

0Bulletin of Educational Psychology, 2011, 43(Special Issue on Reading), 357-376

National Taiwan Normal University, Taipei, Taiwan, R.O.C.

The Influence of Parental Education Level, Parental Reading Attitude, and Current Home Reading Activities on Students' Reading Attainment: Findings from the PIRLS 2006*

Su-Yen Chen

Center for Teacher Education
National Tsing Hua University

Yu-Jen Chang

Graduate Institute of Learning and Instruction
National Central University

Hwa-Wei Ko

By using Taiwanese 4,589 fourth-graders data from the Progress in International Reading Literacy Study (PIRLS) 2006, this study probed the influence of parental educational level, parental reading attitude, and current home reading activities on students' reading attainment. With the multiple-group analyses of structural equation modeling (MGSEM), we also examined the equivalence of these influential relations across gender. The results indicated that the hypothesized model was fitted data separately in male and female groups, and the strengths of relationships among the variables were similar. Parental education level substantially and directly linked to students' reading attainment. Its indirect effect only mediated by parental reading attitude and it was weak. Based on the research findings, the researchers address suggestions pertaining to reading research in Taiwan.

KEY WORDS: multiple-group analysis, parental education level, PIRLS, reading attitude, reading attainment

Reading professionals in Western countries have long held the goals of developing children's reading skills and nurturing reading as a lifelong activity. Over the past several decades, many studies have demonstrated the importance of various family factors in understanding why some children devote considerably more time to leisure reading, possess more positive attitudes toward reading, and perform better on reading assessments.

Family factors and reading practice

* Three authors contributed equally to this paper, and were listed in agreement. Correspondence concerning this article should be addressed to hwawei@cc.ncu.edu.tw ◊

The association between family factors and children's reading practice is well documented in Western literature. Two classical studies have generated insightful findings regarding the importance of family process variables in terms of leisure reading. Neuman (1986) differentiated home-process variables, such as what parents did while interacting with their children, from the more static variables of occupation or economic level, and explored the relation between home environment and leisure reading practice with 254 fifth-graders from the Boston metropolitan area. The researcher found that parental encouragement of reading correlated strongly with children's involvement in reading as a leisure activity (.53), and even after controlling for gender and socioeconomic status, parental encouragement of reading still significantly correlated with leisure reading (.41). When the researcher further analyzed its subcomponents to determine whether one or more factors uniquely contributed to leisure reading, she found the frequency of reading to children when young, reading materials available at home, and encouraging children to read the materials were significantly associated with children's leisure reading, while parental reading habits, after controlling for gender and socioeconomic status, were not.

Study by Greaney and Hegarty (1987) also provided consistent results. In addition to reading achievement and reading attitude, the researchers included home environmental factors in a series of commonality analyses to assess the contributions of various variables to the book reading of fifth-graders. They found that the amount of time given to book reading correlated more highly with the home process variables (e.g., level of parental interest in reading, extent of encouragement to join a public library, parental reading habits, and frequency of discussions about reading) than with socio-economic status (SES). In other words, from the perspective of developing leisure time reading, what parents do is more important than what they are.

The association between family factors and Taiwanese children's reading practices is relatively less explored. Recently, Chen conducted a series of studies on the reading practices of Taiwanese adolescents (Chen, 2008a), college students (Chen, 2007), and adults (Chen, 2008b, 2009). Among them, studies on adolescents have explored the relation between family factors and the likelihood of being an avid reader. Using cross-sectional national data from the Taiwan Educational Panel Survey (TEPS), Chen (2008a) classified 2,909 out of 10,404 ninth-graders, and 2,680 out of 10,651 twelfth-graders that reported reading many extracurricular books during the previous summer vacation as avid adolescent readers, and found that gender, family factors, and teachers are significantly associated with the likelihood of being an avid adolescent reader. Regarding family factors, parental reading frequency and parental bookstore visit frequency have a relatively greater effect on children being avid readers than parental education level and the cultural level of the home environment.

Family factors and reading attainment

A considerable number of Western studies in recent years have also linked family factors with children's reading attainment. First, regarding home library and reading attainment, researchers have found that the number of books at home is a key predictor of reading attainment (Campbell, Kelly, Mullis, Martin, & Sainsbury, 2001). The PIRLS 2006 international survey also found that students who had more than 100 books in their home had an average attainment score of 553, whereas children with less than 10

books at home had an average score of only 462 (Mullis, Martin, Kennedy, & Foy, 2007).

Second, regarding early home literacy activities and students' reading development and performance, Sénéchal, LeFevre, Thomas and Daley (1998) showed how the oral language, reading skills, and habits of children from middle- and upper-middle-class English-speaking home backgrounds benefited from positive literacy experiences at home. Exposure to storybooks at home during childhood was significantly associated with vocabulary development, listening comprehension, and phonological awareness, and children who had been taught how to decode the printed word at home made the most literacy progress in the first grade. Later, Sénéchal and Lefebvre (2002) reported the outcomes of a 5-year longitudinal study of 168 middle- and upper-middle-class children. A model was constructed to represent the relations between children's reading attainment in school and their home literacy experiences, non-verbal intelligence, age, parents' education level, and the extent of experiences with print at home. The model showed that children's exposure to books was significantly associated with vocabulary development in Grade 1, and with reading attainment in Grade 3. Being taught at home how to read and write words by parents was directly related to successful development of early literacy skills in school. A good start in terms of literacy skills significantly predicted success in reading isolated words at the end of Grade 1, and indirectly predicted reading in Grade 3. Sénéchal and Lefebvre concluded that parental involvement in their child's acquisition of early literacy, for example, through providing books to help the child learn how to read and write, had a markedly positive influence on their offspring's reading attainment in school. Similarly, Bus, van Ijzendoorn and Pellegrini (1995) conducted a meta-analysis of studies examining the influence of the extent to which parents reading to their preschoolers at home affected their literacy. They showed that exposure to book reading at home explained 8% of the variance in language growth, emergent literacy skills, and reading attainment.

Using PIRLS data

Recently, a number of Western studies and a few Taiwanese studies have utilized data from PIRLS (Progress in International Reading Literacy Study by the International Association for the Evaluation of Educational Achievement) to investigate the relationships between family factors and students' reading attainment. One of the major advantages of PIRLS data over other national (e.g. TEPS-Taiwan Education Panel Survey; THE- Taiwan Higher Education database; TSCS-Taiwan Social Change Survey) or international (e.g. TIMSS- Trends in International Mathematics and Science Study) survey data related to reading is that it provides a lot of family and school background factors for researchers to explore. For example, concerning home literacy environment factors, ranging from the SES variable to the more home-process-oriented variables, include: parental education level, home library, parental reading attitude, early reading ability, earlier home literacy activities and current home reading activities. With the same data sources but different research focus, the below mentioned studies are valuable for contributing to our understanding of the association between family factors and reading attainment.

First, Myrberg and Rosen (2009) used data from Swedish participation in PIRLS 2001 with some 10,000 students in Grade 3, and aimed at estimating the direct and indirect effects of parents' education on reading achievement with structural equation modeling. The results suggest that the total effect of

parents' education is substantial (.34) and that almost half of this effect (.17) is mediated through other family factors such as the number of books at home (e.g. books at home, children's books), early reading activities (e.g. reading with children, stories to children), and early reading abilities (e.g. recognizing letter, reading words, reading sentences). To be specific, the path analysis revealed that, in addition to the direct effect of parental education on reading attainment, on average, well-educated parents not only have more books at home than the less-educated parents, they also use their knowledge of books to create an literacy environment for their children where reading aloud is an significant activity. And then, these early literacy activities also continue to exert an influence over reading attainment.

Myrberg and Rosen (2008) had also compared representative samples from 7 countries with data from PIRLS 2001: Sweden, Norway, Bulgaria, France, Hong Kong, Hungary, and Italy, and investigated the relative importance of various mediating family factors and the total effects of parents' educational levels on the reading attainment. Also utilizing structural equation modeling, this study indicated that in addition to substantial effects of parental education, the indirect effects of other family factors were also found, even though the pathways for mediating variables varied among countries. The total effect of parental education on students' reading achievement, ranging from the most to the least, were: Hungary (.58), France (.51), Bulgaria (.47), Norway (.40), Sweden (.38), Italy (.29) and Hong Kong (.14), and parental education had considerable effects that were mediated through the size of the home library in all countries. Specifically, five out of the seven countries had larger direct than indirect effects. The total effects of early home literacy activities were strongest in Italy (.30) and Norway (.21), whereas the effect of early reading abilities was largest in Hong Kong (.43). It is interesting to note that, among the 7 countries, Hong Kong has the smallest effect of parents' education on reading attainment, but the effect of early reading abilities at the time of school start is the largest.

Park (2008) also conducted a comparative study of 25 countries with data from PIRLS 2001 on home literacy environment and students' reading attainment. The researcher suggested that early home literacy activities, parental reading attitudes, and number of books at home positively affect reading attainment, but the strength of the effects varies substantially across countries. Furthermore, the extent to which the effect of parental education on reading attainment is mediated by the three family factors was only modest except for a few countries. By focusing on the role of a country's economic level, the research also found evidence of a systematic association between the country's economic level and the effect of early home literacy activities: the higher the economic level, the stronger the effect. And a similar pattern is found for the effect of parental reading attitudes.

From above studies, we can find that, for Western countries, the total effect of parents' education on students' reading attainment is substantial, and for the most part, the extent to which the effect of parents' education on reading attainment is mediated by other family factors (e.g. the number of books at home, early reading abilities, early home literacy activities, and parental reading attitudes) is only modest (Myrberg & Rosen, 2008; Myrberg & Rosen, 2009; Park, 2008). In contrast, Hong Kong as the only community included in the investigation, had very weak total effect of parents' education on reading attainment, and this effect was almost totally mediated through downstream variables, such as early literacy abilities (Myrberg & Rosen, 2008).

On the other hand, Ko and Chan (2009) examined the relation between students' reading attainment and family environmental factors in Chinese and non-Chinese communities with data from the

PIRLS 2006. Six family environmental factors were considered: parents' evaluation of their offspring's early literacy skills, early home literacy activities, current literacy activities, parental attitudes towards reading and their reading habits, parents' reports of the numbers of their own, and children's books in the home. The Chinese communities were those in Hong Kong, Singapore, and Taiwan, and each was matched statistically and numerically with national samples from non-Chinese communities around the world. Although the PIRLS did not report markedly different patterns of attainment scores across the cultural divides, hierarchical multiple regression analysis revealed that Chinese community parents tended to overestimate their children's early literacy skills, but engaged in fewer reading activities at home with their children than their non-Chinese counterparts. Parents' attitudes towards reading in the Chinese community were moderate, and the books provided at home were fewer than those in non-Chinese community homes. Overall, early literacy skills and the number of books at home are the most important predictors of later reading attainment. These two factors together explain a significant 11 to 27 percent of the variance of reading attainment across the eight groups. In the Chinese community, these two factors are especially critical. After these two, other family factors made little or no contribution to reading attainment. An important finding of this study was that while in the Chinese community, parental attitudes about reading did not independently explain students' reading attainment but made a statistically significant contribution of some 1 to 2 percent to the variance in students' attainment in the non-Chinese community.

Also utilizing data from PIRLS 2006, Chen and Ko (2009) explored the associations between Taiwanese fourth-graders' time spent reading outside of school and their reading attitudes and reading attainment, as well as the linkages of five family factors to these three reading dimensions. Regression analysis revealed that reading attitude is the best predictor of reading practice, followed by current home reading activities and gender. Reading practice, reading attainment, and gender all have strong effects on reading attitude, and among the family factors, parental reading attitude has the greatest impact on their children's reading attitude, whereas home library and current home reading activities have moderate impacts. For reading attainment, parental education level was the best predictor, followed by reading attitude, home library, and early home literacy activities, and then gender and current home reading activities.

To sum, even though data from PIRLS 2001 Hong Kong suggested having very weak total effect of parents' education on reading attainment, and this effect was almost totally mediated through downstream variables; Chen and Ko (2009) found parental education level to be the best predictor for Taiwanese students' reading attainment through regression analysis with PIRLS 2006. Regarding the relationships between other family factors and students' reading attainment, Ko and Chan (2009) found early literacy skills and the number of books at home to be the most important predictors of Taiwanese fourth graders' later reading attainment through regression analysis with PIRLS 2006, whereas parental reading attitude did not independently explain students' reading attainment and current home literacy activities had little contribution to reading attainment. On the other hand, parental reading attitude was found to be the most important predictor for students' reading attitude among all the family factors, while current home reading attitude to be the most important predictor for students' reading practice among the family factors (Chen & Ko, 2009). These findings somehow provided evidence to challenge previous studies which utilized data not from the PIRLS sources, and suggested that current home reading activities had

significant positive influence on reading attainment, regardless of family socio-economic status, age and gender were taken into consideration (e.g. Rowe, 1991; Wu, 2002), and parental reading attitudes is the linchpin in the home reading process (e.g. DeBaryshe, 1995). For example, Rowe (1991) conducted an explanatory study of reading activity at home (e.g. reads alone, read to by others, reads to others, and discusses reading), attitude toward reading, and reading achievement with a sample of 5,000 students aged 5-14 in Australia. This study provided strong empirical support for the importance of reading activity at home to reading attainment. For students in the 5-8 year-old groups, higher scores on the reading alone item and the shared reading items were strongly associated with high scores on the measure of reading attainment. For students in the 9-14 year-old groups, related positive associations were mainly with reading alone and discussing reading. Wu (2002) also found that the family reading atmosphere and habits significantly predicted Taiwanese fifth graders' abilities of word recognition and of reading comprehension. Regarding parental reading attitude and children's motivation and interest in reading, DeBaryshe's (1995) study highlights the importance of parent-child literacy interaction by showing that mothers who believe that reading is enjoyable read more frequently to their children and converse more with them during shared reading, and as a consequence, their children show greater interest in books.

Therefore, this study aims at estimating the total effects of parents' educational levels, and the relative importance of parental reading attitudes and current home literacy activities as mediating factors, on the Taiwanese fourth graders' reading attainment. Besides, Tse, Lam, Lam, Chan and Loh (2006) compared data of PIRLS 2001 from Hong Kong, Singaporean and English suggested that gender was a key variable influencing reading attainment and reading attitude across cultural contexts. Chen (2008a) of Taiwan using TEPS had also found gender effect among adolescents of being an avid reader. We would examine the extent of measurement variance across gender, too.

Method

Data

The data in the present study come from a representative sample of 4589 Taiwanese 9- to 10-year-olds who participated in the PIRLS 2006. The design of the international study is described in detail in the PIRLS 2006 International Report (Mullis et al., 2007). The PIRLS assessed the reading achievement of fourth-graders and collected extensive information on the students' family and school experiences (student questionnaire), family socioeconomic conditions, parental engagement with the child in various literacy activities (parental questionnaire), and various school characteristics and instructional practices (school questionnaire). Based on a two-stage stratified cluster design, schools were selected with probability proportional to size. Then, one intact classroom was chosen randomly within each selected school. All students in the chosen class were selected for a reading test. Since the PIRLS program provided a sophisticated model of reading comprehension, and gathered data about the participating children's reading environment, the IDB (International Database) Analyzer was developed by the IEA Data Processing and Research Center as a plug-in for the Statistical Package for the SPSS. It enables the user to combine data files from the IEA's large-scale assessments, and conduct analysis

using SPSS without writing programming code. All procedures offered within the analysis module of the IDB Analyzer make use of appropriate sampling weights, and standard errors are computed automatically (Foy & Kennedy, 2008).

Measures

Parental education level. We constructed the index for parental education level with the father's and the mother's education levels, as suggested by Myrberg and Rosen (2008) in their study.

Parental reading attitude. Parents' attitudes and habits regarding reading were obtained by asking parents to indicate agreement on three items. Each item is based on a four-point scale: disagree a lot, disagree a little, agree a little, and agree a lot. And the items with higher values were indicated more positive attitudes toward reading. The items were as follows:

1. I like talking about books with other people.
2. I like to spend my spare time reading.
3. Reading is an important activity in my home.

Current home reading activities. We constructed the index for current home reading activities with three statements. Parents or caregivers were asked to respond via a four-point scale about the frequency of activities they engage in with the child at home. These activities were:

1. Listening to my child read aloud.
2. Talking with my child about what he/she is reading on his/her own.
3. Discussing my child's classroom reading work with him/her.

Each item was based on a four-point scale: never or almost never, once or twice a month, once or twice a week, and every day or almost every day.

Reading attainment. Students' reading attainment scores were taken from the PIRLS 2006 databank. The overall reading plausible values (PV1-PV5, PVs) were standardized around a mean of 500 and a standard deviation of 100. Instead of a fixed value of reading achievement for each student, PIRLS provides five plausible values for each student estimated on the basis of the Item Response Theory (IRT) method. According to Wu (2004), randomly drawn from the posterior distribution for a student's ability, plausible values are appropriate, especially to estimate population parameters such as mean and variance, taking into account the uncertainty associated with the estimates. Following the recommendation by the user guide for the PIRLS 2006 (Foy & Kennedy, 2008), we conducted the analyses using all five plausible values, and the standard errors are calculated accordingly when achievement scores are used.

Data analysis

As mentioned earlier, we combine parents' file with students' data in the IDB analyzer in order to estimate the relationships of parents' education levels, parental reading attitudes, as well as current home reading activities on the students' reading attainments. Furthermore, it is of great interest to

examine whether the relationships among those latent variables would be equivalent across gender. Consequently, we carried out a series of structural equation modeling (SEM) analyses with appropriate sampling weights (TOTWGT) using Mpuls 6 (Muthén & Muthén, 2010). In this study, the SEM analyses include the confirmatory factor analysis (CFA) and multiple-group analysis for different gender.

To begin with, we identified the inter-correlations among the all observed variables, and then used the CFA to obtain the hypothetical latent variables estimated from the observed items or indicators. In the meanwhile, the latent variables of the measurement model were assumed to be correlated. If the measurement model can fit the observed data, then the reliability and appropriateness of hypothetical latent variables were also set up.

In the second step, the cross-validation and stability of the hypothesized model was the aim of multiple-group analysis. Measurement invariance is the usually implemented via multiple-group comparisons. In order to see how much extent the hypothesized model that was based upon the literature can fit males' and females' data in the 4th graders, the several nested models with more and more parameter constraints (i.e., measurement weights, structural covariances, and structural residuals) were probed hierarchically. If the more constrained model can yield a good fit, the more confidence we can have to convince that the hypothesized model are stabile and valid in the Taiwanese 4th graders. In other words, the measurement invariance of the hypothesized model across gender frequently reflected invariance of relations among observed and latent variables in the model.

Finally, we are also interested in the direct and indirect effects of the parental education level, parental reading attitude, and current home reading activities on student's reading attainment. In the light of the hypothesized model, parental education level had the causal effects on the reading attainment straightforwardly. Moreover, the parental reading attitude and current home reading activities were modeled to mediate the focal relationship between parental education level and reading attainment. With respect to the results of multiple-group analyses, the robust and tenable relations among the latent variables in the so-called structured model were expressed in the standardized loadings, thus we could further confirmed how much effects of parents' education that was mediated through parental reading attitude and current home reading activities.

In the current study, a variety of following fit indices were employed to evaluate models fit. The first one is Chi-square statistic associated with *p* value, a non-significant *p* value indicates good fit. However, the index of Chi-square statistic is sensitivity to sample size (Bentler & Bonett, 1980), and therefore the other substitutive indices were used in this study. According to Hu and Bentler's (1999) recommendations, the Tucker–Lewis index (TLI), comparative fit index (CFI), normed fit index (NFI), the root mean squared error of approximation (RMSEA), and standardized root mean square residuals (SRMR) are also used as indicators of model fit. TLI, CFI, and NFI values equal to or greater than .95 are preferred for a good model fit, and greater than .90 is an acceptable lower bound. The value of .06 for RMSEA and .05 for SRMR are also used as the upper bound for good model fit (Hu & Bentler, 1998; Kline, 2005).

Besides, multiple-group analysis were then conducted to test for the invariance of model parameters across gender, models with sequential added constraints to the less restricted model are tested hierarchically. The fit and comparison of nested models can be assessed by above goodness-of-fit

indices or chi-square difference test (Byrne & Stewart, 2006; Satorra, 2000; Cheung & Rensvold, 2002). However, due to both criteria were sometime contradictory, Cheung and Rensvold (2002) suggested that ΔCFI , it is the widely accepted criterion at present, is unaffected by normality, model complexity, and large sample size practically. When the change value of ΔCFI is equal to or smaller than .01 between two nested models, then the null hypothesis of invariance wouldn't be rejected. In other words, When the criterion of ΔCFI is met, all specified constraints for parameters in the more restricted model are equal across groups, and the model should be accepted. Then, we can continue to analyze the more restricted model of measurement invariance. However, when the criterion is not met, partial measurement invariance of the parameters can be considered (Byrne, Shavelson, & Muthén, 1989).

Results

Preliminary analyses

Due to approximate 2-4% data points of some observed variables were missing, the median imputation was used to handle missing data (Tabachnick & Fidell, 2001). Descriptive statistics (mean, standard deviations, skewness, and kurtosis) are presented in Table 1. As can be seen, the univariate skewness values were ranging from -.72 to .93, and the univariate kurtosis values were from 0.10 to 1.53. The skewness and kurtosis values fell within acceptable ranges of the normal distribution. The preliminary data analysis revealed that multivariate normality assumption was not violated. Consequently, the Maximum Likelihood (ML) estimation method was used in the current study.

Table 1 also showed the correlations among the observed variables. All variables correlated with each other significantly with the exception of the "listening to my child read aloud" (item 3) and "reading attainment PV1-5" (item9-13), as well as the "I like talking about books with other people" (item 6) and "father's and mother's education levels" (item1-2). As anticipated, the correlations among observed variables within the same latent construct were larger than ones among variables belonged to different constructs. However, it should be cautious about interpreting this statistical significance of correlation coefficients with large sample size.

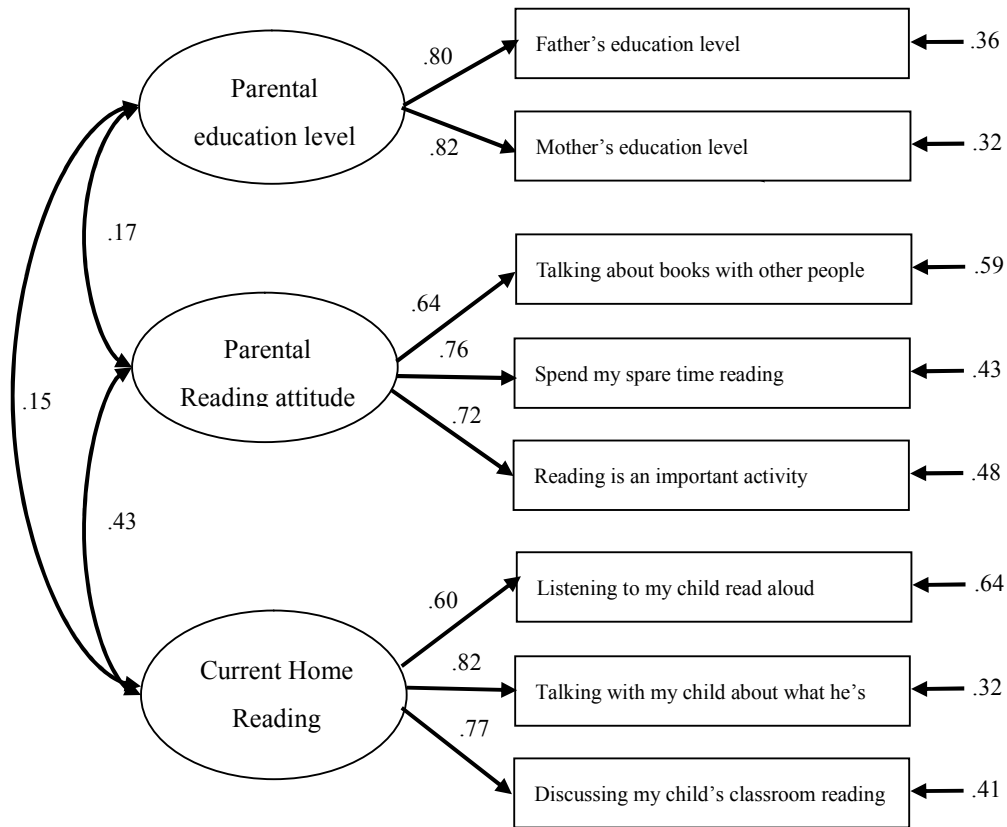
Confirmatory factor analysis

The measurement model is presented in Figure 1. The confirmatory factor analysis (CFA) was implemented to estimate the reliability and validity and hypothetical latent variables that are reflected in two or more observed variables, respectively. The result of CFA analysis showed that the measurement model fitted well for overall sample. The goodness-of-fit statistic and indices were: $\chi^2 = 184.96$; $df = 17$; $p < .001$; CFI = .984; TLI = .973; NFI = .982; RMSEA = .046; SRMR = .029. As can be seen in Figure 1,

Table 1 Descriptive Statistics and Correlations among All Observed Variables

Item / Observed Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13
1. Father's educational level	1												
2. Mother's educational level	1.66***	1											
3. Listening to my child read aloud.	1.03*	1.04*	1										
4. Talking with my child about what he/she is reading on his/her own.	1.12***	1.11***	1.49***	1									
5. Discussing my child's classroom reading work with him/her.	1.14***	1.12***	1.47***	1.63***	1								
6. I like talking about books with other people.	-0.1	1.01	1.17***	1.26***	1.23***	1							
7. I like to spend my spare time reading.	1.08***	1.11***	1.17***	1.24***	1.21***	1.50***	1						
8. Reading is an important activity in my home.	1.14***	1.14***	1.19***	1.29***	1.24***	1.44***	1.55***	1					
9. Reading attainment (PV1)	1.34***	1.32***	1.01	1.11***	1.09***	1.05***	1.09***	1.13***	1				
10. Reading attainment (PV2)	1.34***	1.32***	1.01	1.11***	1.09***	1.05**	1.08***	1.12***	.85***	1			
11. Reading attainment (PV3)	1.34***	1.32***	1.02	1.10***	1.09***	1.05**	1.08***	1.12***	1.86***	1.85***	1		
12. Reading attainment (PV4)	1.34***	1.32***	1.01	1.10***	1.09***	1.04**	1.09***	1.11***	1.85***	1.85***	1.85***	1	
13. Reading attainment (PV5)	1.33***	1.31***	1.01	1.11***	1.10***	1.05**	1.08***	1.12***	1.86***	1.85***	1.85***	1.86***	1
Mean	3.55	3.36	2.42	2.70	2.95	3.07	3.44	3.15	536.86	536.23	535.21	535.92	536.47
Standard Deviation	1.47	1.25	0.76	0.74	0.77	0.65	0.60	0.66	64.05	64.35	63.98	63.39	63.76
Skewness	0.80	0.93	-0.22	-0.35	-0.66	-0.62	-0.72	-0.73	-0.36	-0.37	-0.41	-0.37	-0.40
Kurtosis	0.10	1.08	0.01	0.40	0.51	1.09	1.53	0.97	0.34	0.32	0.30	0.27	0.33

Note. N = 4589. * $p < .05$, ** $p < .01$, *** $p < .001$



Chi-Square = 184.96, $df = 17$, p -value = .000, RMSEA = .046

Figure 1 HY's MLU in English and Mandarin

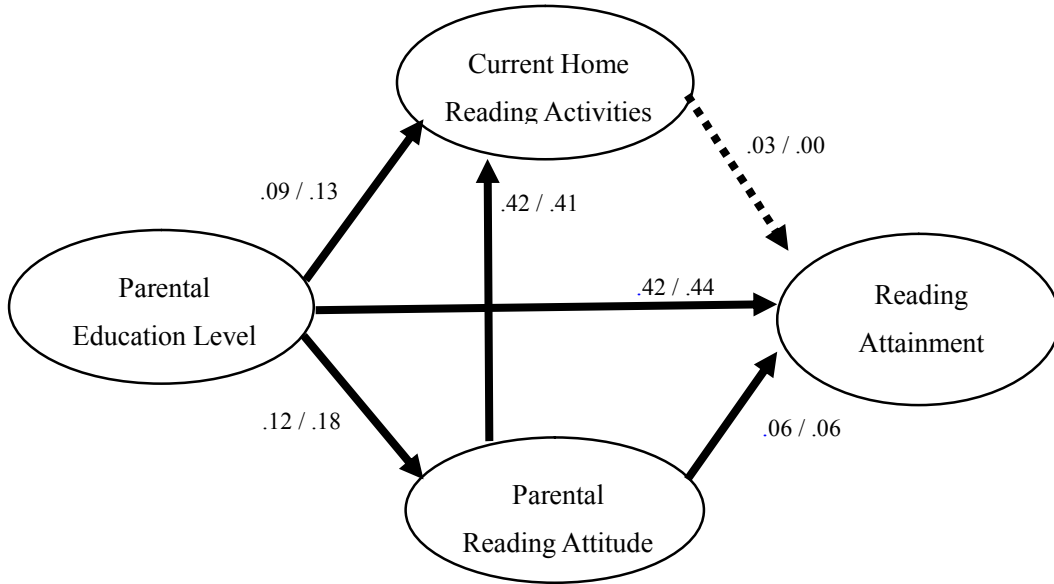
Note. $N = 4589$. All values are statically significant ($p < .001$).

all standardized factor loadings of observed variables in the measurement model were statically significant at the .001 level. Besides, the composite reliabilities (ρ s) of the three latent variables were all greater than .60 (parental education level = .79; parental reading attitude = .77; current home reading activities = .75), as well as the average variance extracted (ρ vs) were also equal or greater than .50 (parental education level = .54; parental reading attitude = .66; current home reading activities = .50). The findings of CFA analysis revealed that the latent variables of this study were somewhat reliable and valid.

Evaluation of Structural Model

In the light of the hypothesized model that proposed by the researchers (see Figure 2), parental education level was the only the independent variable which had the causal effects on students' reading

attainment. In addition, the parental reading attitude and current home reading activities were also modeled to mediate the focal relationship between parental education level and reading attainment.



Chi-Square = 127.79 / 188.41, $df = 63 / 63$, $p\text{-value} = .000 / .000$, RMSEA = .022 / .029

Figure 2 HY's Dominance scores in English and Mandarin

Note. Female group $N = 2185$, male group $N = 2402$. The left value is for female group. All values are significant statically, except for current home reading activities to reading attainment it's represented by dotted line.

The reading attainment is the focal outcome variable we concerned in the hypothesized model. However, the PIRLS 2006 databank provides five plausible values that are imputed for the probable reading attainment of each student. Essentially, plausible values are a sample of ability scores from posterior distribution that represented the student possible range of the true scores. For ease of the estimation of latent variable of reading attainment, we fixed the five factor loadings to a value of 1.00 for PV1-5. This strategy of fixed factor loadings to be invariant is typically used to identify the observed variables with the same importance in the measurement model.

Before to carry out the multiple-group analysis, the accepted structural model for relations of the latent variables should be demonstrated separately for both gender groups. The hypothesized structural model was identified and adequately fitted the data for males ($\chi^2 = 188.41$; $df = 63$; $p < .001$; CFI = .994; TLI = .993; NFI = .991; RMSEA = .029; SRMR = .029) and for the females ($\chi^2 = 127.79$; $df = 63$; $p < .001$; CFI = .996; TLI = .996; NFI = .993; RMSEA = .022; SRMR = .026) groups considered separately. As displayed in Figure 2, all the standardized loadings were found to be statistically significant ($ps < .05$), except the current home reading activities to reading attainment significantly in both groups ($ps > .10$). In male group, the model accounted for approximately 20% variance of reading

attainment, 20% variance of parental reading attitude, and 3% variance of current home reading activities. Similarly, the near variances were also explained in the female group (19% in reading attainment, 19% in parental reading attitude, and 2% in current home reading activities, respectively). The similar loadings, explained variances, and goodness-of-fit indices of structural model indicated that the hypothesized model may be tenable and fitted across gender groups. Drawing from the aforementioned results, support and confidence were provided for us to proceed with multiple-group analysis.

Multiple-group analyses

Multiple-group analysis of SEM was conducted not only to examine the cross-validation and stability of the hypothesized model, but also to obtain the predictive relations among the latent variables in the hypothesized model across groups. In order to test whether the structural model is valid and equivalent across gender groups statistically, a series of nested models were tested hierarchically within the concept of measurement invariance. As mentioned earlier, the values of current home reading activities to reading attainment in both groups were not significant, thus this effect was deleted from the structural model. Then, measurement invariance was tested hierarchically at a set of six levels with the establishment of successive equivalence constraints in the model parameters across groups (Byrne, 2008; Widaman & Reise, 1997). The first level was the configural model (Model 1), was also called baseline model, with least restrictions of the parameters. It was specified that each group had the similar structure, in addition to the same pattern of fixed and freely estimated parameters. The second level was factor loadings invariance (Model 2), also called metric invariance. In this level, the model with the equality constraints on the factor loadings across groups was tested. The third level (Model 3) was to impose the additional constraints on the intercepts of the measured variables to test scalar invariance. Furthermore, In Model 4, the equality constraints of intercepts of latent variables were added on the Model 3. When the factor loadings and intercepts of the measured and latent variables are all constrained to be equal across groups, it suggests that the structure pattern and measurement unit are identical in the groups. The next level (Model 5) was to impose the constraints on factor unique variance of the latent variables to test the invariance of disturbances across groups. Finally, the most restricted model (Model 6), the residual equality constraints of measured variables were added on the Model 5, was tested for measurement error invariance across groups (Byrne, 2008; Byrne & Stewart, 2006; Widaman & Reise, 1997).

Multiple-group analyses of the hypothesized model for males and females were conducted in sequence with more additional constraints embedded in appearance order. The results are presented in Table 2. First, the Model 1 (configural invariance)

showed that the model fit the data well across gender groups. Secondly, for Model 2 (metric invariance), the goodness-of-fit indices were satisfactory for both groups, in other words, it revealed that the model also had an acceptable fit to the data. The $\Delta\chi^2$ between Model 2 and Model 1 ($\Delta\chi^2 = 11.80$, $\Delta df = 5$, $p < .01$) showed a significant difference between gender. However, taking the large sample size ($n = 4589$) into consideration, the ΔCFI was the more practical criterion in the current study

(Cheung & Rensvold, 2002). In this case, the CFI value of Model 2 was identical to Model 1, therefore the invariance of factor loadings of measured variables was accepted for both groups. Thirdly, for model 3, the factor loadings and intercepts of measured variables were all set at equal for both gender groups. Likewise, Model 3 had an acceptable fit to the data, the $\Delta\chi^2$ was also significant ($\Delta\chi^2 = 101.16$, $\Delta df = 13$, $p < .001$), and the ΔCFI was less than .01, therefore the intercepts of measured variables did not vary with gender. Fourthly, Model 4 was estimated with equality constraints on the factor loadings and intercepts of latent variables. This constrained model also displayed acceptable goodness-of-fit. The non-significant $\Delta\chi^2$ ($\Delta\chi^2 = 3.42$, $\Delta df = 5$, $p > .05$) and the value of 0 of ΔCFI indicated the structure and strength of linear relationships among latent variables were invariant across gender groups. Subsequently, disturbances of the latent variables were constrained as equal across groups in Model 5. Even though the chi-square difference test, based on a large sample size, between Model 5 and Model 4 was significant ($\Delta\chi^2 = 14.07$, $\Delta df = 4$, $p < .01$), the change value of CFI ($\Delta CFI = 0$) and the other goodness-of-fit indices also revealed that Model 5 have a good fit to the data. Finally, Model 7 with equality constraints on residual variance across groups was tested. The goodness-of-fit indices showed that Model 7 fit the data well. The $\Delta\chi^2$ was not significant ($\Delta\chi^2 = 17.47$, $\Delta df = 17$, $p > .05$), and the ΔCFI was less than .01, then we concluded that invariance of residuals variance of measured variables across gender was supported and tenable. Using the Cheung-Rensvold recommendations and guidelines, the results of multiple-group analyses consistently indicated that all invariance constraints of the hypothesized model were all equal across gender. Hence, the hypothesized model in the current study was not only robust statistically, but also cross-valid for gender practically.

In addition, with the path analysis with latent variables (PA-LV) in structural equation modeling, we probed the mediating contribution of the variables which affected the causal relationship between parental education level to the reading attainment. In other words, through estimating and disaggregating the direct and indirect effects of parental education level, the relation between parental education levels on reading attainment is clarified with great clearness.

The results of multiple-group analyses supported that the invariance of different gender were on factors loading, intercepts, disturbances, and residual variance. And all restricted models proposed in the multiple-group analyses had good fit across gender. Consequently, the most restricted model (Model 6) was chosen as a reference to explicate aforementioned mediating mechanisms. In this model, the direct effect of the parental education level was substantial (.43), but indirect effect was very weak (.01). Based on the findings of the cross-validity in gender groups, the mediating effects of parental reading attitude were very weak practically for 4th graders in Taiwan.

Table 2 The Fit Indices for Multiple Group Analysis across Gender Groups

Model	χ^2	df	CFI	TLI	NFI	RMSEA	SRMR	Model Comparison	Δ CFI	$\Delta\chi^2$	Δ df
Model 1											
Configural invariance	317.16	128	.995	.994	.992	.018	.029	-	-	-	-
Model 2											
Invariance of factor loadings of measured variables	328.96	133	.995	.994	.992	.018	.029	2 vs. 1	0	11.80*	5
Model 3											
Invariance of intercepts of measured variables	430.12	146	.993	.992	.989	.021	.029	3 vs. 2	.002	101.16***	13
Model 4											
Invariance of intercepts of latent variables	433.54	151	.993	.993	.989	.020	.029	4 vs. 3	0	3.42	5
Model 5											
Invariance of disturbances of latent variables	447.61	155	.993	.992	.989	.020	.029	5 vs. 4	0	14.07**	4
Model 6											
Invariance of residuals variance of measured variables	465.08	168	.992	.993	.988	.020	.030	6 vs. 5	.001	17.47	13

Note. Female group $N = 2185$, male group $N = 2402$. * $p < .05$, ** $p < .01$, *** $p < .001$

Discussion

The main goal of the present study was to analyze the effects of parental education level, parental reading attitude, and current home reading activities on students' reading attainment in a representative sample of PIRLS 2006. In this study, reading attitude showed the inclination for being positive (enjoying reading, and enjoying talking about books with others) toward reading. Current home reading activities was defined as engagement in literacy activities with children and included: parents listening to children reading aloud, talking with them about what they are reading on their own, and talking to them about classroom reading work. And reading attainment was measured by two major types of text: informational, which calls for the reader to acquire, process, interpret, and analyze information, and literary.

A hypothesized model of the relationships among parental education level, parental reading attitude, and current home reading activities on students' reading attainment was proposed and the explanative power of the model could advance the literature on how family influences Taiwanese students' reading. Meanwhile, we also tested for the equivalence of relationships among variables in the hypothesized model across gender with a series of multiple-group analyses. The results showed that the hypothesized model exhibited good fit to the both male and female data. It could explain moderately 19% to 20 % variance of reading attainment. Furthermore, the results from measurement invariance supported the hypothesized model was valid and tenable across gender.

According to the correlation coefficients among all variables, this study found that family factors of parental education level and parental reading attitude were both associated with Taiwanese fourth-graders' reading attainment to various extents, but current home reading activities were not necessarily related to reading attainment, for example: the variable of parents listening to children reading aloud was not. At the first sight, this findings was inconsistent with Western studies on fifth graders (e.g. Greaney & Hegarty, 1987; Neuman, 1986) and a few studies on Taiwanese adolescents (e.g. Chen, 2008a), which both suggested that family process variables exert more impact than family SES on reading practice. But, on second thought, this is quite understandable since reading aloud might be more prevailed when the children were younger rather than in their fourth grade. Furthermore, we found a substantial effect of parental education level on Taiwanese fourth graders' reading attainment, and most of this effect was a direct one. To be specific, the total effect of parental education level on reading attainment is .44 of which .43 is a direct effect and .01 is mediated via parental reading attitude. And most of all, boys and girls data have shared the same pattern. Consequently, this model is robust. Taiwanese 4th grade students' reading attainment substantially linked to parental education levels as Western countries studied by Myrberg and Rosen (2008) is not at all surprising parents with higher education level appreciate and enjoy reading more. In return, they have more literacy activities with their children.

However, according to our model, parental reading attitude and current home reading activities were supposed to serve to mediate the relationship between parental education level and students' reading attainment, but the explanative power of parental reading attitude and current home reading activities were not markedly influential. Even though previous studies have provided empirical evidence to support current home reading activities to have significant impact upon students' reading achievement (e.g. Rowe, 1991; Wu, 2002), our findings challenged the established account, and echoed Chen and Ko's (2009) and Ko and Chan's (2009) study that used regression analyses with the same PIRLS data.

In fact, the result was quite consistent with the findings of Western studies in the sense that parental education level does have a strong total effect on reading attainment. Nevertheless, it is interesting to note this findings did not apply to the situation of our neighbor, Hong Kong (Myrberg & Rosen, 2008; Myrberg & Rosen, 2009; Park, 2008). Also, in practice, the result could be a blowout for those who work hard to promote reading among parents and children. Since this study is a secondary analysis and the questionnaire has some limitations, future studies are recommended to measure the specific variable of reading practice at home more accurately by collecting data with an activity diary over a lengthy period of time. If we can improve the instrument on reading practice, maybe we can get a better picture on the associations among home reading activities, reading attitude and reading attainment. In addition, since the results of this study reveal that the family factors only have moderate explanative power regarding reading attainment, how school factors are linked to Taiwanese children's reading attainment remains a very important area for future research.

References

- Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588-606.
- Bus, A. G., van Ijzendoorn, M. H., & Pellegrini, A. D. (1995). Joint book reading makes for success in learning to read: A meta-analysis on intergenerational transmission of literacy. *Review of Educational Research*, *65*(1), 1-21.
- Byrne, B. M. (2008). Testing for multigroup equivalence of a measuring instrument: A walk through the process. *Psicothema*, *20*, 872-882.
- Byrne, B. M., & Stewart, S. M. (2006). The MACS approach to testing for multigroup invariance of a second-order structure: A walk through the process. *Structural Equation Modeling*, *13*(2), 287-321.
- Byrne, B., Shavelson, R., & Muthén, B. (1989). Testing for the equivalence of factor covariance and mean structures: The issue of partial measurement invariance. *Psychological Bulletin*, *105*, 456-466.
- Campbell, J. R., Kelly, D. L., Mullis, I. V. S., Martin, M. O., & Sainsbury, M. (2001). *Framework and specifications for PIRLS assessment 2001* (2nd ed.). Chestnut Hill, MA: Boston College.
- Chen, S. Y. (2007). Extracurricular reading habits and reading interests of college students in Taiwan - Findings from two national surveys. *Journal of Adolescent and Adult Literacy*, *50*(8), 642-655.
- Chen, S. Y. (2008a). Who is the avid adolescent reader in Taiwan? The role of gender, family and teacher. *Journal of Adolescent and Adult Literacy*, *52*(3), 214-223.
- Chen, S. Y. (2008b). Reading practices and profiles of older adults in Taiwan. *Educational Gerontology*, *34*(5), 427-441.
- Chen, S. Y. (2009). Functions of reading and adults' reading interests. *Reading Improvement*, *46*(2), 108-116.
- Chen, S. Y., & Ko, H. W. (2009, October). *Family factors and reading practice, reading attitude, and reading attainment: Findings from PIRLS 2006*. Paper presented in IDAC Conference by International Reading Association (IRA), Penang, Malaysia.
- Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling*, *9*, 233-255.
- DeBaryshe, B. D. (1995). Maternal belief systems: Linchpin in the home reading process. *Journal of Applied Developmental Psychology*, *16*, 1-20.

- Foy, P., & Kennedy, A. M. (2008). *PIRLS 2006 user guide for the international database*. TIMSS and PIRLS, International Study Center, Chestnut Hill, MA: Boston College.
- Greaney, V., & Hegarty, M. (1987). Correlates of leisure-time reading. *Journal of Research in Reading*, *10*(1), 3-12.
- Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1-55.
- Hu, L.-T., & Bentler, P. M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*, 424-453.
- Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York, NY: The Guilford Press.
- Ko, W. H., & Chan, Y. L. (2009). Family factors and primary students' reading attainment: A Chinese community perspective. *Chinese Education and Society*, *42*(3), 33-48.
- Mullis, I. V. S., Martin, M. O., Kennedy, A. M., & Foy, P. (2007). *PIRLS 2006 international report: IEA's progress in international reading literacy study in primary schools in 40 countries*. TIMSS and PIRLS, International Study Center, Chestnut Hill, MA: Boston College.
- Muthén, L. K., & Muthén, B. O. (2010). *Mplus user's guide*. Los Angeles, Ca: Authors.
- Myrberg, E., & Rosen, M. (2008). A path model with mediating factors of parents' education on students' reading achievement in seven countries. *Educational Research and Evaluation*, *14*(6), 507-520.
- Myrberg, E., & Rosen, M. (2009). Direct and indirect effects of parents' education on reading achievement among third graders in Sweden. *British Journal of Educational Psychology*, *79*, 695-711.
- Neuman, S. (1986). The home environment and fifth-grade students' leisure reading. *Elementary School Journal*, *86*(3), 333-343.
- Park, H. (2008). Home literacy environments and children's reading performance: A comparative study of 25 countries. *Educational Research and Evaluation*, *14*(6), 489-505.
- Rowe, K. J. (1991). The influence of reading activity at home on students' attitudes towards reading, classroom attentiveness and reading achievement: An application of structural equation modeling. *British Journal of Educational Psychology*, *61*(1), 19-35.
- Satorra, A. (2000) Scaled and adjusted restricted tests in multi-sample analysis of moment structures. In R. D. H. Heijmans, D. S. G. Pollock, & A. Satorra (Eds.), *Innovations in multivariate statistical analyses. A festschrift for Heinz Neudecker* (pp. 233-247). London, UK: Kluwer Academic.

- Sénéchal, M., & LeFevre, J-A. (2002). Parental involvement in the development of children's reading skills: A five-year longitudinal study. *Child Development*, 73(2), 445-460.
- Sénéchal, M., LeFevre, J. A., Thomas, E. M., & Daley, K. E. (1998). Differential effects of home literacy experiences on the development of oral and written language. *Reading Research Quarterly*, 33, 96-116.
- Tabachnick, B.G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston, Ma: Allyn & Bacon.
- Tse, S. K., Lam, R. Y. J., Lam, J. W. I., Chan, Y. M., & Loh, E. K. Y. (2006). Attitudes and attainment: A comparison of Hong Kong, Singaporean and English students' reading. *Research in Education*, 76, 74-87.
- Widaman, K. F., & Reise, S. P. (1997). Exploring the measurement invariance of psychological instruments: Applications in the substance use domain. In K. J. Bryant, M. Windle, & S. G. West (Eds.), *The science of prevention: Methodological advances from alcohol and substance abuse research* (pp. 281-324). Washington, DC: American Psychological Association.
- Wu, M. (2004). Plausible values. *Rasch Measurement Transactions*, 18, 976-978.
- Wu, Y. C. (2002). A study of family surrounding factors as related to children's reading abilities. *Bulletin of Educational Psychology*, 34(1), 1-20. (in Chinese)

收稿日期：2010年09月06日

一稿修訂日期：2010年10月05日

二稿修訂日期：2011年01月17日

三稿修訂日期：2011年05月30日

四稿修訂日期：2011年06月07日

接受刊登日期：2011年06月07日

家長教育程度、閱讀態度和家庭閱讀 活動對於學生閱讀成就的影響 ：PIRLS 2006

陳素燕

國立清華大學
師資培育中心

張毓仁 柯華葳

國立中央大學
學習與教學研究所

本研究旨在探索家長教育程度、閱讀態度和家庭閱讀活動對學生閱讀成就的影響，及此影響是否具有跨性別群體的恆等性。研究資料為臺灣地區「促進國際閱讀素養研究」(PIRLS 2006)資料庫，研究者以結構方程模式的多群組分析 (multiple-group analysis) 方法進行探究。結果顯示，家長教育程度、閱讀態度和家庭閱讀活動對於不同性別學生的閱讀成就之結構模型均具有良好適配。其次，測量恆等性分析支持模型有跨性別群體的效度。家長教育程度對學生閱讀成就影響的直接效果十分顯著，而間接效果則僅透過閱讀態度產生影響，且效果微弱。最後，本文提出對於台灣閱讀影響因素研究的建議。

關鍵詞：多群組分析、促進國際閱讀素養研究、家長教育程度、閱讀成就、閱讀態度