factor

One hundred and fifty-five effect sizes were computed from the six sub-categories of the student factor. The lag1 autocorrelation of the residuals of the 155 effect sizes was .50 with a standard error of .08, $p < .001$, and Levene's Test for homogeneity of the variance of the residuals also revealed significance at $F(5,149) = 4.88$, $p < .001$.The Kruskal-Wallis Test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(5, N=155) = 34.17$, $p < .001$. The size of the mean effect of 'prior achievement'(1.45) is large, and that of 'students' educational aspirations'(.74) is medium (presented in Table 7). The other sub-categories in sequence of their sizes of effect are educational engagement during semester (.32), educational engagement during summer vacation (.32), extracurricular activities and recreation (.22), and behavioral problems in school (.21). The results of the *post hoc* comparisons are shown in Table 7.

The Mean Effect Size of Sub-Categories of the Demographic Factor

The demographic variables were divided into familial, school, and student demographics. The mean and mean ranks of the effect sizes of the various demographic sub-categories are provided in Table 7. Fifty-one effect sizes were computed from the eight sub-categories of familial demographics. A Kruskal-Wallis Test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(7, N=51) = 19.59$, $p < .05$. Ethnicity had the largest effect size of 1.01, and mother's education also reached a large size of effect (.83). 'Father's education', 'father's occupation and 'mother's occupation' had medium sizes of effect. Other familial demographic sub-categories revealed only small effect sizes. In addition, three sub-categories were included in the school demographic and eighteen effect sizes were computed. The Kruskal-Wallis Test resulted in no significance, $\chi^2(2, N=18) = .84$, $p > .05$.

The mean effect size of familial and school demographics is compared in Table 8. The mean effect size of familial demographics (.56) is larger than that of school demographics (.47). Because the lag1 autocorrelation of the residuals revealed significance (r=.43, with a standard error of .10, $p < .001$), and the result of Levene's Test for homogeneity of variance was also significant, $F(1,67) = 4.70$, $p < .05$. Therefore the Mann-Whitney U Test was applied. However, the result revealed no significant difference between the familial demographics and the school demographics, $Z(N=69) = -.71$, $p > .05$.

Table 7

Mean and mean rank of effect size of each sub-category of factors relevant to the general analytic ability score

Sub-categories of factors	K	M	SD	Mr
Family				
1 Parents' aspirations	16	.82	.30	64
2 Father's involvement in children's learning	18	.12	.09	20
3 Mother's involvement in children's learning	18	.19	.08	29
4 Cultural capital	20	.26	.20	37
Kruskal-Wallis ANOVA by ranks	72	$\chi^2(3, N=72) = 41.62, p < .001$		
Mann-Whitney U Test		1 > (2,3) * 1 > 4 > 2 *		
School				
5 Teacher-student interaction	23	.23	.16	58
6 Safety and order	15	.18	.10	53
7 Teacher's highest degree	9	.11	.05	39
8 Teacher's years of teaching experience	9	.30	.18	69
9 Teacher's teaching involvement	45	.17	.28	46
Kruskal-Wallis ANOVA by ranks	102	χ^2 (4,N=102) = 7.25, $p > .05$		
Student				
10 Prior achievement	3	1.45	.20	154
11 Students' educational aspirations	12	.74	.33	131
12 Educational engagement during semester	45	.32	.19	84
13 Behavior problems in schol	30	.21	.30	64
14 Engagement during summer vacation	7	.32	.19	84
15 Extracurricular activities and recreation	58	.22	.16	65
Kruskal-Wallis ANOVA by ranks	155	$\chi^2(5, N=155) = 34.17, p < .001$		
Mann-Whitney U Test		11 > 12 > (13,14,15)* 13 > 16 *		
Demographics				
Familial demographics				

16 Family income	15	.48	22	24
17 Father's education	4	.63	.34	30
18 Mother's education	4	.83	.37	38
19 Father's occupation	7	.58	.22	28
20 Mother's occupation	7	.59	.25	28
21 Living with parents	6	.33	.16	15
22 Number of siblings	4	.27	.14	10
23 Ethnicity	4	1.01	.12	47
Kruskal-Wallis ANOVA by ranks	51	$\chi^2(7, N=51) = 19.59, p < .05$		
Mann-Whitney U Test		24 > (17, 20,22) * (19, 20) > 23 * 19 > 22 *		
School demographics				
24 School type (private/public)	4	.31	.61	8
25 School community	8	.54	.26	11
26 School program	6	.47	.46	10
Kruskal-Wallis ANOVA by ranks	18	$\chi^2(2, N=18) = .84, p > .05$		
Student demographics				
Gender	1	.20		

Note. * Significant at least at p<.05.

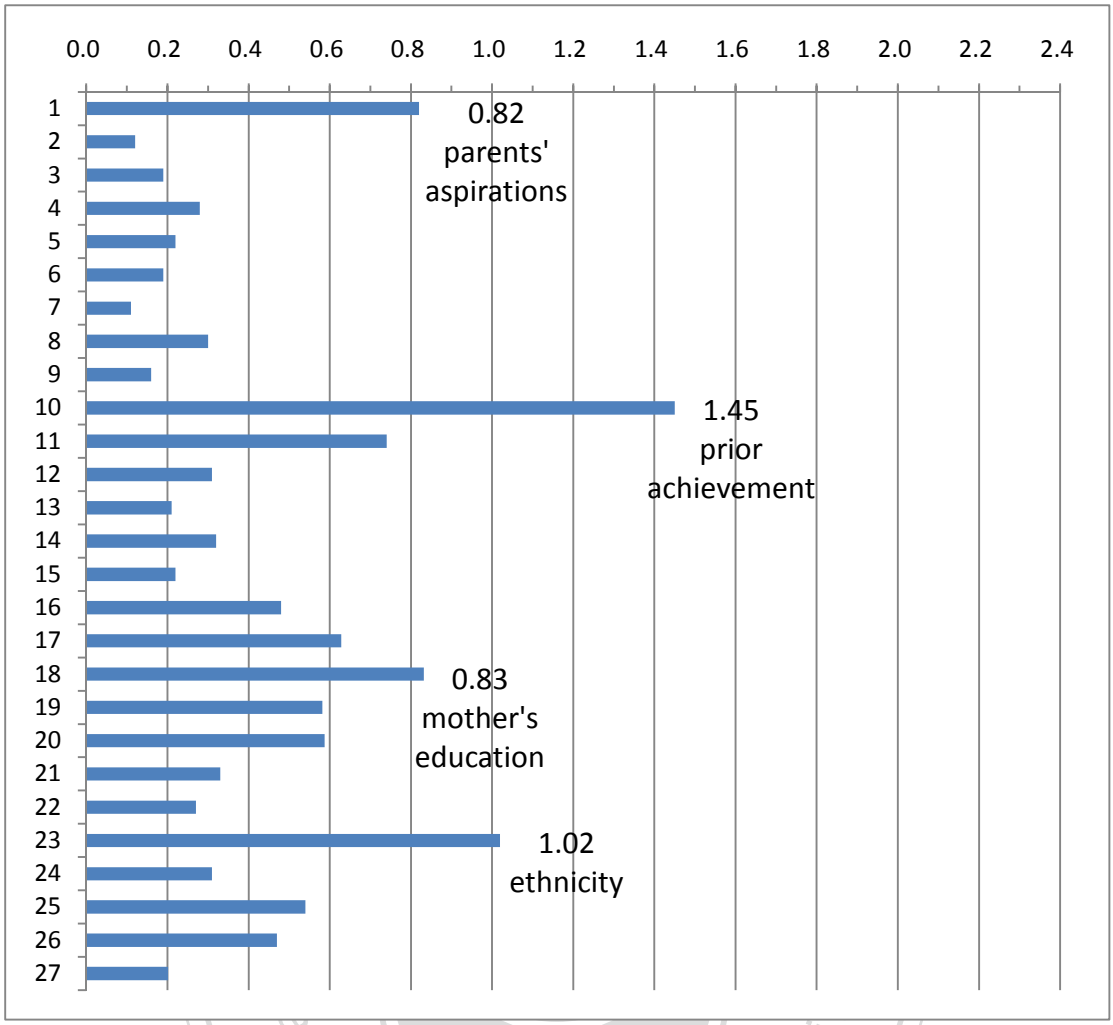

Figure 2 *The effect sizes of sub-categorical factors relevant to the general-analytic ability score*

Table 8

Mean and mean rank of effect size of familial and school demographics relevant to the general analytic ability score

The demographic factor	K	M	SD	MR
Familial demographics	51	.56	.29	36
School demographics	18	.47	.41	32
Mann-Whitney U Test	69	Z(N=69) = -.71, p > .05		

Part Three The Effects of Relevant Factors on Mathematic Ability

The average size of effect was .37 (SD=.38). The following sections present the mean effects of factors and sub-categories and the results of the statistical tests in relation to the research questions.

The Mean Effect Sizes of Factors Relevant to Mathematic Ability

The mean and mean ranks of the effect sizes of the five categories are presented in Table 9. The mean effect size of the demographic factor (.59) was medium, larger than effect sizes of the family factor (.42), the school factor (.16) and the students' engagement (.28). The mean effect size of 1.90 of the students' prior achievement exhibited a prominently large effect size. The variable 'students' prior achievement' was obtained from the mathematic ability scores gauged from the 1st, 2nd, and 3rd waves of the standard tests of the TEPS, and it reflects the accumulated abilities of the students.

Before applying statistical tests to examine whether there are significant differences between the five factors, it was confirmed that the lag1 autocorrelation of the residuals was significant (r = .57, with a standard error of .05) , and Levene's Test for homogeneity of variance also showed that the residuals were not homogeneous, $F(4,333) = 3.80$, $p < .05$, indicating violation of the assumptions of parametric tests. Therefore non-parametric statistics were applied. The Kruskal-Wallis Test resulted in significance, $\chi^2(4, N=338) = 68.95$, $p < .001$, referring to differences between the mean ranks of the effect sizes of the five factors. The results of *post hoc* comparisons by means of the Mann-Whitney U Test are shown in Table 9.

Table 7

Mean and mean ranks of effect sizes of factors relevant to the mathematic ability score

Factors	K	M	SD	Mr
1 Family	82	0.42	0.40	175
2 School	41	0.16	0.18	106
3 Student prior achievement	3	1.90	0.28	336
4 Students' engagement	152	0.28	0.31	149
5 Demographics	70	0.59	0.36	239
Total	338	0.37	0.38	
Kruskal-Wallis ANOVA by ranks	$\chi^2(4, N=338) = 68.95, p < .001$			
Mann-Whitney U Test	3 > 5 > (1,4) >2 *			

Note. * Significant at least at $p<.05$.

The Mean Effect Sizes of Sub-Categories of Factors Relevant to Mathematic Ability

The Mean Effect Sizes of Sub-Categories of the Family Factor

Seventy-two effect sizes were generated from the four sub-categories of the family factor. Parents' aspiration for child's education had a large size of effect (1.03), while father's involvement in child's learning had almost no effect. Mother's involvement and family cultural capital had a small effect size with the values of .26, .30, respectively. The lag1 autocorrelation of the residuals of the 72 effect sizes was .75, with a standard error of .12, p < .001, and Levene's Test for homogeneity of the variance of the residuals also revealed significance, $F(3,68) = 11.36$, $p < .001$. Such results showed that the distribution of the residuals was not independently distributed, and that the variance of the residuals was not homogeneous. Therefore the Kruskal-Wallis Test was applied. The results demonstrated significance, $\chi^2(3, N=72) = 41.19$, $p < .001$. *Post hoc* comparisons by means of the Mann-Whitney U Test were demonstrated in Table 10.

The Mean Effect Sizes of Sub-Categories of the School Factor

Forty-one effect sizes were generated from the five sub-categories of the school factor. Although the Levene's Test for homogeneity of the variance of the residuals revealed no significance, $F(4,36) = 1.27$, $p > .05$, the lag1 autocorrelation of the residuals of the 41 effect sizes was significant (.35, with a standard error of .15, $p < .05$). Therefore the Kruskal-Wallis ANOVA by ranks was applied. The results of the test showed that the mean rank of the effect sizes of the five sub-categories had significant difference, $\chi^2(4, N=41) = 16.45$, $p < .05$. Post hoc comparisons by means of the Mann-Whitney U Test are demonstrated in Table 10.

The Mean Effect Sizes of Sub-Categories of the Student Factor

One hundred and fifty-five effect sizes were computed from the six sub-categories of the student factor. The lag1 autocorrelation of the residuals of the 155 effect sizes was .50 with a standard error of .08, $p < .001$, and Levene's Test for homogeneity of the variance of the residuals also revealed significance at $F(5,149) = 4.88$, $p < .001$.The Kruskal-Wallis Test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(5, N=155) = 33.90$, $p < .001$. The size of mean effect of 'prior achievement' (1.90) is large, and that of 'students' educational aspirations' (.85) is medium (presented in Table 10). The other sub-categories in sequence of their sizes of effect are educational engagement during semester (.37), educational engagement during summer vacation (.24), extracurricular activities and recreation (.22), and behavioral problems in school (.19). The results of the *post hoc* comparisons are shown in Table 10.

The Mean Effect Size of Sub-Categories of the Demographic Factor

The demographic factor was divided into familial, school, and student demographics. The mean and mean ranks of the effect sizes of the various demographic sub-categories are presented in Table 10. Fifty-one effect sizes were computed from the eight sub-categories of familial demographics. A Kruskal-Wallis Test resulted in a significant difference of mean ranks of effect sizes, $\chi^2(7, N=51) = 15.53$, $p < .05$. Ethnicity had the largest effect size of 1.23. Other familial demographic sub-categories such as family income, parents' education, parents' occupation and 'living with parents' reached a medium size of effect with values from .50 to .74. And 'number of siblings' had a small size of effect (.35). In addition, three sub-categories were included in the school demographic and eighteen effect sizes were computed. The Kruskal-Wallis Test resulted in no significance, $\chi^2(2, N=18) = .73$, $p > .05$.

The mean effect size of familial and school demographics is compared in Table 11. The mean effect size of familial demographics (.60) is larger than that of school demographics (.58). Because the lag1 autocorrelation of the residuals revealed significance ($r = .25$, with a standard error of .12, $p < .05$), and the result of Levene's Test for homogeneity of variance was also significant, $F(1,67) = 6.53$, $p < .05$. Therefore the Mann-Whitney U Test was applied. However, the result revealed no significant difference between the familial and the school demographics, $Z(N=69) = -.25$, $p > .05$.

Table 8

Mean and mean rank of effect size of each sub-category of factors relevant to the mathematic ability score

Sub-categories of factors	K	M	SD	Mr
Family				
1 Parents' aspirations	16	1.03	.39	64
2 Father's involvement in children's learning	18	.16	.14	19
3 Mother's involvement in children's learning	18	.26	.12	31
4 Cultural capital	20	.30	.16	35
Kruskal-Wallis ANOVA by ranks	72	$\chi^2(3, N=72) = 41.19, p < .001$		
Mann-Whitney U Test		1 > (3,4) > 2 *		
School				
5 Teacher-student interaction	4	.44	.09	38
6 Safety and order	16	.19	.12	24
7 Teacher's highest degree	3	.06	.08	13
8 Teacher's years of teaching experience	3	.20	.24	27
9 Teacher's teaching involvement	15	.05	.15	14
Kruskal-Wallis ANOVA by ranks	41	χ^2 (4,N=41) = 16.45, $p < .05$		
Mann-Whitney U Test		6 > 7 > 10 *		
Student				
10 Prior achievement	3	1.90	.28	154
11 Students' educational aspirations	12	.85	.39	135
12 Educational engagement during semester	45	.24	.25	76
13 Behavior problems in school	30	.19	.34	65
14 Engagement during summer vacation	7	.37	.25	94
15 Extracurricular activities and recreation	58	.22	.17	69
Kruskal-Wallis ANOVA by ranks	155	$\chi^2(5, N=155) = 33.90, p < .001$		
Mann-Whitney U Test		11 > 12 > (13,14,15,16)*		
Demographics				

Familial demographics				
16 Family income	15	.50	22	23
17 Father's education	4	.64	.37	29
18 Mother's education	4	.74	.33	33
19 Father's occupation	7	.62	.25	27
20 Mother's occupation	7	.57	.33	25
21 Living with parents	6	.53	.16	22
22 Number of siblings	4	.35	.14	12
23 Ethnicity	4	1.23	.19	49
Kruskal-Wallis ANOVA by ranks	51	$\chi^2(7, N=51) = 15.53, p < .05$		
Mann-Whitney U Test		24 > (17, 20, 21, 22,23) *		
School demographics				
24 School type (private/public)	4	.30	.70	8
25 School community	8	.64	.30	10
26 School program	6	.70	.53	10
Kruskal-Wallis ANOVA by ranks	18	$\chi^2(2, N=18) = .73, p > .05$		
Student demographics				
Gender	1	.12		

Note. [a] Significant at least at p<.05.

Table 9

Mean and mean rank of effect sizes of familial and school demographics relevant to the mathematic ability score

The demographic factor	K	M	SD	MR
Familial demographics	51	.60	.31	35
School demographics	18	.58	.48	34
Mann-Whitney U Test	69	$Z(N=69) = -.25, p > .05$		

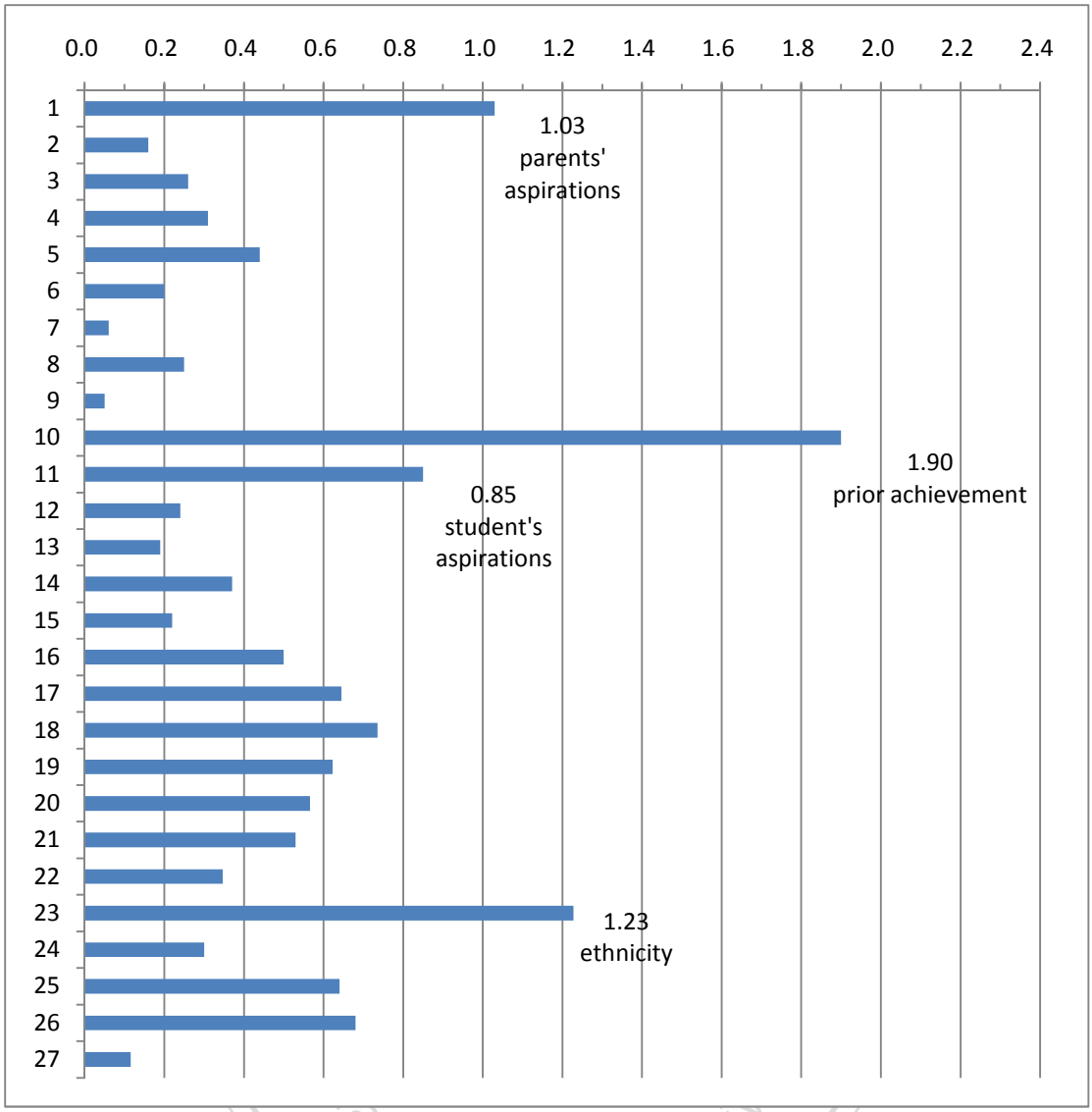

Figure 3 *The effect sizes of sub-categorical factors relevant to the mathematic ability score*

Part Four The Differences between the Effect Sizes Based on Different Ability Scores

Operationally, the present research used the ‘comprehensive ability score’, the ‘general analytic ability score’, and the ‘mathematic ability score’ as the indicator of student academic achievement. Therefore, the effects of the family, school, student, and demographic factor were computed based on the three kinds of ability scores as

the dependent variable, specifically. According to the results in the previous sections, the order of the magnitude of average effect sizes among the factors is similar, no matter which kind of scores was used as the dependent variable. However, the Kruskal-Wallis Test resulted in significance, $\chi^2(2, N=1166) = 15.53$, $p < .001$ (see Table 12), referring to differences between the mean ranks of the effect sizes of the factors based on the three different kinds of ability scores. And the Mann-Whitney U Test showed that the mean rank of effect sizes based on the comprehensive ability score was significantly larger than that based on the general analytic ability score or on the mathematic ability score, between which there was no significant difference.

Table 10

Mean and mean rank of effect sizes of factors based on the three kinds of ability scores

Dependent Variables	K	M	SD	MR
1 Comprehensive ability score	409	.43	.40	631
2 General analytic ability score	409	.32	.31	539
3 Mathematic ability score	348	.37	.38	579
Kruskal-Wallis ANOVA by ranks	$\chi^2(2, N=1166) = 15.53$, $p < .001$			
Mann-Whitney U Test	1 > (2,3) *			

Note. * Significant at least at $p<.05$.

Chapter Five General Discussion

The present study serves to investigate the magnitude of various variables associated with high school student academic achievement. The variables were classified into four factors: family, school, student, and demographics; and three kinds of standard test score served as the dependent variable: the comprehensive ability scores, the general analytic ability score, and the mathematic ability score. The mean effect sizes of the four factors based on the different domains of academic ability scores were compared through statistical methods, and the results indicated that the order of the magnitudes of the mean effects was the same no matter which kind of ability score served as the dependent variable. That is, the students' prior achievement showed the largest effect size; the demographic factor showed the second largest effect size; the family factor and the student factor showed the third largest effect size with no significant difference between each other; and the school factor fell into the smallest size of effect in the whole analysis. The effect sizes of the main factors based on the three kinds of academic ability scores were graphed as Figure1.

Although the order of the magnitude of the main factors was the same, the mean effect sizes of the sub-categories within each factor were different. And they also differed from the results based on other kinds of ability scores. These results reveal meaningful implications both practically and theoretically. This chapter will discuss them in four parts according to the classification of the factors: school, family, student, and demographics.

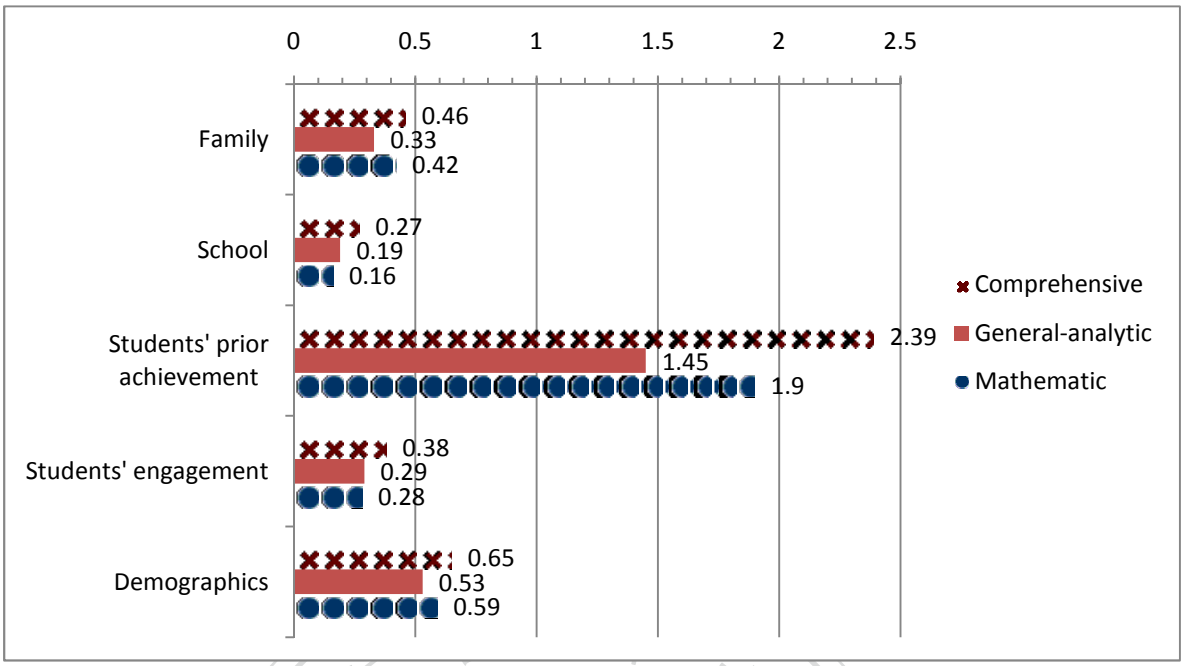

Figure 4 *The effect sizes of the main factors based on the comprehensive ability score, the general-analytic ability score, and the mathematic ability score*

The School Factor

Since Coleman (1966) reported that school resources had little influence on student academic achievement, the question, whether schools make a difference, has been widely discussed over the few decades. One of the intentions of the present research is to answer the question through an overall review of factors relevant to student academic achievement. Similarly, the present research findings implied that school had the least effect on students' learning performance. Instead, it was the demographic factor that counted. However, the present research findings also imply that the school factor still has a certain effect that cannot be ignored.

In the present research, the mean effect sizes of the school factor based on the comprehensive ability score, the general analytic ability score, and the mathematic ability score were .27, .19, and .16, respectively, showing small effects or moderately less than that. These results are similar to some prior research findings. For example,

H. H. Ma (2008) conducted a meta-analysis based on the synthesized results of several studies with data coming from the NELS, and he found that the school factor had an effect size of .29, which was reported to be consistent with other meta-analyses as well. And Wenglinsky (1997) also indicated that part of the school resources resulted in a raise of achievement. As for local research findings, Wu (2005) suggested that though school factors did not hold large effects, they still had significant influence with 5~15% of the variation with regard to the mathematic scores.

However, other research has held the opposite conclusion on school effects. Zigarelli (1996) claimed that 'the greatest influences on a student achievement level are often beyond the control of the teacher or the school' according to his findings that the R square of the school regressor was only .05 in a simple regression analysis. Lin and Wu (2007) also suggested that the real variation attributable to the teaching and resources available in schools may be much lower than 20% because most of the 20% variation was explained by the average socio-economic status in the school district and the educational aspirations that students held.

The inconsistency among these researches may be caused by the problem of the lack of consensus on the question: 'What possibly makes a school effective?' It can be found that different studies often included different aspects of the school factors in their models of analysis. In that case, it is hard to reach a final conclusion as to whether schools make a difference. Since Coleman (1966) was criticized in the case of aspects of his methodology and the measurement of school factors, the problem of what should be included as representative of school effect has long been a great concern. Frankly, the present research has to face the problem, too. When the present

research concludes that the school factor has a small effect, it has to be borne in mind that the effects come from a synthesized result of ‘positive teacher-student interaction’, ‘safety and order of the campus’, ‘teacher’s highest degree’, ‘teacher’s years of teaching experience’, and ‘teacher’s teaching involvement’. In other studies, various other aspects were included, such as school spending, physical facilities, average socio-economic status of students in the school, teacher-student ratio, teachers’ psychological characteristics, administration characteristics, school culture, and various aspects of the school social environment (Coleman, 1966; Zigarelli, 1996; Wenglinsky,1997; Wu, 2005; Lin &Wu, 2007; Ma, 2008).

Since so many related variables had been explored in the past studies, and most of them still concluded that school had little effect on student academic achievement, it seems that the most important task is not to refute the conclusions of the Coleman Report, but to focus on those parts that really make schools effective. In the present research, the mean effect size of ‘positive teacher-student interaction’, ‘safety and order of campus’, and’ teacher’s years of teaching experience’ only reached small effects, while ‘teacher’s highest degree’ and ‘teacher’s teaching involvement’ had almost no effect.

These results are consistent with the past research findings related to the social environment of the campus. Among them, Crosone, Johnson and Elder (2004), and Burchinal, Peisner-Feinberg, Pianta, and Howes (2002) suggested that positive student-teacher relationship was associated with better academic achievement; Griffith (2000), Levine (1992), and Stockard and Mayberry (1992) indicated that a safe and orderly school environment was associated with a higher student academic performance.

As for the characteristics that are related to teacher quality, teacher's educational level is often regarded as the amount of their knowledge which will be used in the teaching process. However, the present results suggest that whether teachers had master's degrees or even above did not make a difference to students' academic performance. On the contrary, their years of teaching experience showed significant effect. Such result concurs with Hsieh's (2007) findings, and also agrees with Aksoy & Link's (2000) conclusion that teacher experience was statistically significant but had only a small positive effect on achievement, although such results disagree with Park's (2005) research, which indicated that teacher's experience had no effect.

Why teacher's experience is more crucial than their highest degree can probably be explained by the system of the cultivation and selection of teachers in Taiwan. In earlier years, teachers must graduate from National Normal Universities, which were set to train up teachers and often attracted individuals with an excellent academic performance. In the recent past decade, qualified teachers must excel in competitive teacher-selecting tests, which test pre-teachers on their academic ability, educational expertise, and also practical teaching skills. Therefore, it can be inferred that the teachers in schools are often of approximately quality at the level of their knowledge, no matter the elder ones or the younger ones. For this reason, whether teachers got master's degrees or above might not make substantial difference in their teaching of their subject. It is also possible that the graduate degrees that teachers have won are not necessarily related to the subjects they taught. This explains why Hill (2003) found that for a teacher to hold a graduate degree 'in the field the student is studying' has a significant effect on students' achievement tests.

On the other hand, the reason why teachers' years of teaching experience had a

comparatively higher effects on student academic achievement may result from the practical exposure to the educational context, which made them more adept in teaching and in ways to help students improve their academic performance than the less-experienced teachers. Far early in Collins's (1971) research, the question 'Are vocational skills learned in schools, or elsewhere?' has been discussed. By presenting several related research results, Collins found that in some professions like engineering and academic research, actual skills are learned in practice rather than in schools. In the present research, the result that teacher's teaching experience is more influential than their educational level exactly suggests that more practice in working places makes people more adept in the profession.

To sum up, although most past research indicates that schools make no difference, the present research found that schools had small effects, especially in school social environment and teacher quality. It is true that the results of the present research are unable to solve the problems of determining the representative variables for school factors, but the present research still has meaningful implications for educators to remind them of the importance of maintaining a safe, ordered, and positive learning environment, and also of advancing themselves to compensate for the disadvantages of being less experienced. At the same time, the results also provide empirical evidence for other researchers who intend to explore the effects of school factors in the future.

The Family Factor

Among studies related to student academic achievement, the influence of family socio-economic status is discussed most often. However, in the present research, the

family SES was classified as the demographic factor. Therefore the findings associated with family SES will be discussed in the later part of the present research. In this chapter, the effects of practices that parents carry out to facilitate their child's learning are discussed. In related studies, these practices are often regarded as family resources, which included family social capital and cultural capital (L. J. Chen, 2005; Li & Yu, 2005; Lin & Huang, 2008). The present research synthesized the above two aspects of family resources to generate the average effect size of the family factor, with the exception that not all concepts of social capital were included. The two sub-categories of the family factor, parents' aspiration for their child's education and parents' involvement in their child's learning, are actually components of 'within-family' social capital only. Therefore in the following discussion, the term 'parents' aspirations' and 'parents' involvement' will be used instead of 'social capital'.

The mean effect sizes of the family factor were .46, .33, and .42, respectively, based on the comprehensive ability score, the general analytic ability score, and the mathematic ability score, showing small effect sizes. In contrast to research on school factors, which leads to unclear conclusions about effective characteristics, most research findings are consistent on the effects of social capital, and showed a slightly diverse perspective with regard to the effect of cultural capital. Lin and Huang (2008) summed up several studies that deal with the same issue and proposed a model to briefly illustrate the relationship of the effect of family resources: People with different family background have their educational achievement, including academic scores and the total years of education, influenced by the family cultural capital, social capital, and financial capital they hold. Chen and Cheng (2000) also found that

the effect of family background on people's total years of education is mediated by four factors: the family social capital, the amount of extra academic courses after school, having to help parents earn a living, and family cultural capital. Therefore it is not surprising to find in the present research that the family factor has an effect on student academic achievement, because the abundant evidence in the past has supported such result.

Specifically, it was found that parents' aspirations had the largest effect size among the sub-categories within the family factor with the values of 1.13, .82, and 1.03, respectively, based on the three domains of academic ability scores. Such results are similar to the past findings that parents' aspirations had positive and crucial effect on students' academic performance (Cherian, 1994; Chou, 2006; Fan, 2001; Lee, 2007; Lin & Wu, 2007; Trivette & Anderson ,1995; Yan & Lin, 2005). Parents' aspiration for their children's education is highly valued both in the field of psychology or sociology. It is because parents are often the ones who have a crucial influence on the process of their children's socialization and the formation of their personalities. Just as Coleman (1988) proposed in his research that 'mother's expectation for child's education' could be an indicator of adult attention in the family, which in turn is part of a family's social capital. It is often the case that what parents expect for their child affects the expectation that the child holds to him or herself, and further makes difference to his or her academic achievement (Bandura, Barbaraneli, Caprara, & Pastorelli, 2001; Buchmann & Dalton, 2002; Chang, Hung, Chang, Chang, & Liu, 1997). Although in the present research, the pure computation of effect size is not able to verify the complex mechanism of how parents' aspirations influence student academic achievement, it is possible that parents with high academic

aspirations for their children foster more educational activities for their children in pursuit of academic success. As a result, parents' aspirations have a great and positive effect on their children's academic performance.

Comparatively, the mean effect size of parental involvement in their children's learning was much lower, though mother's involvement still reached small effects with the value of .27, .19, and .26, respectively, based on the three domains of academic ability scores. In the present research, the effects sizes of the three variables: parents' discussion with children on their education, parents' supervision on the condition of children's learning, and parents' participation in school activities, were synthesized as a mean effect of parents' involvement on academic achievement. According to the past researches, the effects on these aspects of parental involvement are disputable (Astone & McLanahan ,1991; Fehrmann, Keith, & Reimers, 1987; Sui-Chu & Willms, 1996; Trivette & Anderson, 1995) . The present research provides evidence under the whole concept of 'parental involvement'. Its purpose is not to compare the effect of specific variables with the past research. However, the average effect size is still meaningful. It can be inferred that the small or even less effect of parental involvement is probably due to the adolescents' need for autonomy. People at the adolescent stage of life usually desire autonomy, independence, and gradual detachment from their families (as cited in Fan, 2001). Therefore the intuitive connection between more parental involvement and better academic performance may be interrupted by such mental change, so that more involvement only leads to a moderately higher academic performance.

Additionally, it is noteworthy that the statistical significant difference between the effects of father's and mother's involvement was found in the present study when

comprehensive ability scores and mathematic ability scores were dependent variables, respectively. To be clear, the result indicates that mother's involvement had a stronger effect than father's. In the past studies, few researchers examined the difference between father's and mother's involvement, except for Lin & Wu (2007), who found that mother's involvement had a significant influence on student academic achievement while father's didn't. Other studies indicated there were differences between the mother-child relationship and the father-child relationship. Craig (2006) found that compared to fathering, mothering involves not only more overall time commitment but more multi-tasking, more physical labor, a more rigid timetable, more time alone with children, and more overall responsibility for managing care. And the gender differences applied even when women work full-time. It was also found that adolescents more often choose mothers over fathers when they seek advice on how to solve problems (as cited in Youniss & Ketterlinus, 1987). If it is believed that the role of parents as child's 'a mother is obviously more critical than a father in regard to the aspects of children's daily life. Therefore it is also inferable that mother's involvement in children's learning tends to be more effective than father's in the case of children's academic achievement.

As for cultural capital, the result of small sizes of effect with the value of 0.35, 0.28, and 0.31, respectively, based on the comprehensive ability score, general analytic ability score, and the mathematic ability score respectively, prove that cultural capital indeed has a positive effect on student academic performance, just as the past research has found (Chen & Cheng, 2000; Dumais, 2002; Sullivan, 2001; Wong, 1998). However it is noteworthy that among the measurement items of cultural capital in the present research, the item, parents going to classical music

concert or dancing and drama performance with the child, has obviously lower mean effect sizes than the other items. For example, the values are only .07, -.03, and .08, respectively, based on the three kinds of ability score in the w4 data. However, the other measurement items such as ‘parents going to book stores with the child’ and ‘having magazines, journals, foreign newspapers, or encyclopedias at home’ both show nearly medium mean effect sizes; and ‘having Internet access at home’ shows medium mean effect size.

Such result implies that the component of cultural capital in Taiwan may not be totally the same as the ‘formal culture’ Bourdieu proposed. Therefore, to some degree, Lin and Wu’s (2007) findings, which revealed little effect of ‘formal cultural’ and suggested that the component of cultural capital be modified in regard to the social context in Taiwan, are somewhat reasonable. It is also inferable that though Chen and Cheng (2000) indicated that cultural capital, measured as the ‘formal culture’ form, had significant positive effects on students’ obtaining more years of non-obligatory schooling, the result may be different if the dependent variable had been students’ academic test scores. On the contrary, the result of the present research suggests that creating an environment of more exposure to reading, such as having magazines, journals, newspapers, and encyclopedias at home, or taking the child to book stores often, may be indicators of cultural capital in the Taiwan society. In addition, ‘having Internet access at home’ also has a small mean effect. In the modern society, the Internet is also a convenient access of culture. Although it is a source of not only classic or so-called ‘formal’ culture but also a variety of sub-culture of the youths, it is reported to have positive effect on student academic achievement. Further studies are needed to clarify the suitable indicator of cultural capital in the Taiwan society.

The Student Factor

In addition to the factors of school and family, students' characteristics and their engagement in learning are of course intuitively related to their academic achievement. And the results based on the present research suggest that students' prior achievement has an extremely high effect, but that the average effect of students' engagement has only small effect.

Such result is similar to the past findings that students' prior academic achievement is positively related to their future academic performance (Burkam, Lee, and Smerdon, 1997; Engerman and Bailey, 2006; House, Keely, & Hurst, 1996; Ma, 2008; Reynolds and Walberg, 1992) . The high correlation of the prior and subsequent academic achievement implies significant meanings to educators in two ways. First, if the prior achievement is so important for the future performance, the idea of 'no child left behind' needs to be put into practice urgently. Once a child is unable to catch up with the basic content of the knowledge taught, it will be more difficult for him or her to acquire the subsequent and more advanced materials. As a result, a vicious circle will continue until one day he or she gives up learning. However, the critical point to cease the vicious circle can be at any moment as long as the low-achievers are given remedial lessons to make up what they failed to understand in the past. Second, educators should be cautious not to enlarge the disparity in individual difference on academic achievement; instead, more encouragement and care should be paid to lower-achievers. The students who perform well are more likely to be praised or to receive reinforcement from their teachers and parents; thus they are motivated to achieve more. In contrast, those who fail in school work have less opportunity to receive reinforcement or be noticed and tend to lose the motivation to learn. Therefore,

it is often the case that higher-achievers perform better while lower-achievers turn to achieve even less in the future. Educators should always understand that effort can produce change, just as the implication of the theory of the Pygmalion Effect in educational psychology that what the teacher expects for his or her students will be true in the future.

As for the other aspects of the student factor, which were classified as a category named ‘students’ engagement’, the mean effect sizes are 0.38, 0.29, and 0,28, respectively, based on the three kinds of academic ability scores, showing small effects. It is notable that the effect size of students’ engagement has no statistically significant difference from the effect of the family factor. And both factors showed the third largest effects among all the related factors, smaller than students’ prior achievement or the demographic factor. Such result suggests that except for those factors that one has already got or one cannot change, there are still many things a student him or herself can do to make an impact on academic achievement, such as devoting more time to learning during the semester and the summer vacation, reading more, spending less time watching TV and videos, spending less time on Internet chatting rooms, messenger, or online games, avoiding getting into trouble over behavioral problems in school, and participating in extracurricular activities properly. However, among all the sub-categories, the one of ‘students’ aspirations for their own education’ is the only one which reached large effect sizes with the value of .97, .74, and .85, respectively, based on the three kinds of academic ability scores.

These results are similar to prior research, given that Sirin and Rogers-Sirin (2004) found that educational expectations and engagement in school learning had the strongest relation to academic performance for African-American middle-class

adolescents. Local researchers such as Lin and Wu (2007) also support the finding that students' aspirations in regard to their highest academic degrees had a significant effect on academic achievement. In addition, Carbonaro (2005) and Park (2005) demonstrated that students' efforts and engagement had positive effects on student academic performance. The results of other detailed variables examined in prior studies also support the results of the present research (Aksoy and Link's study, 2000; Chen, Kuo, and Lee, 2007; Dumais, 2009) that spending more time studying, doing homework, and less time watching TV has a positive effect on academic achievement. However, these variables only showed small sizes of effect.

Although few researchers would doubt the claim that high aspirations are an important predictor of eventual educational achievement and attainment, educational aspiration is a problematic topic, just as Kao and Thompson (2003) indicated after they reviewed related studies. They demonstrated that the uniformly high aspiration of completing college was reported by the United States youth in most surveys, and that it was unclear whether these students had thought seriously or had simply reported lofty goals. It is true that, with the education reform in the past decade in Taiwan, more and more opportunities have been provided for students who want to attend college, and this might explain why more than three-fourths (3/4) of students reported that they expected themselves to complete college or even higher degrees. However, through the computation of effect size, the present research demonstrates that the disparity in the reporting of a desire to graduate with high schools, colleges, or master's and doctoral diplomas indeed correlates to different outcomes of students' academic performance, implying that the degree of their aspirations functions in some reasonable way.

In addition, it is also inferable that students' aspirations show their general degree of awareness whether they are capable academically, especially in Taiwan where the results of entrance exams are always set as the standard for whether schools admit students or not. Numerous studies have shown that students with a high sense of academic efficacy display greater persistence, effort, and intrinsic interest in their academic learning and performance (Zimmerman, Bandura, & Martinez-Pons, 1992). If this is the case, then it is reasonable that students who hold higher aspirations performed better academically.

To sum up, it is concluded that students' higher prior achievement, expectation for higher diploma, more engagement during the semester and summer vacation, and less time spent on recreation like watching TV and using the computer are associated with better academic performance.

The Demographic Factor

In the present research, demographic variables were viewed as 'ascribed' characteristics, which are hard for an individual to change by his or her own effort, in distinction from other 'achieved' characteristics. The practice is due to the findings that demographic factors often have a critical influence on student academic achievement, and also the intention to compare the effects of factors between those which cannot be change and those one could strive to achieve. The result of the present research revealed the effects of demographic factors with values reaching medium to large effects, except for the three variables: 'the number of siblings' and 'school type (private/public)' with only a small effect, and 'gender' with no

significant effect. In addition, the demographics showed the second largest effect size among the related factors, being inferior only to students' prior achievement. Such results demonstrate the strong influence of the demographic factor.

- **Familial Demographics**

Just as Coleman (1966) claimed: 'Socioeconomic factors bear a strong relation to academic achievement' , and the effect of family SES has been confirmed by many prior studies (Chen & Cheng, 2000; Hofferth, Brisjoly, & Ducan, 1998; Li & Yu, 2005; Lin & Huang, 2008; Lin & Wu, 2007; Marks, 2008a; Roscigno & Ainsworth-Darnell, 1999; Tzeng, 2006; Wu, 2005). The present research is no exception, suggesting a medium to large effect of family income, parents' education, and parents' occupation. And among them, parents' education showed the largest effects; the second largest is parents' occupation; and the smallest is 'family income'. Education, occupation, and income are often correlated, given that Hofferth, Boisjoly, and Duncan (1998) indicated in their reviewing of the related literature that better-educated youths make more money and have more stable employment. Since education is often a predictor of occupation and income, and it also shows the largest effect on the achievement of the offspring, it must stand for something very important. Indeed, Coleman (1988) proposed that parents' education is an important indicator of assessing human capital, which is embodied in the skills and knowledge and is part of the family resources to facilitate a child's learning. He also indicated that when parents receive a higher education, they are more likely to create a proper learning environment for their children, to stimulate their cognitive development, and to promote their further educational attainment. Li (2007) also verified that parents' education not only influences family income, but also affects children's educational achievement

indirectly through social capital. Therefore it is not surprise that parents' education has a strong effect on a child's academic achievement.

In addition to the family SES, the present research revealed that living with parents and the numbers of siblings had small to medium effects among the familial demographic variables. This result suggests that co-habitation of a child with both parents has positive effects on student academic achievement, compared with the situation of those who live with only one or none of their parents. This result is consistent with the prior research (Amato, Keith, 1991; Kuan & Yang, 2007; Shaff, Wolfinger, Kowaleski-Jones, and Smith, 2008; Wu, 2005). Generally, it is clear that intact families provide the best environment for children's educational achievement while children in step-families suffer a disadvantage (Kuan & Yang, 2007). Astone and McLanhan (1991) found that children who live with single parents or step-parents during adolescence receive less encouragement and less help with school work than children who live with both natural parents. Wu's (2005) research also demonstrated that the more intact families hold more social capital, cultural capital, and financial capital. That is to say the deficiency of either or both parents means fewer family resources, and that in turn leads to disadvantage for children's academic achievement.

On the other hand, fewer siblings also showed positive effects, similar to the findings of some researchers (Li and Yu, 2005; X. Ma, 2005). There are several theoretical models explaining the inverse relationship between the number of siblings and the academic achievement. In Taiwan, related studies verified that more siblings would dilute household education resources and play a mediating role between household education resources and educational achievement (Li and Yu, 2005; Wu, 2005). However, other theories like the 'confluence model' (Zajonc, 1983) indicated

that children with more siblings tend to interact more with those immature siblings in the family environment than with mature adults. And the situation is disadvantageous to the development of their intelligence development, and further affects their academic achievement. It is also hypothesized that those parents who have more children are often of a lower SES and lower academic achievement, which are also disadvantageous to children's achievement. Further research is needed to interpret the situation more finely.

The last but not the least important part of the familial demographic factor is the effect of ethnicity which showed a large size of effect in the present research, suggesting that the performance of aboriginals was far behind the other students. The result is similar to that in the prior studies (Lin and Wu, 2007; Sun & Huang, 1996; Wu, 2005). In U.S. society, the racial achievement gap between whites, blacks, Hispanics, and other groups has long been a matter of great concern in educational research. Although population in Taiwan is less complex, including only aboriginals and people from the region of the present China, the aboriginals are obviously ethnic minorities compared to Minnan, Hakka, and mainlanders and are disadvantaged in academic achievement, just as Wu (2005) found that the aboriginal students performed much worse than non-aboriginals. Wu further attributed the situation to the lower family financial capital, social capital, cultural capital, and the disadvantageous family background of aboriginals. Educators should be aware that aboriginal students and parents may share different culture and values from the non-aboriginals who established the modern society and also the education system. Therefore more concern and flexibility should be paid to the minority groups to help them adjust well to academic learning.

- **School Demographics**

Among the school demographics, school community (city/town/country) and school program showed a medium effect size, and school type (public/private) showed a medium effect, compared to the group that studied in rural schools, enrolled in five-year junior colleges, or attended private schools.

Through the calculation of effect sizes, it was found that students who attended schools in cities and towns performed better academically than those who studied in country schools. The result is similar to Lin and Wu's (2007). On the other hand, it is notable that the effect of attending public or private schools is inconsistent between junior years (7 -9th grade) and senior years (10-12th grade). The findings of the present research show that at junior high school level, students' academic achievement in private schools was better than that in private ones, however at senior high school level, the inverse result was found. Consequently, the mean effect size was still positive when 'private' was treated as the reference category; and it reached a small size of effect, which means that attending public schools has a positive impact on student academic achievement through the whole process of the high school years. This result is consistent with Lin's (2002) findings that attending public schools has a positive influence on educational attainment. Moreover, Lin demonstrated that attending public senior high schools has superior effects to attending public senior vocational schools in Taiwan. The results suggested that not only school type, whether public or private, but also school program play an important role in students' academic achievement. Indeed, the present research shows that students who went to normal senior high school performed superior to those in comprehensive programs, vocational programs, and five-year senior colleges.

Compared to the United States, where students' achievement in private schools is higher than that of students in public schools (Brunsma & Rockquemore, 1998), the effect of school type in Taiwan is totally inverse. In Taiwan, public schools at senior high school level (10-12th grade) often have a better reputation and are considered to be of higher quality. Therefore, students who get higher scores in the nationally-held entrance exams often choose to enroll in public schools. In addition, senior high schools which aim to prepare students for further academic study are often the first priority on the students' and parents' selection lists. As a result, it is possible that students in public schools and academic programs differ from those in private schools and vocational programs substantially in their academic ability.

- **Familial Demographics vs. School Demographics**

The above discussion has highlighted the significant effects of both familial and school demographics on student academic achievement. Further, these deserves to be examined as to whether familial demographics have a different effect from school demographics because it is believed, to certain degree, that the school one attends is still determined by one's efforts, especially in Taiwan where one's score on entrance exams is the main criterion whereby students are selected to go to senior high schools and colleges. And the result demonstrated that there is no statistically significant difference of effect sizes between familial and school demographics. In considering such result in an optimistic light, it is good news that both of factors have an equal medium effect on academic achievement. One who strives to go to a quality school can make up the effect of a disadvantageous family background.

- **Student Demographics--Gender**

The average effect sizes of gender suggest small or even lower effects on student

academic achievement with the value of .10, .20, and .12, respectively, based on the comprehensive ability score, general analytic ability score, and the mathematic ability score. The result agrees with Lin and Wu's (2007) research, which adopted data from the wave1 investigation of TEPS and also suggested that boys outperformed girls in the comprehensive ability score. In addition, boys slightly surpassed girls in mathematic ability at 12^{th} grade can be explained by prior findings. Downey and Yuan (2005) summed up the finding of several studies and highlighted boys' modest advantage on standardized mathematics tests; they also indicated that gender differences in mathematics test scores are typically small or nonexistent during elementary and middle school but increase during the high school years. As for general analytic ability in which boys outperformed girls with the effect of .20, it is noted that the general analytic ability scores were gauged from the results of the non-curriculum-based analytical ability sub-test, testing students on their ability of analyzing, applying, and creativity (Yang, Tam, & Huang, 2003) . Since it is not a universal academic subject, and examples of the test items are not available now, the results based on it will not be comparable to those of other studies. However, the limited result based on general analytic ability score is still valuable information for further studies.

Other Important Findings

Although the results based on the three dependent variables are similar when comparing the magnitude of the effect sizes of the family, school, student, and demographic factor, it is noted that the total effects of all the relevant variables revealed significant differences on the three kinds of academic ability scores. Such

result has theoretical implications: (1) the degree that various characteristics are relevant to different domains of academic achievement may be different, and (2) multiple dimensions are needed to define student academic achievement.

Among the mean effect sizes of the main factors and the sub-categories, it is found that the effect sizes based on the comprehensive ability score always revealed the largest effect while those based on the general analytic ability score were the lowest, with the exception that some sub-categories based on the mathematic ability scores showed the lowest effects: teacher's highest degree, teacher's years of teaching experience, student's engagement during the semester, and behavioral problems at school. In addition, it is especially notable that the mean effect size of positive teacher-student interaction based on the mathematic ability score showed the largest effect sizes among the three kinds of scores.

The situation that the various characteristics revealed different degrees of correlation with different domains of academic achievement is also found by observing Li and Yu's (2005) report of the correlation values between various variables adopted in their research. Li and Yu obtained data from the 2001 TEPS to verify a structural equation model including SES, sibling, household education resources and educational achievement. It was found in the table of correlation matrix that the correlations between the general analytic ability score and the various relevant variables were the weakest, though still reaching a significant level, compared to the relationship between the variables and the other ability scores.

The comprehensive ability score is not a universal academic subject, and examples of the test items are not available, but the Psychometric Report for the Ability Tests of TEPS 2001(Yang, Tam, & Huang, 2003) has indicated that the general

analytic ability scores were gauged from the results of the non-curriculum-based analytical ability sub-test, which tested students on their ability in analyzing, applying, and creativity. Therefore it is inferable that this score may be quite different from that of typical subject-matter standard tests. In the present research, it has been found that the variables that have been reported to have an impact on student academic achievement in prior studies indeed affect students' general analytic ability scores. However, other critical factors might exist. Since the ability of thinking, analyzing, applying, and creativity is emphasized in the modern society instead of merely memorization and the acquisition of mechanical skills, further studies are necessary to discover the critical factors for promoting these highly valued abilities.

At the same time, the results of the present research also imply that academic achievement should be discussed in multiple dimensions. Take gender differences for example, boys surpassed girls in the general analytic ability score in a significant small effect while boys' and girls' performance shows little difference in other kinds of ability scores. The Psychometric Report for the Ability Tests of TEPS 2001(Yang, Tam, & Huang, 2003) reported that among the four kinds of ability scores in the 2001 TEPS, the correlation between either two of the ability scores often reached a value of more than .08, with the only exception being for the correlation between the mathematic ability score and the general analytic ability score, which showed around .07. Although there are high correlations between different ability scores, the empirical results do reveal that the effects of various variables are different on the different domains of academic achievement. Therefore we need to be cautious when determining the indicator of student academic achievement; and the impact of various factors relevant to it should be discussed in relation to different dimensions in case we

miss information as to critical distinctions among them.

Chapter Six　Conclusion and Suggestion

After the general discussion, the present chapter makes conclusions according to the above research findings and also gives suggestions for educational practice and further studies.

Conclusion

There were significant differences in this study among the family, school, student, and demographic factor. The four factors all revealed positive effects, and among them students' prior achievement showed the largest effect size. The demographic factor held the second largest effects, larger than the effects of the family factor and student's engagement, which revealed no significant difference. The school factor generated the smallest effects among all.

Students' prior achievement was the most prominent factor in the present research, and had an extremely large effect size with a value of 2.39, 1.45, and 1.90, respectively, based on the comprehensive ability score, the general analytic ability score, and the mathematic ability score.

At the same time, Colemen's claim that socio-economic factors bear a strong relation to student academic achievement is enhanced by the present research given that parents' education had a large effect, and that both parents' occupation and family income reached medium effect size. In addition, ethnicity had a large effect size, and both co-habitation with parents and numbers of siblings received small to medium sizes of effect. However, the school factor still accounted for a small effect, rather than no effect, on student academic achievement. Specifically, positive

teacher-student interaction, safety and order of campus, and teacher's years of teaching experience all reached small effects. However, teacher's highest degree had no significant influence, and teacher's involvement in teaching had small effect only on the comprehensive ability score. It is also noted that school demographics such as school type (public/private) and school program showed a medium effect, and that school community (city/town/country) also showed a small effect.

In addition to the highlight of the impact of family background, family resources like social capital, cultural capital, and financial capital were found to have small effects on student academic performance with the exception that the most prominent variable, parents' aspirations for their child's education, showed large effects. Comparable with the family resources, which are efforts parents made to enhance children's achievement, students' engagement in learning, which showed a small effect, also accounts for their own achievement. Students' educational engagement during the semester and the summer vacation, students' behavioral problems in school, and extracurricular activities and recreation all showed small effects. The most remarkable finding is that student's aspiration for his or her own education had a large effect size. The result that both parents' aspirations on their children and children's own aspirations for further education showed significant large effect is similar to the prior empirical studies.

Suggestions

The computation of the effect sizes allows the researcher to include a variety of variables relevant to student academic achievement and to generate the average effect sizes of certain factors, which further enable the present study to compare in effects and to gather practical implications for educators. This chapter serves to bring out a few suggestions according to the results of the present research.

First of all, remedial lessons should be provided for the lower-achievers to fulfill the ideas of 'no child left behind'. Since prior achievement has an extremely large effect on students' subsequent achievement, educators should take any of students' learning seriously because previous parts of knowledge and skills are the foundation for more advanced learning. In addition, if a student falls behind at the beginning and is always frustrated by the experience of failure, he or she is less likely to produce high aspirations for his or her future education, which is also reported to be one of the important variables with a large effect on student academic achievement.

Second, educators should maintain a social environment which is helpful for student academic achievement, such as positive teacher-student interaction and a safe and orderly campus. Although the present research suggests that the school factor only accounts for a small effect, the researcher believes that there are still many things that educators can do to facilitate students' learning. The impact of significant others is emphasized in educational psychology, and the teacher is exactly a person by whom students were greatly influenced. Teachers' attitudes toward their students are especially important given that the teacher-student positive interaction has small effect, with the comparatively prominent value of the mean effect size of students' reporting of their perception of positive interactions with their math teachers. On the

other hand, less-experienced teachers should consult often with more-experienced teachers as they are reported to have more effect on student academic achievement.

Third, educators should be aware of the disadvantageous situation of students coming from families with a lower SES, more siblings, or deficiency of parents. The above familial demographics are reported to have medium effects on student academic achievement. That teachers are aware of these facts should not lead them to label these students as incurable failures. Instead, teachers should view such background as part of students' characteristics and to help them in appropriate ways, for example, to help the students' parents (or single parent) to enhance the family resources. And this suggestion brings us to the fourth suggestion.

Fourth, parents should enhance family resources by holding high aspirations for children's future education and being involved more in students' learning, and also by increasing family cultural capital and financial capital. Practical actions are to check children's homework and test results, to talk with children about their future education and employment, to visit bookstores and various exhibitions with their children often, to equip their children with facilities like books, newspapers, encyclopedias and internet access at home, and to provide children with extra academic lessons after school. Undoubtedly, parents are the most important persons relevant to students' achievement. According to the relevant studies, parents' aspirations for their children's education may decide the degree of their involvement and also affect the formation of their children's own aspirations. The large effect of parents' aspirations revealed in the present research further enhances the importance of parents' positive attitudes.

Fifth, students should be encouraged to keep a balance between their studies and

the extracurricular activities. Though the present research suggests that spending more time in studies has a nearly medium effect, it is also found that participating in extracurricular activities properly and developing beneficial habits like reading are also helpful. In addition, parents should keep eyes on children's habits and prevent them from spending too much time watching TV or using computers. This is especially important in an age in which students are exposed too much to multimedia and convenient access to the Internet.

Finally, the government should make policies to balance the disparity between the academic outcomes of city and country schools, and between public and private schools. The prominent distinction in the average academic outcomes among schools is often the cause of stress on achieving excellence in the entrance exams. The overall promotion of students' achievement is needed in reflection of the idea of 'no child left behind' so as to bring up healthy and intelligent youth for the country.

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Appendix A

Results of mean effect size of each dependent variable

Main Category [a]	Variables	Sub-category [b]	Mean of comprehensive ability score	Mean of general analytic ability score	Mean of Mathematic ability score
1	w1: Parents' aspirations for the child	1	0.93	0.72	0.83
1	w2: Parents' aspirations for the child	1	1.00	0.79	0.90
1	w3: Mother's aspirations for the child	1	1.30	0.96	1.24
1	w3: Father's aspirations for the child	1	1.30	0.82	1.17
Mean			1.13	0.82	1.03
1	**w1**: Father talks with the child about advanced schooling and obtaining employment in the future.	2	0.09	0.05	0.09
1	**w1**: Father checks the child's homework or test scores.	2	0.16	0.12	0.13
1	**w1**: Father takes part in school activities, or serves as a parent committee member or volunteer	2	0.05	0.04	0.05
1	**w3**: Father talks with the child about advanced schooling and obtaining employment in the future.	2	0.25	0.17	0.24
1	**w3**: Father checks the child's homework or test scores.	2	0.34	0.24	0.34
1	**w3**: Father takes part in school activities, or serves as a parent committee member or volunteer.	2	0.22	0.09	0.10
Mean			0.18	0.12	0.16
1	**w1**: Mother talks with the child about advanced schooling and obtaining employment in the future.	3	0.21	0.15	0.20
1	**w1**: Mother checks the child's homework or test scores.	3	0.43	0.34	0.42
1	**w1**: Mother takes part in school activities, or serves as a parent committee member or volunteer.	3	0.13	0.13	0.12
1	**w3**: Mother talks with the child about advanced schooling and obtaining employment in the future.	3	0.27	0.13	0.27
1	**w3**: Mother checks the child's homework or test scores.	3	0.35	0.19	0.36
1	**w3**: Mother takes part in school activities, or serves as a parent committee member or volunteer.	3	0.23	0.19	0.21
Mean			0.27	0.19	0.26
1	**w3**: Parents went to bookstores or exhibitions with the child when he/she was at grade 7-9.	4	0.42	0.36	0.37
1	**w4**: Parents went to bookstores or exhibitions with the child.	4	0.38	0.31	0.16
1	**w3**: Parents went to classical music concerts, or watch dancing and drama performances with the	4	0.17	0.08	0.33

	child when he/she was at grade 7-9.				
1	**w4**: Parents went to classical music concerts, or watch dancing and drama performances with the child when he/she was at grade 7-9.	4	0.07	-0.03	0.08
1	**w1**: Having Chinese magazines, journals; foreign language newspapers, magazines, journals; or encyclopedias at home.	4	0.47	0.43	0.41
1	**w3**: Having Chinese magazines, journals; foreign language newspapers, magazines, journals; or encyclopedias at home.	4	0.42	0.36	0.38
1	**w1**: Having internet-access at home.	4	0.52	0.46	0.46
1	**w3**: Having internet-access at home.	4	0.48	0.40	0.43
Mean			0.35	0.28	0.31
2	**w1**: The number of the child's teachers who use various different ways to help the child understand the content of the learning.	5	0.22	0.16	
2	**w2**: The number of the child's teachers who can explain the content of the learning clearly.	5	0.39	0.27	
2	**w2**: The number of the child's teachers who interact well with the child's class.	5	0.27	0.20	
2	**w4**: The number of the child's teachers who can explain the content of the learning clearly.	5	0.44	0.19	
2	**w4**: The number of the child's teachers who interact well with the child's class.	5	0.42	0.29	
2	**w2**: The child's math teacher can explain the content of the learning clearly.	5			0.45
2	**w2**: The child's math teacher interacts well with the child's class.	5			0.32
2	**w4**: The child's math teacher can explain the content of the learning clearly.	5			0.49
2	**w4**: The child's math teacher interacts well with the child's class.	5			0.51
Mean			0.32	0.21	0.44
2	**w1**: The child feels that his or her school is not safe.	6	0.27	0.18	0.22
2	**w1**: The child have had something stolen, been robbed, threatened, subject to extortion, sexually-harassed, raped, or provided with illegal drugs since the semester started.	6	0.30	0.21	0.26
2	**w1**: The child feels that the rewards and punishments, and the grading are not fair in the school.	6	0.17	0.16	0.12
2	**w3**: The child have had something stolen, been robbed, threatened, subject to extortion, sexually-harassed, raped, or provided with illegal	6	0.34	0.25	0.30

	drugs since the semester started.				
2	**w3**: The child feels that the rewards and punishments are not fair in the school.	6	0.27	0.23	0.21
2	**w3**: The child feels that the grading is not fair in the school.	6	0.15	0.09	0.11
Mean			0.25	0.19	0.20
2	**w1**: The Chinese teacher's highest degree	7	0.14	0.10	
2	**w3**: The Chinese teacher's highest degree	7	0.16	0.15	
2	**w4**: The Chinese teacher's highest degree	7	0.14	0.10	
2	**w1**: The math teacher's highest degree	7	-0.03	-0.00	-0.04
2	**w3**: The math teacher's highest degree	7	0.11	0.11	0.08
2	**w4**: The math teacher's highest degree	7	0.11	0.14	0.13
2	**w1**: The English teacher's highest degree	7	0.05	0.08	
2	**w3**: The English teacher's highest degree	7	0.21	0.19	
2	**w4**: The English teacher's highest degree	7	0.16	0.16	
Mean			0.12	0.11	0.06
2	**w1**: The Chinese teacher's years of teaching experience	8	-0.01	0.03	
2	**w3**: The Chinese teacher's years of teaching experience	8	0.45	0.38	
2	**w4**: The Chinese teacher's years of teaching experience	8	0.54	0.49	
2	**w1**: The math teacher's years of teaching experience	8	-0.03	-0.01	-0.03
2	**w3**: The math teacher's years of teaching experience	8	0.47	0.45	0.39
2	**w4**: The math teacher's years of teaching experience	8	0.48	0.44	0.40
2	**w1**: The English teacher's years of teaching experience	8	0.20	0.20	
2	**w3**: The English teacher's years of teaching experience	8	0.40	0.35	
2	**w4**: The English teacher's years of teaching experience	8	0.44	0.35	
Mean			0.33	0.30	0.25
2	**w1**: The hours the Chinese teacher spent on preparing lessons every week	9	0.16	0.14	
2	**w3**: The hours the Chinese teacher spent on preparing lessons every week	9	0.33	0.32	
2	**w4**: The hours the Chinese teacher spent on preparing lessons every week	9	0.25	0.04	
2	**w1**: The hours the math teacher spent on preparing lessons every week	9	-0.07	-0.05	-0.02

2	**w3**: The hours the math teacher spent on preparing lessons every week	9	0.19	0.13	0.15
2	**w4**: The hours the math teacher spent on preparing lessons every week	9	0.03	-0.05	0.02
2	**w1**: The hours the English teacher spent on preparing lessons every week	9	0.30	-0.12	
2	**w3**: The hours the English teacher spent on preparing lessons every week	9	0.70	0.68	
2	**w4**: The hours the English teacher spent on preparing lessons every week	9	0.40	0.37	
Mean			0.25	0.16	0.05
3	**w1-w4** correlation of the test scores	10	1.98	1.28	1.60
3	**w2-w4** correlation of the test scores	10	2.42	1.41	1.94
3	**w3-w4** correlation of the test scores	10	2.77	1.68	2.15
Mean			2.39	1.45	1.90
4	**w1**: The degree the child expects him or herself to accomplish	11	0.87	0.68	0.84
4	**w2**: The degree the child expects him or herself to accomplish	11	1.14	0.91	0.97
4	**w3**: The degree the child expects him or herself to accomplish	11	0.89	0.64	0.75
Mean			0.97	0.74	0.85
4	**w1**: The hours the child spent on taking in-school or out-of-school academic courses after school.	12	0.15	0.10	0.14
4	**w1**: The average number of hours the child spent every day on homework, studies, and preparing for tests except for the time taking courses in and out of school.	12	0.19	0.13	0.17
4	**w2**: The hours the child spent every week on taking in-school extra academic courses.	12	0.41	0.36	0.40
4	**w2**: The hours the child spent every week on taking out-of-school academic courses after school.	12	0.17	0.11	0.17
4	**w2**: The average number of hours the child spent every day on homework, studies, and preparing for tests except for the time taking courses in and out of school.	12	0.32	0.17	0.30
4	**w3**: The hours the child spent every week on taking in-school extra academic courses.	12	0.41	0.38	0.05
4	**w3**: The hours the child spent every week on taking out-of-school academic courses after school.	12	0.74	0.53	0.13
4	**w3**: The average number of hours the child spent every day on homework, studies, and preparing for tests except for the time taking courses in and out of school.	12	0.49	0.36	0.46

4	**w4**: The hours the child spent every week on taking in-school extra academic courses.	12	0.53	0.40	0.48
4	**w4**: The hours the child spent every week on taking out-of-school academic courses after school.	12	0.70	0.52	0.06
Mean			0.41	0.31	0.24
4	**w1**: The child ever cut classes or avoided going to school since the semester started.	13	0.59	0.54	0.65
4	**w1**: The child ever fought in school or had a conflict with the teacher since the semester started.	13	0.66	0.30	0.08
4	**w2**: The child ever cut classes or avoided going to school since the semester started.	13	0.12	-0.02	0.05
4	**w2**: The child ever fought or created a disturbance in school since the semester started.	13	-0.03	-0.13	-0.09
4	**w3**: The child ever avoided going to school since the semester started.	13	0.38	0.20	0.40
4	**w3**: The child ever cut classes since the semester started.	13	0.26	0.27	0.24
4	**w3**: The child ever fought in school or had a conflict with the teacher since the semester started.	13	0.13	0.10	0.06
4	**w4**: The child ever avoided going to school since the semester started.	13	0.30	0.43	0.26
4	**w4**: The child ever cut classes since the semester started.	13	0.15	0.15	0.21
4	**w4**: The child ever fought in school or had a conflict with the teacher since the semester started.	13	0.12	0.25	0.09
Mean			0.27	0.21	0.19
4	**w1**: The child attended in-school or out-of-school academic courses during the summer vacation before 7th grade.	14	0.11	0.07	0.04
4	**w2**: The child attended in-school academic courses during the summer vacation before 9th grade.	14	0.37	0.34	0.33
4	**w2**: The child attended out-of-school academic courses during the summer vacation before 9th grade.	14	0.28	0.21	0.27
4	**w3**: The child attended in-school academic courses during the summer vacation before 10th grade.	14	0.17	0.15	0.15
4	**w3**: The child attended out-of-school academic courses during the summer vacation before 10th grade.	14	0.78	0.60	0.74
4	**w4**: The child attended in-school academic courses during the summer vacation before 12th grade.	14	0.48	0.38	0.43
4	**w4**: The child attended out-of-school academic courses during the summer vacation before 12th grade.	14	0.66	0.49	0.63
Mean			0.41	0.32	0.37

4	**w1**: The hours the child spent every week on activities in school clubs.	15	0.15	0.15	0.11
4	**w1**: The hours the child spent every day on sport, listening to music, watching TV or videos.	15	0.27	0.21	0.25
4	**w1**: The hours the child spent every week on outside reading.	15	0.30	0.27	0.27
4	**w1**: The hours the child spent every day on using the computer or surfing the internet.	15	0.25	0.23	0.23
4	**w2**: The hours the child spent every week on internet chatting rooms, BBS, using e-mail, or using ICQ, MSN, or SKYPE etc.	15	0.25	0.21	0.18
4	**w2**: The hours the child spent every week on playing on-line games.	15	0.29	0.21	0.22
4	**w3**: The hours the child spent every week on activities in school clubs or school teams.	15	0.28	0.27	0.23
4	**w3**: The hours the child spent every day on sport, listening to music, watching TV or videos.	15	0.53	0.46	0.44
4	**w3**: The hours the child spent every week on internet chatting rooms, BBS, using e-mail, or using ICQ, MSN, or SKYPE etc.	15	0.11	-0.03	0.02
4	**w3**: The hours the child spent every week on playing on-line games.	15	0.28	0.27	0.23
4	**w4**: The hours the child spent every week on internet chatting rooms, BBS, using e-mail, or using MSN, Yahoo Messenger, or SKYPE.	15	0.25	0.10	0.22
4	**w4**: The hours the child spent every week on playing on-line games.	15	0.39	0.29	0.31
Mean			0.28	0.22	0.22
5	**w1**: Monthly family income	16	0.55	0.47	0.49
5	**w2**: Monthly family income	16	0.56	0.46	0.52
5	**w3**: Monthly family income	16	0.55	0.51	0.49
Mean			0.55	0.48	0.50
5	**w1**: Father's education	17	0.91	0.63	0.64
5	**w1**: Mother's education	18	0.83	0.83	0.74
5	**w3**: Father's occupation	19	0.67	0.58	0.62
5	**w3**: Mother's occupation	20	0.63	0.59	0.57
5	**w1**: Cohabitation with parents	21	0.59	0.39	0.58
5	**w3**: Cohabitation with parents	21	0.41	0.28	0.48
Mean			0.50	0.33	0.53
5	**w1**: Number of siblings	22	0.41	0.27	0.35
5	**w1**: Ethnicity	23	1.27	1.02	1.23
5	**w1**: School type	24	-0.32	-0.20	-0.31
5	**w2**: School type	24	-0.33	-0.24	-0.31

5	**w3**: School type	24	1.02	0.83	0.91
5	**w4**: School type	24	1.02	0.84	0.91
Mean			0.35	0.31	0.30
5	**w1**: School community	25	0.42	0.35	0.39
5	**w2**: School community	25	0.41	0.34	0.39
5	**w3**: School community	25	0.93	0.74	0.89
5	**w3**: School community	25	0.93	0.74	0.89
Mean			0.67	0.54	0.64
5	**w3**: School program	26	0.71	0.47	0.68
5	**w4**: School program	26	0.71	0.47	0.68
Mean			0.71	0.47	0.68
5	**w1**: Gender	27	0.10	0.20	0.12

Note: a. Main categories 1: Family factors; 2: School factors; 3: Prior achievement; 4: Student factors; 5: Demographic factors.

b. Sub-categories 1: Parents' aspirations for their child's education; 2: Father's involvement in child's learning; 3: Mother's involvement in child's learning; 4: Cultural capital; 5: Positive teacher-student interaction; 6: Safety and order; 7: Teacher's highest degree; 8: Teacher's years of teaching experience; 9: Teacher's teaching involvement; 10: Prior achievement; 11: Student's educational aspirations; 12:Student's educational engagement during semester; 13: Less behavioral problems in school; 14: Educational engagement during summer vacation; 15: Extracurricular activities and recreation; 16: Family income; 17: Father's education; 18: Mother's education; 19: Father's occupation; 20: Mother's occupation; 21: Living with parents; 22: Number of siblings; 23: Ethnicity; 24: School type; 25: School community; 26: School program; 27: Gender.