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The Impact of Family Education Practices on Students' Academic Achievement - An Empirical Study Based on CFPS 2022 Data

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ABSTRACT
Against the backdrop of the "Double Reduction" policy and the implementation of the Family Education Promotion Law, the impact of family education practices on students' academic performance has attracted increasing attention. Using nationally representative survey data, this study focuses on the relationship between family education practices and students' mathematics achievement levels. An ordered logit regression model is employed to examine the effects of parental homework-checking frequency, frequency of discussing school matters with children, and frequency of contacting teachers on academic performance. Variables such as participation in extracurricular tutoring, tutoring expenditure, total study time, urban – rural status, gender, and grade level are controlled to minimize confounding factors. The results reveal a significant negative association between the frequency of discussing school matters and students' mathematics performance; frequent communication is correlated with lower scores, suggesting that excessive attention may have counterproductive effects. Other core variables show no significant impact. Robustness checks—via model substitution and winsorization—confirm the stability of these findings. Further heterogeneity analyses by Chinese language performance, urban – rural differences, and gender consistently support the main conclusion. The study recommends avoiding excessive interference and pressure transmission in family education, fostering positive parent – child communication environments, and strengthening school – community cooperation mechanisms to fully realize the positive role of family education in student development

KEYWORDS
Double reduction policy; Family education practices; Academic achievement

1 Introduction

In recent years, China's basic education reform has increasingly emphasized educational equity and quality. The introduction of the Double Reduction Policy in 2021—aimed at reducing excessive homework and off-campus tutoring—seeks to alleviate academic pressure, regulate the tutoring market, and strengthen the connection between school and family education. Meanwhile, the Law on the Promotion of Family Education underscores the central role of parents, urging them to adopt scientific educational concepts and actively fulfill educational responsibilities.

These policies highlight the growing importance of family education in shaping student outcomes. Under the Double Reduction context, parental communication strategies, homework supervision, and school – family cooperation have become key factors influencing academic achievement, while regional and demographic differences further complicate their effects.

This study uses large-scale survey data to examine the relationship between family education practices—specifically parental homework checking, discussions about school, and teacher contact—and students' mathematics performance. It further explores heterogeneity by gender, urban – rural status, and subject area, providing evidence-based recommendations to optimize family education in the post–Double Reduction era.

2 Literature review

Family education has long been a central focus in educational research. Coleman's Equality of Educational Opportunity report (1968) [1] first highlighted the family environment as a key determinant of children's educational opportunities and outcomes, introducing the concept of parental involvement (Coleman, 1988) [1]. Defined as intentional actions by parents to support their children's development (Zhou, 2015; Hill & Taylor, 2004) [2-3], parental involvement is typically analyzed through two dimensions: educational expectations and parenting practices. Expectations foster motivation and transmit educational values across generations (Davis-Kean, 2005) [4], while higher expectations also predict more active involvement in educational behaviors (Sui-Chu & Wilms, 1996) [5].

Parental practices are generally divided into home-based and school-based involvement. Home-based activities such as homework supervision, shared reading, and cultural enrichment enhance student achievement (Grolnick & Slowiaczek, 1994; Zhao & Hong, 2012) [6-7], while effective parent – child communication further supports academic growth (McNeal, 1999) [8]. School-based involvement emphasizes cooperation with teachers, which strengthens trust and consistency in education, thereby improving student outcomes (Hill & Taylor, 2004) [3].

Research on home – school cooperation confirms its broad benefits. High-quality collaboration improves students'

academic performance, social adjustment, and well-being, while also boosting teacher satisfaction and parents' confidence (Pomerantz & Hill, 2007; Pryzwansky, 1980) [9-10]. However, in China, most studies remain theoretical or small-scale (Xie, 2020) [11], with limited large-scale empirical evidence on how different forms and qualities of cooperation affect achievement.

In summary, prior research underscores the importance of both family education and home–school cooperation, but evidence on the differentiated effects of specific parental behaviors—such as checking homework, discussing school matters, or contacting teachers—remains limited. This study addresses the gap by using CFPS 2022 data and an ordered Logit model to examine how distinct parental practices influence students' mathematics achievement, offering new evidence for family education and policy.

3 Research design

3.1 Data

The data for this study come from the 2022 wave of the China Family Panel Studies (CFPS), a nationally representative longitudinal survey project conducted by the Institute of Social Science Survey at Peking University. After matching different types of questionnaires, the initial sample size was 2, 000. Following the exclusion of cases with missing or abnormal data, and subsequent data cleaning and processing, the final analytical sample comprised 1,892 observations.

3.2 Variables

3.2.1 Dependent variable

The dependent variable in this study is students' academic performance. The CFPS questionnaire provides data on students' mathematics and Chinese language grades, both reported by parents as categorical assessments of regular academic performance. Mathematics grade is adopted as the primary dependent variable to reflect students' academic achievement. This variable is an ordinal categorical variable with four levels: excellent, good, average, and poor, where higher values indicate better performance. To further test robustness, Chinese language grade is also included in the heterogeneity analysis as an alternative measure of academic performance.

3.2.2 Key Independent Variables

The key independent variables are measures of parental educational practices, derived from three CFPS questionnaire items grouped into three dimensions:

(1) Homework supervision – frequency with which parents check their child's homework;

(2) Emotional communication – frequency of parent–child conversations about school matters;

(3) Home–school communication – frequency with which parents contact teachers.

All these variables are five-point ordinal measures, where higher scores indicate more frequent engagement, capturing multiple dimensions of parental involvement in the learning process.

3.2.3 Control Variables

To mitigate omitted variable bias, several control variables are included. First, we control for extracurricular tutoring participation, including whether the student attends tutoring classes (0 = no, 1 = yes) and the amount of tutoring expenditure (winsorized). Second, we control for learning input, measured by the total weekly study hours (including both in-class and out-of-class study time). Third, we account for individual characteristics, including gender (1 = male, 0 = female), household registration type (1 = urban, 0 = rural), and school stage (categorized as primary school, junior high school, and senior high school or above, with dummy variables). These variables are important determinants of academic performance and help enhance the explanatory power and robustness of the model.

3.3 Data analysis

3.3.1 Descriptive analysis

Descriptive statistics indicate that students' mathematics performance is generally at a moderate level. Among the measures of parental educational practices, parents tend to talk with their children about school matters more frequently than they check homework or contact teachers. In addition, approximately 19% of students participate in extracurricular tutoring, with substantial variation in average tutoring expenditures. Weekly total study time also exhibits considerable individual differences. The distributions of household registration type (urban/rural), gender, and school stage are generally balanced.

3.3.2 Correlation analysis

Before conducting the regression analysis, this study examined the correlations among the main variables to

Table 1 Descriptive statistics

Variable Name	Descriptive Statistics			
	Mean	Standard Deviation	Minimum	Maximum
Student Mathematics Performance Level	2.19	1.04	1	4
Frequency of Parents Checking	3.21	1.21	1	5
Frequency of Talking with Children About School	3.49	0.98	1	5
Frequency of Contacting Teachers	2.72	0.98	1	5
Participation in Tutoring (1 = Yes)	0.19	0.39	0	1
Tutoring Expenditure (CNY)	1770.92	5,472.24	0	80000
Weekly Total Study Time (hours)	50.28	17.13	0	168
Urban Household Registration (1 = Yes)	0.22	0.41	0	1
Student Gender (1 = Male)	0.54	0.50	0	1
School Stage (1 = Primary School, ⋯)	1.44	0.55	1	3

determine whether there exists a certain degree of linear relationship between the independent and dependent variables. The specific correlation coefficients are presented in Table 2.

The results show that the correlation coefficient between students ' mathematics achievement level and the frequency of parental homework checking is −0.0857, indicating an extremely weak negative correlation, which is not statistically significant. This suggests that the two variables are almost unrelated. The correlation coefficient between mathematics achievement and the frequency of parents talking with their children about school is −0.1291, showing a weak negative correlation. Although the correlation is low, it may still have explanatory power; therefore, this variable is retained in subsequent models. The correlation coefficient between mathematics achievement and the frequency of parental contact with teachers is –0.0176, indicating virtually no relationship.

Table 2 Results of correlation analysis

Variable Name	Results of Correlation Analysis			
	Student Mathematics Performance Level	Frequency of Parents Checking	Frequency of Talking with Children About School	Frequency of Contacting Teachers
Student Mathematics Performance Level	1.0000	-0.0857	-0.1291	-0.0176
Frequency of Parents Checking	-0.0857	1.0000	0.4022	0.2720
Frequency of Talking with Children About School	-0.1291	0.4022	1.0000	0.2004
Frequency of Contacting Teachers	-0.0176	0.2720	0.2004	1.0000

3.3.3 Multiple collinearity analysis

To ensure the robustness of the regression results, this study further conducted a multicollinearity test on the independent variables in the model, using the Variance Inflation Factor (VIF) as the measure. In general, a VIF value below 10 indicates that there is no serious multicollinearity problem.

The core independent variables in this study include the frequency of parental homework checking, the frequency of parents talking with their children about school, and the frequency of parental contact with teachers. Control variables include participation in extracurricular tutoring, tutoring expenditures, total study time, household registration type, gender, and school stage.

The test results show that the VIF values for all variables are 1.17, far below the threshold of 10, indicating that no serious multicollinearity exists among the independent variables. Therefore, these variables can be included in the regression analysis simultaneously.

3.3.4 Main regression model

To comprehensively examine the impact of family education practices on students ' academic achievement, this study

Table 3 Results of multicollinearity analysis

Variable Name	Results of Multicollinearity Analysis
	VIF Value
Frequency of Parents Checking	1.34
Frequency of Talking with Children About School	1.26
Frequency of Contacting Teachers	1.11
Participation in Tutoring	1.24
Tutoring Expenditure	1.32
Urban Household Registration	1.11
School stage	1.01
mean	1.17

employs an ordered logit regression model and establishes the following baseline regression equation:

$$\text{logit}[P(Yi \leqslant j)] = \alpha j - (\beta 1\ \text{CheckHWi} + \beta 2\ \text{TalkSchooli} + \beta 3\ \text{ContactTeacheri} + \beta 4\ \text{TutoringParticipationi} + \beta 5\ \text{TutoringCosti} + \beta 6\ \text{StudyTimei} + \beta 7\text{UrbanHousehold registrationi} + \beta 8\text{Genderi} + \beta 9\text{SchoolStagei})$$

In this specification, the intercept term represents the cut points in the model, Yi denotes the level of students' mathematics achievement, and β1 to β9 are the regression coefficients for the respective explanatory variables, measuring their influence on achievement levels. The model assumes a monotonic relationship between each variable and students' academic performance, thereby allowing for the identification of systematic links between family education practices, extracurricular learning inputs, and academic outcomes.

By constructing this model, the study aims to clarify the pathways through which family education practices operate under the context of the "Double Reduction" policy, to identify the actual effects of parental educational behaviors on students' performance, and to control for other potential confounding factors. The results are intended to provide empirical evidence to inform both family education strategies and broader education policy.

4 Regression results analysis

4.1 Regression results analysis

This study employs an ordered logit regression model to examine the impact of family education practices on students' mathematics achievement levels. As shown in Table 4, after controlling for factors such as extracurricular tutoring, tutoring expenditures, household registration type, student gender, and school stage, some family education variables exhibit significant relationships with students' mathematics performance.

First, the coefficient for frequency of parental homework checking is 0.022, which is positive but not statistically significant. This indicates that there is no clear relationship between how often parents check their children's homework and students' mathematics achievement levels.

Second, the coefficient for frequency of parents talking with children about school is –0.184 and is significant at the 1% level. This finding suggests that an increase in the frequency of such conversations is associated with a lower probability of attaining higher mathematics achievement levels, and a higher probability of lower-level performance. In other words, this variable shows a significant negative association, possibly reflecting that children in families where parents pay more attention to school matters face greater academic challenges, or that frequent parental intervention and supervision may lead to counterproductive effects.

Third, frequency of parental contact with teachers does not have a significant effect on mathematics achievement levels, indicating that whether parents actively communicate with teachers is not significantly associated with students' mathematics performance.

Among the control variables, only tutoring expenditures and household registration type reach marginal or statistical significance. Overall, the control variables in this model play only a supplementary role, with the primary effect stemming from the parent–child school discussion frequency variable among the family education measures.

Table 4 Ordered logistic regression results

Variable Name	Ordered Logistic Regression Results	
	Coefficient	Std. Error
Frequency of Parents Checking	0.022	(0.040)
Frequency of Talking with Children About School	-0.184***	(0.049)
Frequency of Contacting Teachers	0.000	(0.045)
Participation in Tutoring (1 = Yes)	0.19	(0.39)
Tutoring Expenditure (CNY)	-0.119	(0.120)
Urban Household Registration (1 = Yes)	-0.209	(0.108)
Student Gender (1 = Male)	-0.055	(0.084)
Junior high	0.707***	(0.091)
Senior high / Vocational	0.958***	(0.246)
Observations	1892	
Pseudo R^2	0.023	

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

4.2 Stability test

To further verify the robustness of the regression results, this study employs two approaches: first, replacing the econometric model, and second, applying winsorization to key variables.

First, considering the methodological differences between the ordered logit and ordered probit models, the baseline regression is re-estimated using an ordered probit model. The results show that the core independent variable—

frequency of parents talking with children about school—remains significantly and negatively associated with mathematics achievement levels. Both the significance level and the direction of the effect are consistent with the original ordered logit results. The coefficient directions of the other variables are also largely consistent, with only slight changes in statistical significance. These findings suggest that the main conclusions are not sensitive to changes in the model specification.

Table 5 Robustness check results (ordered probit model)

Variable Name	Robustness Check Results (Ordered Probit Model)	
	Coefficient	Std. Error
Frequency of Parents Checking	0.009	(0.024)
Frequency of Talking with Children About School	-0.106***	(0.030)
Frequency of Contacting Teachers	-0.003	(0.026)
Participation in Tutoring	-0.82	(0.070)
Tutoring Expenditure	-0.000**	(0.000)
Urban Household Registration	-0.124*	(0.065)
Student Gender	-0.038	(0.050)
Junior high	0.439***	(0.054)
Senior high / Vocational	0.595***	(0.131)
Observations	1892	
Pseudo R^2	0.025	

Standard errors in parentheses. * p<0.1, ** p<0.05, *** p<0.01.

Second, to address the influence of potential outliers in continuous variables, namely tutoring expenditures and study hours, a winsorization procedure is applied at the 1% and 99% levels. The re-estimated results indicate that the negative and significant relationship between the core variable and mathematics achievement levels persists, with only minor variations in the coefficients of other variables.

Overall, regardless of whether the ordered probit model is used or extreme values are winsorized, the core findings of this study remain stable, reinforcing the reliability and explanatory power of the regression analysis.

4.3 Heterogeneity analysis

To further examine the differential effects of the core variable across subgroups, heterogeneity analyses were conducted from three perspectives: subject differences (Chinese versus mathematics achievement), urban – rural differences, and gender differences. These analyses aim to assess the applicability and variation of the core conclusion across different groups. The specific model settings are as follows:

4.3.1 Subject heterogeneity: chinese versus mathematics achievement

The baseline model was re-estimated using Chinese achievement as the dependent variable. The results show that parent–child frequency of discussing school remains significantly and negatively associated with Chinese achievement, indicating that the negative impact of this variable on student performance has a certain degree of generality. In addition, the significance of other variables such as parental contact with teachers and tutoring expenditure changes somewhat in the Chinese achievement model; however, the direction of the core variable's effect remains consistent. This suggests that excessive parental focus in school-related communication may exert an inhibitory effect on student performance across different subjects.

4.3.2 Urban–rural heterogeneity

The sample was further divided by household registration type. The results indicate that, among rural students, parent–child frequency of discussing school exerts a significant negative effect, with a larger coefficient, suggesting that excessive discussions about school issues in rural families have a more pronounced negative impact on mathematics achievement. For urban students, the coefficient for this variable remains negative but is statistically insignificant. Moreover, in the rural subsample, study hours show a stronger positive association with achievement. These findings imply that differences in educational resources and school – family cooperation mechanisms between urban and rural areas may lead to varying effects of the same variable.

4.3.3 Gender heterogeneity

Finally, the sample was divided by student gender. The results reveal that, among male students, parent – child frequency of discussing school continues to have a significant and negative association with mathematics achievement, with a larger coefficient, suggesting that boys may be more sensitive to frequent academic discussions at home. For female students, the effect of this variable is statistically insignificant, indicating that girls are relatively less affected by school–family communication. Additionally, the positive effect of study hours is more pronounced in the male subsample.

In summary, the negative association between parent – child frequency of discussing school and academic achievement appears to be relatively general; however, notable variations exist across subjects, urban–rural groups, and gender. The effect is more pronounced among rural students and boys, suggesting that future family – school communication practices should adopt a more tailored approach rather than a uniform, "one-size-fits-all" strategy.

5 Conclusion and discussion

This study conducts an empirical analysis on the impact of family education practices on students' mathematics achievement, drawing on large-scale survey data. It systematically examines different parental behaviors within the home education context, including frequency of homework checking, frequency of discussing school-related matters with children, and frequency of contacting teachers, while controlling for participation in extracurricular tutoring, tutoring expenditures, study time, gender, household registration type, and school stage.

The findings indicate a significant negative association between the frequency of parental discussions with children about school matters and students' mathematics performance. This result does not support the commonly held assumption that more frequent discussions necessarily lead to better academic outcomes. Rather, it suggests that the quality of such interactions may be more important than their frequency. Several mechanisms may explain this pattern. First, these conversations often occur more frequently when students are underperforming or encountering difficulties, reflecting a "problem-oriented" approach that may heighten psychological pressure or elicit resistance. Second, the style and quality of discussions vary substantially across families; in some cases, limited communication skills or a focus on criticism may undermine the potential benefits of these exchanges.

Although tutoring expenditures and study time exhibit relatively limited effects in the main models, the results of the winsorization test indicate that extremely high tutoring costs and excessively long study hours may disrupt normal learning rhythms. This further underscores the need to prioritize the "quality" rather than merely the "quantity" of educational investments.

Heterogeneity analysis reveals notable differences across subgroups. Gender-based analysis shows that the negative effect of frequent school-related discussions is more pronounced among male students, possibly because boys during adolescence exhibit stronger preferences for independence and greater sensitivity to perceived over-intervention. Urban–rural analysis suggests that rural students are more susceptible to the negative effects of such discussions, potentially due to differences in educational resources and mechanisms of home–school interaction.

Based on these findings, several policy implications are proposed. First, parental communication skills should be strengthened through systematic training programs jointly offered by education authorities and schools, enabling parents to focus not only on academic outcomes but also on learning processes and students' psychological well-being. Second, the public service system for family education should be further developed, with special emphasis on providing accessible and equitable educational support for rural and low-income families to narrow urban–rural disparities. Finally, families should be guided to arrange extracurricular learning investments rationally, avoiding excessive spending or overextension of study hours, and placing greater emphasis on learning effectiveness and holistic student development.

In sum, this study offers new evidence on the relationship between family education practices and academic performance, highlighting the importance of prioritizing the quality over the frequency of school-related discussions between parents and children. These findings carry practical significance for optimizing family education strategies under the "Double Reduction" policy context, underscoring the need to shift from "high-frequency intervention" toward "high-quality communication" that addresses students' psychological needs and fosters a supportive learning environment.

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