

GENDER INEQUITIES AMONG THE TOP SCORING NATIONS, SINGAPORE, REPUBLIC OF KOREA, AND CHINESE TAIPEI, IN MATHEMATICS ACHIEVEMENT FROM THE TIMSS-R STUDY

Sharon O'Connor-Petruso, S.U.N.Y College at Old Westbury, USA
Kathleen Miranda, S.U.N.Y College at Old Westbury, USA

Abstract

This study sought to identify the array of motivational and environmental predictor variables that produce high mathematics achievement for males and females among the top three scoring countries from the TIMSS-R Study (1999). This study extracted data from approximately 17,000 eighth-grade students from Singapore, Republic of Korea, and Chinese Taipei and compared various parental, pedagogical, and environmental influences. The results disclosed that the strongest predictor for achievement for both males and females was mathematics self-concept. The predictor attitude in mathematics was significant in all three Asian countries excluding females in Singapore. In addition, both males and females paralleled each other on educational resources and were strongly influenced by societal and familial mores but their study time differed. Outside study time was insignificant for males and females in Singapore. Parental nurturing and pedagogical factors were also key influences to high mathematics achievement. Although both genders evinced negligible differences on achievement tests, averred high self-concept in mathematics, had availability of educational resources and aids, only males within all three countries were currently enrolled or planning to complete more courses in high-level mathematics. Similarly, parental expectations for their progeny's future careers mirrored gender typing. Male students were encouraged to pursue technical careers in the hard sciences while female students were directed towards fields in literature. These findings support the need to recognize that gender disparities in student achievement in mathematics exist and are most likely a result of various social and environmental factors.

INTRODUCTION

A critical concern that continues to plague international researchers and educators is the steadfast gender gap in mathematical achievement at the secondary level that

continues to transcend time and culture. Although diversified theories and frameworks have existed for over thirty years (Benbow & Stanley, 1980; Campbell, 1994; Eccles, 1983; Feingold, 1992; Hedges & Nowell, 1995; Kerr, 2000; Lubinski & Benbow, 1992; Plomin, 1997; Stanley, Keating, & Fox, 1974), researchers continue to seek the configuration of predictor variables that influence high mathematics achievement and explore these influences in order to help eliminate gender inequity.

To date researchers continue to launch a legion of studies (Cho, 2001; Lubinski, Benbow, & Morelock, 2000; Mullis, Martin, Gonzalez, Smith, Chrostowski, Garden, & O'Connor, 2000; NCES, 2001a; 2001b) in the anticipation of identifying the array of predictor variables that lead to high student achievement in mathematics. However, results remain inconclusive (O'Connor, 2002). Albeit most social scientists cite a combination of "socialization factors" (Campbell, 1994; Eccles, 1982; Lubinski & Benbow, 1992), a minority aver there are genetic and hormonal differences such as the "Deficit Learning Theory" (Stanley, 1973; Benbow & Stanley, 1980), while others cite a combination of nature and nurture (Plomin, 1990; 1997; Feingold, 1992; Hedges & Nowell, 1995; Lengfelder & Heller, 2001). Within America and Europe, the thrust has been mandated accountability measures and increasing educational resources within the classroom. There is no definitive answer.

These authors believe that further analysis is warranted and the key might lie in investigating the predictor variables of the top scoring nations of the 1999 TIMSS-Repeat International Assessment (NCES, 2001). As the results of the TIMSS-R evince, parental and pedagogical factors categorically influence high mathematical achievement regardless of economic and educational opportunity. These nations have a lower GNP per capita and less opportunity to advance educationally than their counterparts in the West (O'Connor & Miranda, 2002), and yet their students continue to excel in mathematics achievement.

The objectives of this study were: 1. To identify specific parental, pedagogical, and social factors that contribute to male and female's mathematics achievement in Singapore, Republic of Korea, and Chinese Taipei; 2. To investigate the students' perceptions of their ability to solve mathematical problems and their attitude towards mathematics; 3. To determine the structural linkages between the amount of time students devote to scholastic work (both general and mathematical) outside of school; 4. To determine the structural linkages among mathematics self-concept and achievement; and 5. To identify various social and environmental factors that contributes to gender disparities in mathematics achievement.

LIMITATIONS

Although this study was based on a large sample of international eighth grade students and is intended to represent the population of students from Singapore, Taiwan, and Korea, Taiwan, who were in the eighth grade in 1999, there are several limitations to note. Students who were emotionally, educationally, or physically disabled were excluded from the TIMSS 1999 study, as were students with limited proficiency in the language of the country in which the study was being conducted.

These omissions lead to potential bias in the reported results.

Many of the variables used in this study were obtained from self-reported surveys, and may include a certain degree of bias. In addition, since the study was international and was administered in the language of the country being measured, each country had the opportunity to modify wording and to include options more consistent with the country's national system (Gonzalez & Miles, 2001). Both these attributes, although carefully monitored by the National Research Coordinator (NRC) and documented in Supplement 2 of the User Guide, are sources of potential bias in international comparisons of influence of background variables on student achievement.

To alleviate some of the potential limitations and to allow the sample to represent the respective eighth grade populations, the TIMSS 1999 data used in this study have been weighted as prescribed by the TIMSS 1999 User Guide (Gonzalez & Miles, 2001). The weighting factors adjust the data to compensate for the unequal probability of selection of the sample and to reduce the bias caused by student (unit) non-response. There is no adjustment available to compensate for the bias introduced by sector (disabled students, non-language proficient students) under-representation (Foy & Joncas, 2000).

In addition, the means used by TIMSS 1999 to measure overall mathematics ability, although efficient and reliable for measuring population characteristics, result in a loss of information with respect to individuals, and could be a source of bias (Wingersky, Kaplan, & Beaton, 1987). The possible bias introduced by using aggregate methods of measuring achievement was statistically controlled by imputing missing information and generating plausible value scores (Gonzales & Miles, 2001). The plausible value scores for overall mathematics achievement were used in this study.

The complicated sample design used in TIMSS does not meet the assumptions needed for making inferences from standard, parametric, statistical procedures. The effect of clustering, in selecting a classroom and its members as a unit, but then considering the students within the class as the primary sampling units, reduces the variance among subjects. Students within the same class exhibit less variance among themselves than do subjects randomly sampled from the population. The effect of using this non-random design influences the standard error and can cause apparent statistical significance where none exists. Thus it is imperative that the effects of the design be considered and the resulting adjusted effective sample size be used when drawing conclusions from these data.

The IEA statistically controlled for design effect by using a jackknife repeated replication method which provides approximately unbiased estimates of sampling error (Gonzalez & Miles, 2001). The appropriate jackknife procedures were used in this study. Since regression methods were applied and plausible values in mathematics served as the dependent variable, analyses were done using the JACKREGP.SPS macro to compute weighted regression coefficients and adjusted standard errors in accordance with the instructions in the TIMSS 1999 User Guide (Gonzalez & Miles, 2001).

REVIEW OF LITERATURE

A myriad of empirical studies (Bandura, 1986; Campbell, 1994; Chao, 1996; Dornbusch, Ritter, Mont-Reynaud, & Chen, 1990) concur that home environmental variables affect student achievement (Bandura, 1986; Campbell, 1994; Chao, 1996; Dornbusch, Ritter, Mont-Reynaud, & Chen, 1990) and that the most robust influence resides within the caretaking role of the parent (Chao, 1996; Eccles & Harold, 1993; Epstein, 1988; Wang, Haertel & Walberg, 1993; U. S. Department of Education, 1994). Researchers (Dempsey & Jones, 1997; Deslandes, Royer, Turcotte, & Bertrand, 1997; Dornbusch, Ritter, Leiderman, Roberts, & Fraleigh, 1987; Dornbusch et al. 1990; Gottfried, Fleming, & Gottfried, 1994) suggest that parental "actions" are more important than socioeconomic status, race, and other social differences. The parent(s) provide both psychological support and academic stimulation (Eccles & Harold, 1993; Wang, Haertel, & Walberg, 1993).

Similarly, positive correlations have been demonstrated between a person's attitude toward learning mathematics and his/her persistence in the subject (Gwizdala & Steinback, 1990; NCES, 1991). The more favorably a student views mathematics, the more likely the student is to persist and to participate in higher levels of the subject (American Association of University Women, 1991; Gross, 1988). Successful students work hard to maintain high standards, worry about the consequences of poor performance, and accept personal responsibility for success and failure (Steinberg, Brown, & Dornbusch, 1996).

Psychologists have described two general philosophies which described ability, either as a fixed trait based on native intelligence or as a malleable quality that can be developed with persistence and hard work (Dweck, 1986; Steinberg et al., 1996; Weiner, 1980). Dweck's (1986) implicit theories model compared the two views of intelligence by defining two implicit theories. The first, entity theory, construes intelligence as a fixed trait that remains constant throughout life. Entity theorists believe that although one can learn new things, intelligence or ability is inalterable (Dweck, Chiu & Hong, 1995). The second, incremental theory, describes intelligence as a fluid quality that can be changed and developed through one's effort (Dweck et al., 1995).

Studies showed that students holding either view do not differ in ability (Schunk, 1994) and initially do equally well on tasks (Bergen, 1991; Hong & Dweck, 1992), but when faced with failure or negative feedback the two groups respond differently. Entity theorists tend to blame failure on lack of intelligence or ability, and they often give up, resorting to helplessness. They feel that increased effort is worthless and that failure indicates one does not have the ability to succeed. Incremental theorists blame failure on lack of effort or poor problem solving strategy. As a result, incremental theorists tend to increase their efforts or to use alternate strategies; they are more persistent in overcoming failure (Bergen, 1991; Dweck & Leggett, 1988). Improved performance and higher perception of capabilities often follow (Schunk, 1994). These theories were observed in a large study of Chinese, Japanese, and Taiwanese students, where the culture emphasizes the importance of effort as the ultimate factor affecting achievement (Stevenson, Lee, Chen, Kato, & Londo, 1994). These researchers found that Chinese and Japanese students set standards for

themselves that were higher than those they expected to attain, and higher than they believed their parents would impose.

These findings also support those of Steinberg, et al. (1996), who found that students who succeeded in school believed they controlled their success and that their performance was related to effort. Based on a concept similar to Dweck's (1986), Steinberg compared achievement attributes to academic achievement. He defined attributional style as healthy if students believe success is the product of hard work and failure is caused by insufficient effort. These students do not feel performance is fixed by intelligence; they place less blame on teachers, luck, or the difficulty of the material.

In a longitudinal study of more than 2000 high school subjects, Steinberg et al. (1996) consistently found that attributional style significantly predicted performance in school with successful students more likely to attribute success to hard work and failure to lack of effort. Successful students reported doing more homework, paying attention, and being challenged in mathematics class. The researchers also investigated the different achievement levels of different ethnic groups and concluded, after controlling for student demographics (Socio-Economic Status, parental education, and occupation) that Asian students had the highest achievement levels as well as the strongest beliefs in the importance of effort and hard work. The Asian students spent significantly more time on homework and in school than the Caucasian, African-American, and Latino students taking part in the study.

The "time factor," or differences in time spent studying between high and low achieving students has also been repeatedly observed (Hoffer, 1995; Mullis, 1994; Peterson & Fennema, 1985; Rock & Pollack; 1995 Walberg, 1984). Time spent studying is emphasized in China and Japan. In a study of 240 first graders and 240 fifth graders each from city schools in China, Japan and the United States (1440 children), it was found that both Chinese and Japanese students outscored their American counterparts (Stevenson, Lee, & Stigler, 1986). In looking for explanations the researchers found that Chinese first-graders spent an average of 77 minutes a day (including weekends) doing homework, Japanese first graders spent an average of 37 minutes, whereas American first graders spent an average of 14 minutes a day. In fifth-grade, the time was closer except on weekends. Chinese students reported spending an average of 114 minutes per day during the week, Japanese students claimed 57 minutes, and U.S. students stated 46 minutes. However, the time students' spent studying over the weekend were vastly different: Chinese reported studying 83 minutes (Saturday) and 73 minutes (Sunday), Japanese claimed 37 and 29 minutes, and American students said 7 and 11 minutes respectively. Researchers also found that the highest achieving Chinese and Japanese high school students reported studying mathematics after school for more than six hours a week (Stevenson, et al., 1994).

In Singapore, the top scoring nation in the 1999 TIMSS-Repeat Study, education is seen as a passport to upward social mobility. Parents ensure that their children get extra tutoring from kindergarten through secondary school. Similarly, government subsidized tutoring centers exist for lower income groups (Menon, 2000). Tutoring and extra private lessons are the norm in Korea, Taiwan, and Japan (three other of the five top scoring countries in the TIMMS-R mathematics achievement tests) as

school rankings and individual scores on achievement tests are closely linked to admission to competitive high schools and later to prestigious universities (Chang, Park, & Kim, 1998; Lee, Park, & Kim, 2000, Stevenson, Lee, & Chen, 1994).

Students in these top schools also study more advanced mathematics than is studied in the United States (Menon, 2000). McAdams (1993) examined earlier international studies and concluded that wide exposure to many topics in mathematics was more useful for increased achievement than repetitive review and/or remediation. Welch, Anderson and Harris (1982) found that the number of semesters of mathematics completed explained more than one-third the variance in achievement in NAEP mathematics achievement scores of 17 year olds. However, both Goertz (1989) and Secada (1992) found that taking additional mathematics had little affect on achievement unless students were required to take more advanced mathematics. An analysis of the NAEP data (Dossey, Mullis, Lindquist & Chambers, 1988) revealed a significant increase in mathematics proficiency scores among 17 year olds with each additional mathematics course taken from pre-algebra to pre-calculus or calculus. The latest National Mathematics Assessment (NCES, 2000) supports this finding as both student achievement scores and taking advanced mathematics classes have declined. Only 2% of American twelfth-graders are at the advanced level and 14% at the proficient level which indicates solid academic performance. The majority of the American twelfth grade students fell below basic proficiency level with only 48% at or above the basic level (which denotes partial mastery of prerequisite knowledge and skills fundamental to each grade) and an unconscionable 35% of seniors below the basic skill level (NCES, 2001).

METHODS

The Third International Mathematics and Science Study-Repeat (NCES, 1999), conducted by the International Association for the Evaluation of Educational Achievement (IEA), supplied the data for this study. TIMSS 1999 is a large, international study which provides background and achievement data for eighth grade students from 38 different nations, background information from their mathematics and science teachers, and from their school principals. The study allows for cross-national comparisons of background and achievement in mathematics.

Sample

Student data files were extracted from the top three scoring countries in mathematics: 4,962 from Singapore, 6,110 from Republic of Korea, and 5,767 from Chinese Taipei eliciting a cumulative sample size of approximately 17,000. These countries were chosen because their students had the highest mathematics achievement scores in the TIMSS 1999. The subjects were chosen from the TIMSS 1999 data file by selecting the sample members from the three-targeted nations who had a positive weighting factor (TOTWGT). Each student was asked to complete a self-administered background questionnaire and mathematics and science achievement tests.

When weighted the subjects represent all students from their respective nations who were in the eighth grade in 1999. The weights adjusted the responses of a particular

subject to represent the non-sampled members of the population.

TIMSS 1999 used a two-stage stratified cluster sample design. In each nation schools containing eighth grade classes were partitioned into 75 strata. The first stage of sampling chose two schools in each country from each stratum. The second stage randomly selected one mathematics class from the eighth grade (equivalent) from each of the selected schools. Every eligible student in the class participated in the study. These students comprised the principal units of the analysis.

The clustering resulting from choosing an intact class tends to restrict the variation among students in the sample compared to the variation among students in the population. This makes a clustered sample design less efficient than a simple random sample and must be taken into consideration when approximating standard errors.

Instrumentation

The instruments used in the TIMSS 1999 study were designed to serve the goal of all IEA studies: to learn how various factors contribute to school achievement (Gonzalez & Miles, 2001). In particular, TIMSS 1999 examined factors that affect the students' opportunity to learn. Background questionnaires were developed to measure students' attitudes toward mathematics, their academic self-concept, home background, and out of school activities. Two sets of student questionnaires were prepared; one for schools which taught an integrated science curriculum and another for schools with a segregated science curriculum. Mathematics and home questions were identical on each.

The instruments were formulated in English and translated into the language of the country being measured. Cultural modifications were made to the questions, following explicit guidelines. Multiple independent translations and back translations were made to ensure consistency across the questionnaires. Statistical tests were done to detect items that were not comparable across nations, and were adjusted when necessary (Gonzalez & Miles, 2001).

The mathematics test was comprised of 162 items, one-third of which were identical to the test administered to the eighth grade in TIMSS (1995). The remaining questions were new to the 1999 study. Care was used to develop questions that were similar in content, format, and difficulty to the ones replaced. The questions tested five curricular topics: fractions and number sense; measurement; data representation, analysis and probability; geometry; and algebra.

The 162 questions were distributed among eight versions of the test. Each student was randomly assigned one version and was asked to complete the questions. One third of the questions were free response and were graded according to a detailed rubric. Item response theory (IRT), which allows reliable scores to be attained when many students answer few questions, was used in the TIMSS 1999 study. The NRC from each country was responsible for overseeing testing within their schools and insuring compliance with the standardized procedures.

Variable Selection

Based upon the theoretical framework of this study, six derived variables, representing 19 source variables, were chosen from the TIMSS 1999 data. Each of these derived variables was formed by merging and rescaling source variables within the student questionnaires (Gonzalez & Miles, 2001). They were chosen by the authors as their attributes fit the logical time frame of student growth and achievement. Variables used to measure similar constructs by other researchers (Campbell, 1994, 2002; O'Connor & Miranda, 2002; O'Connor, Miranda, & Beasley, 1999) served as a guide to the current selection. All variables chosen originated from the Student Background Questionnaires (TIMSS 1999 User Guide, Supplement 1) and from the mathematics achievement tests. In this study only the general form of the student questionnaire was utilized, since the three countries taught an integrated science curriculum.

The overall plausible scores from the mathematics achievement tests served as the dependent variable. The authors' decision to use the combined scales was based on the purpose of the study and the increased reliability attained by IEA in computing combined scores. As suggested by TIMSS 1999 User Guide, all five plausible scores (BSMMAT01 - BSMMAT05), representing the National Council of Teachers of Mathematics (2000) content standards of "Data Representation, Analysis and Probability, Algebra, Fractions and Number Sense, Geometry, and Measurement", were used to measure mathematics achievement.

It was assumed that demographic variables occur at the onset of the educational continuum. The derived variables BSDGHERI and BSDGPSA represent students' access to educational resources and diversified educational aids within the home. Home resources include number of books, educational aids, and level of parental education. Educational aids specify students' ownership of dictionaries, study tables, and computers within the home. The issue of multicollinearity for the aforementioned predictors will be addressed within the discussion section as BSDGHERI includes BSDGPSA.

Students' perceptions on hours spent each day studying or doing homework in any subject outside of class was measured by the variable BSDGOSTI. To focus specifically upon hours spent studying mathematics or doing mathematics each day, the predictor BSDMDAY7 was selected. Again the issue of multicollinearity for these predictors will be addressed within the discussion section as BSDGOSTI includes BSDMDAY7.

Student attitude toward and self-concept of ability in mathematics were measured by derived variables that utilized indices. Positive attitude in mathematics was measured by the variable BSDMPATM and represented an index of overall attitudes, ranging from most negative to most positive. It was composed of five individual variables concerning the students' liking of mathematics, their interest in learning or pursuing mathematics, and their perceived importance of mathematics in life. The derived variable was reverse coded so that those who generally disagreed with the statements had low positive attitudes (1) and those who generally agreed had high positive attitudes (3) toward mathematics.

Self-concept in mathematics was measured by the predictor BSDMCMAI which was also based on five questions rated with a four point Likert scale ranging from strongly agree to strongly disagree. The derived variable was recoded to three levels. High self-concept (3) if a student strongly disagreed or disagreed with all five statements, low self-concept (1) if a student agreed or strongly agreed with all five statements, and medium self-concept if a student had any other combination of responses.

To identify country, grade, and gender of the student the following classification variables were used: IDCNTRY, IDGRADER, and ITSEX. Similarly, the variables JKZONE and JKREP were used for sampling information, and the variable TOTWGT for sampling weight.

Statistical Analyses

Data were analyzed through Statistical Package of Social Science (SPSS) program, v. 12.0. and invocation of the JACKREGP macro created by the programmers at the International Association for the Evaluation of Educational Achievement (IAE) . The syntax file was created from the control file BSASCRM2 which extracted student achievement and background files for the five selected countries.

In order to determine each predictor's contribution to the criterion for each country, the JACKREGP.SPS macro was used. This macro computes the multiple correlation coefficients between specified plausible values and independent variables within subgroups defined by a set of classification variables, as well as the regression coefficients and the JRR standard errors, TIMSS 1999 User Guide (Gonzalez & Miles, 2001).

The coefficient of determination (R^2) was determined statistically significant if its calculated t -value had a probability less than 0.05 and was greater than the Bonferroni critical value of 2.39. As recommended in the TIMSS User Manual (Gonzalez & Miles, 2001), the Dunn-Bonferroni procedure was used to correct for the increased probability of a Type I error when comparing simultaneous comparisons. See Tables 1-6 for regression statistics using the macro JACKREGP.SPS for selected predictor variables for the three top scoring countries in mathematics achievement of the 1999 TIMSS-R Database.

Table 1: Regression Statistics for Predictor BSDGHERI (General Index of Home Educational Resources) Using the Macro JACKREGP.SPS

<i>Country</i>	<i>Gender</i>	<i>N</i>	<i>R²</i>	<i>Beta</i>	<i>Beta_{SE}</i>	<i>* Sig.</i>
Singapore (SGP)	Female	2423	6.6%	53.06	4.89	*10.85
	Male	2539	6.1%	57.04	6.83	* 8.35
Republic of Korea (KOR)	Female	3043	10.5%	59.69	3.48	*17.15
	Male	3967	10.2%	57.30	3.17	*18.08
Chinese Taipei (TWN)	Female	2872	9.6%	77.72	5.22	*14.89
	Male	2895	10.2%	86.64	5.75	*15.07

$P \leq 0.05$

$P \leq .05$

Table 2: Regression Statistics for Predictor BSDGPSA (General Possessions - Educational Aids in the Home) Using the macro JACKREGP.SPS

Country	Gender	N	R ²	Beta	Beta _{SE}	* Sig.
Singapore (SGP)	Female	2422	5.1%	-39.73	5.06	* 7.85
	Male	2534	5.1%	-43.14	6.48	* 6.66
Republic of Korea (KOR)	Female	3041	6.6%	-39.71	3.11	*12.77
	Male	3064	6.1%	-42.33	2.95	*14.38
Chinese Taipei (TWN)	Female	2868	6.8%	-51.54	4.28	*12.09
	Male	2887	7.9%	-63.64	5.23	*12.17

P ≤ 0.05

P II .05

Table 3: Regression Statistics for Predictor BSDGOSTI (General Out-of-School Study Time) Using the macro JACKREGP.S

Country	Gender	N	R ²	Beta	Beta _{SE}	* Sig.
Singapore (SGP)	Female	2162	0.5%	9.02	3.67	
	Male	2343	1.5%	15.04	3.45	
Republic of Korea (KOR)	Female	2952	5.2%	24.61	2.12	*11.61
	Male	2967	5.9%	27.52	1.96	*14.04
Chinese Taipei (TWN)	Female	2739	10.4%	41.02	2.54	*16.15
	Male	2750	9.8%	46.76	3.36	*13.92

P ≤ 0.05

P II .05

Table 4: Regression Statistics for Predictor BSDMDAY7 (Hours Spent Each Day Studying Math) Using the Macro JACKREGP.SPS

Country	Gender	N	R ²	Beta	Beta _{SE}	* Sig.
Singapore (SGP)	Female	2422	0.1%	-1.78	1.84	
	Male	2535	0.0%	0.99	1.77	
Republic of Korea (KOR)	Female	3015	3.4%	19.50	3.01	* 6.48
	Male	3031	3.9%	20.74	1.84	*11.28
Chinese Taipei (TWN)	Female	2837	7.1%	21.81	2.97	*10.04
	Male	2841	4.9%	28.06	3.89	* 7.21

P ≤ 0.05

P II .05

Table 5: Regression Statistics for Predictor BSDMPATM (Index of Student's Positive Attitude Towards Mathematics) Using the Macro JACKREGP.SPS

Country	Gender	N	R ²	Beta	Beta _{SE}	* Sig.
Singapore (SGP)	Female	2416	1.7%	16.43	3.58	
	Male	2534	6.2%	32.70	3.04	*10.80
Republic of Korea (KOR)	Female	3029	8.6%	40.84	2.51	*16.28
	Male	3051	7.0%	37.02	2.54	*14.58
Chinese Taipei (TWN)	Female	2862	11.0%	51.47	3.06	*16.82
	Male	2872	14.2%	64.61	3.33	*19.40

P ≤ 0.05

P Π .05

Table 6: Regression Statistics for Predictor BSDCMAI (Index of Student's Self-Concept in Mathematics) Using the Macro JACKREGP.SPS

Country	Gender	N	R ²	Beta	Beta _{SE}	* Sig.
Singapore (SGP)	Female	2419	9.5%	48.54	3.76	*12.91
	Male	2537	14.4%	58.43	4.75	*12.30
Republic of Korea (KOR)	Female	3035	9.4%	67.24	4.07	*16.52
	Male	3051	9.2%	60.76	3.75	*16.20
Chinese Taipei (TWN)	Female	2861	12.5%	74.96	3.65	*20.54
	Male	2869	15.3%	80.50	3.64	*22.12

P ≤ 0.05

P Π .05

RESULTS

Utilizing the JACKREGP.SPS macro, six separate regressions were run to reflect the unique contribution (R^2) of each predictor variable. The data were sorted by country and by gender. The chosen predictor variables were entered into regression analyses using Campbell's (1997) guidelines of chronology, logic, and research. The order of the predictor variables were BSDGHERI, BSDGPSA, BSDGOSTI, BSDMDAY7, BSDMPATM, and BSDMCAI. After the initial regression was run, the macro was called five additional times for analyses for each independent variable.

Tables 1 through 6 report the regression coefficients and coefficient of determination (R^2) for each predictor variable. Tables 1 and 2 refer to educational resources and aids in the home. Table 1 refers to general educational resources and parents' education and reports significance for both males and females in Singapore, Korea, and Chinese Taipei, with coefficients of determination ranging from 6.1% to

10.5%. The results of Table 2 echo the findings in Table 1. Specific educational resources and aids within the home for both genders were similar and significant with a range of 5.1% to 7.9%.

Tables 3 and 4 refer to study time. Table 3 reports general out of school study time as significant for both males and females in Korea and Chinese Taipei. The coefficients of determination ranges range from 5.2 % to 10.4%. Both males and females in Singapore report general study time as insignificant.

Table 4 refers to hours spent each day studying mathematics. Significance was found for both males and females in Korea and Chinese Taipei. The range was 3.4% to 7.1%. For both genders in Singapore the predictor was insignificant.

Table 5 is an index of the students' positive attitude towards mathematics and is significant for all three countries precluding females in Singapore. The coefficients of determination have a broad range from 6.2% to 14.2%.

Table 6 is an index of the students' self-concept in mathematics and is the strongest predictor for both genders in all three countries with the coefficients of determination ranging from 9.2 % to 15.3%.

DISCUSSION

Within the comparisons of parental and pedagogical influences and motivational variables, student self-concept in mathematics was the strongest predictor for both males and females in all three countries. Attitude toward mathematics was significant in all three countries excluding females in Singapore; this implies that although these female students scored the highest in the series of mathematics tests from the TIMSS-R (1999), they did not necessarily like it nor have an interest in pursuing a career in mathematics, as they did not perceive mathematics as important in life.

Both genders within all three countries relied upon educational resources in the home and found their parents' educational level as significant to the criterion. However an issue of multicollinearity exists with the variables, BSDGHERI and BSDGPSA, as these composite predictors include the same source variable [SQ2-11b, c, d], which refers to students' ownership of dictionaries, study tables, and computers within the home.

Outside study time was significant for both genders in both Korea and Chinese Taipei and insignificant for both genders in Singapore. Possible explanations for disparate results in Singapore include parental factors and that high achieving students are able to complete their mathematics homework and overall general homework more efficiently and in less time than lower achieving students.

Future implications include the need to continue to investigate the array of predictor variables that develop mathematical abilities of our precocious youth in order to prepare them to become productive citizens (Dewey, 1916) in the global age. To recognize that although successful nurturing begins in the home and involves parents, gender disparities in mathematics achievement at the secondary level remain steadfast, transcend time and cultural traditions, and are influenced by parental and pedagogical factors regardless of economic and educational

opportunity. Educational leaders and families need to recognize that female students' attitude towards mathematics and choosing a career in the field of mathematics will remain resolute unless cultural and familial milieus institute reform.

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