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The School Community as a Mediating Factor in the Relationship Between Family Processes and Mathematics Performance

Frank Wai-ming Tam, Shuk-han Pun
Faculty of Education
The Chinese University of Hong Kong

The present study aims to explore how social contexts of schools mediate the relationship between family processes and academic performance of Primary 1 to Primary 3 students in Mathematics within an ecological model of human development built on the work of Bronfenbrenner. A total of 1,383 families with children studying in 29 primary schools were recruited to participate in a questionnaire survey research on parental education. Hierarchical linear regression was used to assess the direct and interaction effects of the individual factors and school social contextual factors. Findings suggest that averaged parental involvement as a contextual factor of school mediates the relationship between gender and mathematics performance. The results of this research provide researchers a better

Correspondence concerning this article should be addressed to Frank Wai-ming Tam, Department of Educational Administration and Policy, Faculty of Education, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong. E-mail: wmtam@cuhk.edu.hk

understanding of the linkage between family and school, and have implications for the current home-school-community relations.

Key words: home-school relations, parental involvement, school effectiveness, home effects

In understanding the academic performance of children, a wealth of research has demonstrated the crucial role of family background in mediating the physical, human and social capital available to them (e.g., Alexander, Riordan, Fennessey, & Pallas, 1982; Anyon, 1980; Coleman, 1990; Duncan, 1994; Entwisle & Alexander, 1992; Lareau, 1987; Roscigno & Ainsworth-Darnell, 1999). One's family covers a set of characteristics: family structure, family size, family relationship, socio-economic status (SES) of the family, parenting styles, parenting values and parental involvement in the direct care and education of children. These characteristics tend to take effect on one's academic performance in an interactive way. For example, parents' educational level which tends to constitute the socio-economic status of the family may affect how they raise their children and what kind of values they want to inculcate in them. The interplay of all these family characteristics constitutes the family environment in which children are socialized. The general understanding is that parents have greater control than their children over environmental contingencies and they tend to possess focused socialization goals for their children (Baumrind, 1980; Stafford & Bayer, 1993). Pursuit of these goals will determine how parents raise, discipline and support their children in development. Therefore, the family, especially in the Chinese society, does exert influence on the way how children work and whether they will strive to achieve in school. It is within this general understanding that we assess the relative importance of different family determinants, and their interaction with contextual factors of schools, in affecting the academic performance of students at levels from Primary 1 to 3 in Hong Kong.

Conceptualization of Family Environment

Based on Bronfenbrenner's (1979) ecological model of human development and its modification (Epstein, 1987), one's family environment is conceptualized at three levels in the present study. The first level is the microsystem level. Microsystem refers to the particular small settings, such as families, schools, and neighborhoods. For example, the family is the setting where parental roles are asserted. It provides nurturance, affection, and a variety of opportunities for children to strive to grow physically, emotionally and cognitively. The family environment is also a context in which family members are actively engaged in reciprocal interactions with each other. The second level, the mesosystem, consists of linkages and interrelationships between two or more microsystems. Parental involvement in the schools of their children, for instance, provides opportunities for parents to receive support from the school and from other parents. Participation in community activities, such as voluntary work by parents, brings in more social and cultural resources to the family. The macrosystem level is the third level where all the sub-systems are embedded. This level involves the society and culture to which the parents belong, with particular reference to the belief systems, lifestyles, and patterns of social interchange. The macrosystem level influences the value system of the parents, the parenting ideology, as well as the nature of parent-child interactions.

Socioeconomic Background

Ample evidence demonstrates that there are important relationships between the socioeconomic conditions of families and student achievement (Alexander et al., 1982; Duncan, Brooks-Gunn, & Klebanov, 1994; Garrett, Ng'andu, & Ferron, 1994; Huston, 1991). In the present study, the socioeconomic condition is taken as the combination of two factors: income of the family and education level of the parents. Family income, which is an important resource for the family, is a key indicator to describe how families manage themselves. One may look at how family income contributes to

family well being in two ways. First, family income can be seen as the primary measure of the economic base of the family. Second, it can be seen as a standard below which issues of basic subsistence and survival dominate. Studies on the effects of poverty on child development establish that material deprivation is unfavorable to both child development and school performance (Duncan & Brooks-Gunn, 1997).

Parents' educational level, though being closely related to family income, is an important human resource of a family which contributes to child development in both direct and indirect ways (Parcel & Dufur, 2001). In a meritocratic society, most parents, whether having higher or lower educational attainment, tend to have high expectations for their children's academic performance. Yet, it is those parents with higher educational attainment who have more means, both physical and human, to provide home-based educational support for their children, such as the engagement of a private tutor or having themselves as tutors, and to keep children in school longer. Furthermore, they facilitate greater chance of school success for their children as their family socialization tends to match the middle-class expectations of the schools and their teachers (Bourdieu, 1986).

While the better physical and human resources available in families with higher SES do enhance the academic performance of many children, it should be noted that the effect of one's socio-economic background may vary at different life stages of the students and in different social-cultural contexts. Fuligni (1997) found among a group of adolescents from immigrant families with Latino, East Asian, Filipino, and European backgrounds that in explaining their academic success, the strong emphasis on education shared by their parents, their peers and the students themselves was more a significant correlate than their SES background.

Family Relationship

The relationship among family members has long been considered an important factor that leads to a number of important individual and family outcomes, such as life satisfaction (Barber & Thomas, 1986; Rohner, 1986),

marriage satisfaction (Bell, Daily, & Conzalez, 1987; McRae & Brody, 1989), positive family atmosphere (Barber & Thomas, 1986; Rollins & Thomas, 1979), children's self-esteem (Gecas & Schwalbe, 1986; Peterson & Rollins, 1999), personal and social competence (Felson & Zielinski, 1989), and adolescent delinquency (Lau & Chan, 1997). Positive family relationship has been characterized by a number of researchers as cohesion and adaptability (Olson, 1995), attachment and emotional bondage (Patterson, 1982), as well as involvement, communication and support (Lau & Chan, 1997). In a study of the perceptions of Chinese adolescents and their parents towards a happy family, Shek and Chan (1998) have derived five dimensions of family relationship in the context of Hong Kong. These dimensions are affection and support, understanding and acceptance, cohesion within the family, conflict resolution and harmony, and handling of family issues together. It is generally believed that within such a happy family, children can perform to their best in different dimensions of their lives.

Parental Involvement as Social and Cultural Resources for Child Development

Parental involvement in the care and education of children can take place both within and outside of the family. Within a family, parental involvement can be broadly conceived as a form of relationship between parents and children. Normally, regular communication, and a minimum amount of time and effort is needed. The involvement process could consist of reading to children, helping with homework, listening to their problems, praising their achievements, comforting their failures, teaching basic values and social skills, as well as building self-control and good habits. Parental involvement taking place outside the family can take the forms of participating in children's school activities, doing voluntary work together with children and taking them to museums and cultural activities.

Many studies have found that parental involvement has an important relationship with family functioning and student achievement. Similarly to what Lee (1993) and Astone and McLanahan (1991) have found, Epstein

(1987) finds a significant improvement in student achievement and attitudes when parents assume an educational role in the home, such as tutoring, informal learning games, or simply listening to their child read, and in school, such as volunteering, making decisions. Several studies with children of low socio-economic background have shown that programs that increase parental participation and interaction of parents with children and the school can be very important in improving the performance of children (Chall & Snow, 1988; Comer, 1988). Having parents read to children is found particularly effective in predicting success in school among children whose parents have low levels of education (De Graaf, De Graaf, & Kraaykamp, 2000; Guo & Mullan Harris, 2000). Also, Cheung and Andersen (2003) learn from a longitudinal study, which tracked the relationship between family characteristics and factors associated with educational attainment for individuals from birth to aged 33 in Britain, that cultural and social resources in the family play an independent role as important as that played by social class. In particular, social resources, measured as a scale consisting of items on the frequency at which the mother read to the child, the frequency at which the father read to the child, whether the parents inspired their child to attain higher education, father's interest in the child's education, and mother's interest in the child's education, have direct and lasting effects on academic success. It is also found that such effects are most pronounced in the earlier stages of the child's educational career.

Community Effects—SES Context and Parental Involvement in School

It has been mentioned that both socioeconomic background of the family and parental involvement are important factors contributing to children's academic outcomes. Yet, the characteristics of other systems within the ecology of a family also affect student learning. The SES context of a school has been reported to have an independent effect upon the educational aspiration of students (Coleman, 1990). McDill and Rigsby (1973) found

that the effect of SES context is due to its influence on the academic climate and policies of the schools. Parental involvement in schools, such as participation in the affairs of a child's school and parent education, is signified by a high degree of interconnectedness between students, parents, and teachers (Coleman, 1988, 1990). When teachers and parents have a joint interest in the well-being of the students, the school will become a functional community (Arthur & Bailey, 2000; Smrekar, 1996). Hence, the aggregated effect of involvement of parents in schools can be regarded as a form of social capital available to the children in the school community. More specifically, it will affect the expectation and behavior of students, their access to educational resources, classroom climate and teachers' practice (Roscigno & Ainsworth-Darnell, 1999). Lareau (1989) has shown that higher SES students do better in school partly because their parents are more involved in the school than working-class parents are.

Family Environment, School Community and Academic Performance

Based on the ecological framework developed above, the present study investigates the extent to which family environment as well as the social contexts of school contribute to the academic performance of children. Family environment is conceptualized in terms of two aspects. The first aspect is family background which includes family's SES. It is expected that higher family SES will lead to better academic performance. The aspect is family relationship. As expected, better family relationship will lead to better academic performance.

In the present study, we hypothesize that the SES context of a school as well as the averaged parental involvement in schools are assumed to have mediating effects on the relationship between family processes and students' academic achievement. As argued above, the former being an aggregate measure of students' family SES is a determinant of the learning atmosphere of the school and it will have impacts on certain school policies. It is assumed

that parental involvement at the school level can generate social capital for the school because when parents are involved, the social network and a norm of reciprocity and trust generated between and among parents and teachers can help develop an environment conducive to learning for students.

Children's academic achievement is assessed by their performance in Mathematics subjects in the Hong Kong Attainment Test, which is a norm-referenced, graded test administered to all primary and junior secondary students every year. This is a means to systematically monitor the academic performance of students in Hong Kong.

Method

Sampling. The present study was a cross-sectional survey using a stratified sampling method. The data were taken from a large scale research project on parent education headed by W. M. Tam of The Chinese University of Hong Kong (Tam, Lam, Cheng, Ho, & Ma, 2002). The subjects of this study were students and their parents who were randomly selected from the schools which participated in the study. There were 29 primary schools involved. A total number of 1,383 families were involved in the survey and they were identified through their children who were studying in the sampled primary schools.

Survey Instrument. A questionnaire, called Parent Questionnaire which consists of different sets of questions, was used to probe respondents on their family processes. The students who were selected to participate in the survey were asked to take the questionnaires to their parents and return them to the school after completion. Information about students' Hong Kong Attainment Test scores were provided by the participating schools.

Family relationship is a 20-item scale based on a research for the assessment of the perceptions of Chinese adolescents and their parents towards a happy family (Tam et al., 2002). The reliability in their study had been reported to be within a range of 0.7 to 0.8 for families with children of different age cohorts. The scale measures the level of support, care,

understanding and acceptance among family members and level of coherence within the family. Some sample items are "Parents and children have much time being together," "Our family atmosphere is usually pleasant." Respondents are asked to rate each of the twenty items on a five-point scale ranging from "very accurate" (5), "accurate" (4), "somewhat accurate" (3), "inaccurate" (2) to "very inaccurate" (1). Alpha reliability of the scale reported in this study is 0.3917.

Socioeconomic background of the family is a composite score based on two variables: monthly household income and average educational levels of parents. For the monthly household income, respondents are asked to provide information on a nine-point scale ranging from "5,000 or less" (1), "5,001 to 10,000" (2), "10,001 to 15,000" (3), "15,001 to 20,000" (4), "20,001 to 40,000" (5), "40,001 to 60,000" (6), "60,001 to 80,000 (7), and "80,001 or above (8) in Hong Kong dollars. For the educational level, respondents are asked to provide information on a ten-point scale ranging from "no formal education" (1), "primary education" (2), "junior secondary" (3), "senior secondary" (4), "matriculation" (5), "vocational school" (6), "vocational school (diploma level)" (7), "community college or sub-degree programs" (8), "university degree" (9), "graduate school" (10). Socioeconomic background of the family is the average of the standardized values of the monthly household income and average educational levels of parents.

Parental involvement in school is based on Ho's (1999) conception that parents can be involved in two domains of activities in school. One domain is involvement in school activities, and the other is involvement in decision making. There are six items in each domain. A sample item in the activity domain is "I will participate in activities for parents in school, such as attending parent education seminars." A sample item in the decision domain is "I will give my opinions about school policies." Respondents are asked to rate their level of involvement on a five-point scale ranging from "always" (3), "sometimes" (2), "seldom" (1), "never" (0). Alpha reliability of the composite scale reported in this study is 0.6668.

Statistical Model. The present study employed a hierarchical linear regression model for statistical analysis (Raudenbush & Bryk, 2002). The academic achievements of students were considered to be a function of family environment variables. Such method is employed because it is assumed that there is an aggregated community effect at the school level which influences the academic performance of students. The hierarchical linear model normally has a nested structure—individuals nested within social units such as schools. The biggest advantage of a hierarchical model over a single level one is that in single level model, such as data treated at the school level, lower level data will be averaged to provide mean school level scores, so variations at the lower levels will be totally ignored, whereas in the hierarchical model, variations at all levels are retained.

Results

The focus of the present investigation is on the multi-level analysis with the family process variables and school social contexts as independent variables and mathematics performance of children as dependent variables. Due to the lengthiness of the questionnaire, some participating parents omitted certain parts of the questionnaires, such as the family relationship scale. This explains the variation in response rates found in Table 1.

Table 1 Means and Standard Deviations of the Variables and Scales

Variables	Responses	Response range	Actual *M*	*SD*
Household income	1,080	1 to 8	$17,600	$13,972
Father's education	1,054	1 to 10	9.0 years	3.4 years
Mother's education	1,143	1 to 10	8.7 years	3.3 years
Family relationship	1,183	1 to 5	3.67	0.46
Averaged parental involvement in school[a]	29	0 to 3	0.94	0.13
Averaged SES of school[b]	29	—	—	—
Academic performance: Mathematics	1,383	—	42.08	25.12

a Averaged parental involvement in school is the school level aggregation of the parental involvement in school measure.

b Averaged SES of school is computed by aggregating the sum of the standardized values of household income and average of father's and mother's education.

Descriptive Statistics of the Variables and Scales

Table 1 reports the response rates, response ranges actual means, and standard deviations of the variables and scales. The averaged parental involvement in school is an aggregated measure at the school level. Similarly, averaged SES is the family socio-economic status aggregated at the school level. In some of the scales in Table 1, the actual means deviate much from the middle of the response range, sometimes up to two standard deviations. An example of it is parental involvement in school. These suggest that parents in Hong Kong, in general, are not eager to be involved in their children's schools, which is considered a normal behavior for Chinese parents. Table 2 reports the zero order correlation for the variables.

Table 2 Correlation Coefficients of the Variables

		Individual level variables				
	Variables	1	2	3	4	5
1	Gender (girls = 2; boy = 1)	—				
2	Family relationship	0.028	—			
3	Parental involvement (PI)in school	−0.065*	0.194**	—		
4	Socioeconomic background	−0.004	0.290**	0.166**	—	
5	Mathematics attainment scores	−0.020	0.130**	0.022	0.227**	—

*$p < 0.05$ **$p < 0.005$

Multi-Level Analysis of Academic Performance (Base Model)

Multi-level analysis is employed to assess the effects of the family factors, school contextual characteristics, and children's gender (male = 0, female = 1) on the attainment test scores of Mathematics (see Table 3). As gender difference in mathematics performance has always been noted, it is included here as an independent variable. Tables 3 reports the results of the base model of the multi-level analysis.

Contribution of gender. Gender difference in academic performance has been well documented, but the findings are somewhat contradictory (Alexander & Eckland, 1974; Sadker, Sadker, & Kline, 1991). Studies have shown that girls receive unequal treatment in the classroom and in curriculum opportunities, their work is undervalued relative to boys' work, and their

Table 3 Multi-level Analysis of Mathematics Achievement (Base Model)

Main Effects	*df*	Coefficients	*SE*	T-ratio
Individual level				
gender	28	0.022	0.067	−0.332
socioeconomic background	28	0.104	0.042	2.504*
family relationship	28	0.102	0.061	1.674
School level				
average SES of school (SSES)	26	0.443	0.122	3.640**
average parental involvement in schools (PI)	26	0.170	0.331	0.514
Random effect		*SD*	Variance com.	Chi-square
gender	27	0.209	0.044	42.08*
family SES	27	0.030	0.001	28.61
family relationship	27	0.038	0.001	19.87
No. of schools = 29; No. of students = 1,508				
Within-group (Individual level) variations			85.10%	
Between-group (School level) variations			14.90%	

*$p < 0.05$ **$p < 0.005$

self-confidence and self-esteem may be damaged during teacher-student interactions, and yet many studies have also shown that girls do better than boys academically, except in the areas of mathematics and science (Hedges & Nowell, 1995; Riordan, 1990; Sadker & Sadker, 1994). In the present research, the performance of girls in Mathematics is not significantly different from that of boys.

Contribution of family factors. School effectiveness studies have consistently revealed that socioeconomic status is the most important family background variable (Alexander et al., 1982). The higher the social class of the home, the higher the achievement of students will be. Only in developing and less-developed countries is the relationship attenuated (Fuller & Heyneman, 1989). In the present study, socio-economic background of the family, which is the combination of family income and parents' educational level, contributes significantly to children's attainment in Mathematics ($\beta = 0.104$, $SE = 0.042$, $p < 0.05$). The moderate contribution of socio-economic background to Mathematics attainment is somewhat expected because students' performance of Mathematics has been found to be less dependent on their social background than language subjects.

Contribution of school social contexts. Aggregated socio-economic background of the families at the school level contributes significantly to Mathematics ($\beta = 0.443$, $SE = 0.122$, $p < 0.005$), but averaged parental involvement in school does not contribute significantly to Mathematics. The effect of the SES context of school is expected given the effect of family SES found earlier but the insignificant effect of averaged parental involvement in school is unexpected since the contribution of social capital to academic performance has been well documented (Epstein, 1987). Putting the results in the context of Hong Kong, a clue to this unanticipated relationship has been delineated. The occasion where parents need to make contact with teachers or go to school, a form of parental involvement in school, is usually the time when their children are not doing well, whether academically or in conduct. This probably explains the insignificant impact observed here.

Contribution of the random part. The presence of significant contributions in the random part of a multi-level model suggests that there may be subtle relationships between the independent and the dependent variables. There may be several reasons for a significant contribution from the random part. Some common ones are the unequal distribution of variance in the model, unequal distribution of variance among the classes, or a nonlinear relationship between the independent and dependent variables (Tam & Cheng, 1995). For example, in Table 3, it has been shown that gender does not contribute to Mathematics attainment at the individual level. Yet, a significant contribution of gender is found in the random part ($\tau = 0.043$, $X^2 = 42.08$, $p < 0.05$). This suggests that the variance of the gender-attainment slope is not distributed evenly and there may be an interaction effect taking place. Therefore, in the next section, interaction effects of the multi-level regression will be explored for those variables that have a significant contribution in the random part.

Multi-Level Analysis of Academic Performance (Interaction Effect)

Table 4 reports the result of the interaction analysis. Only one interaction

term is shown to have significant contributions, and it is the interaction between averaged parental involvement in schools (PI) and gender ($\beta = 0.944$, $SE = 0.259$, $p < 0.005$). In order to demonstrate the interaction effect, we have drawn the plot of the relationship between gender and Mathematics attainment for schools with low average parental involvement and schools with high average parental involvement. The two lines in the plot are two groups of schools with high and low average parental involvement. The gradient for high PI schools is close to zero, but the gradient for low PI schools is negative. The explanation for this may be that in the two groups of schools, the relationship between gender and Mathematics attainment are different. In the low PI schools, boys have higher Mathematics attainment than girls, but in high PI schools, the two genders have similar attainment in Mathematics. The finding may imply that while boys in general perform slightly better than girls in Mathematics, yet the high PI schools may have created a more inclusive environment that is more equally favorable to both boys and girls for learning Mathematics.

Table 4 Multi-level Analysis of Mathematics Achievement (Interaction Effect)

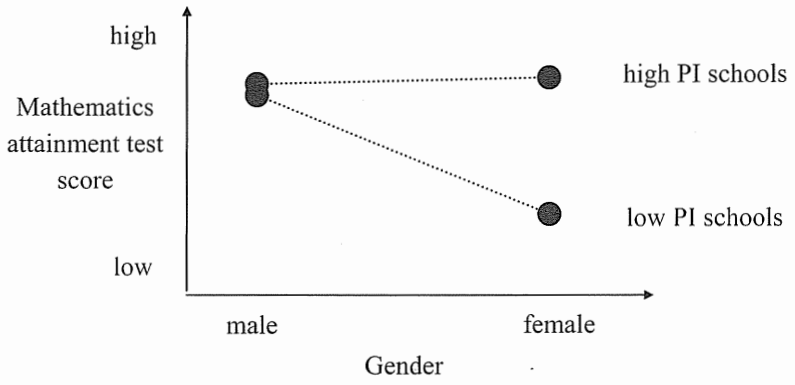
Main Effects	*df*	Coefficients	*SE*	T-ratio
Individual level				
gender	28	0.112	0.087	−1.292
socioeconomic background	28	0.108	0.041	2.620*
family relationship	28	0.078	0.159	0.488
School level				
average SES of school (SSES)	26	0.445	0.134	3.320**
average par. involve. in schools (PI)	26	−0.109	0.372	−0.294
Interaction effect				
gender x SSES	26	0.078	0.135	0.570
gender x PI	26	0.944	0.259	0.001**

*$p < 0.05$ **$p < 0.005$

Discussion

In understanding the academic performance of children, we draw on an ecological framework to outline the different but intertwined ecosystems where parents and children interact and reinforce one another in striving for

Figure 1 Plot of Gender Against Mathematics Attainment for High and Low Parental Involvement (PI) Schools (The plot is not drawn to scale)



some life goals. Two family factors, namely: family socioeconomic background and family relationship, and two school contextual factors, namely, averaged socioeconomic background and averaged parental involvement, are identified as key factors that affect the performance of children in Mathematics. With children coming from the lower primary levels of P1 to P3, a hierarchical regression model was constructed to assess the effects of different variables on student's attainment in Mathematics.

The findings do not support our hypotheses that the contribution of family processes to students' academic performance is mediated by the social contexts of the school. Modest interaction effect between gender and averaged parental involvement in school was seen for students' attainment in Mathematics, but no interaction effect was found between family-level factors and school-level factors. Nevertheless, the finding does confirm the person-context fit hypothesis that when the personal characteristics are inconsistent with the school ecology, the "misfits" may influence the performance of students in schools (Wright, Giammarino, & Parad, 1986).

Findings in this study suggest that parental involvement in school as a school-level factor has a mediating effect on students' academic performance. Existing evidences show that parental involvement in school contributes positively to student's academic achievement (Ho & Willms, 1996). The

present study does suggest that the effects of parental involvement on student performance may be more profound and subtle than merely a direct relationship. Hence, the present paper can be seen as bridging some of the gaps in existing school effectiveness research.

Limitations

There are, nevertheless, a number of limitations in the present study. Firstly, the size of the school samples, that is 29 primary schools, is considered small in hierarchical linear modeling. There is a possibility that this relatively small sample may generate some bias in the interpretation of the results. Secondly, more family process variables, such as the actual amount of time parents spend on the care and education of their children and the frequency at which they perform such a role, can be added to the multi-level model which may shed more light on the relationship between family determinants and academic performance. Thirdly, the majority of question items in the survey questionnaire in the present study were answered by parents. Yet, some of them, such as those on family relationship, could be more valid if they were answered by their children, the students. Finally, having considered only the aggregated family SES and parental involvement in school as effects contributed by the school community, the present study neglects other school-level factors, such as school organization, financial arrangement, curriculum, etc., that may have stronger explanatory power.

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