Parental Involvement and Students' Science Achievement: A Longitudinal Study

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Abstract

A longitudinal study was conducted to examine the relationships between parental involvement and students' science achievement over time. Four dimensions of parental involvement were used: parent-child communication, school participation, educational aspiration for children, and home supervision. Data used in this study consisted of three waves of student information and parent surveys from Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-K). Regression analyses results showed that levels of parental involvement in terms of parent-child communication, parents' school participation, and educational aspiration for children were consistently and positively associated with students' science achievement over time. However, home supervision had a negative relationship with students' science achievement.

Perspective and Objective

This study examined the relationships between different dimensions of parental involvement and students' academic achievement in science. Parental involvement has been considered important for children's growth and academic achievement in science, which is positively associated with students' further persistence in the pipeline for science, technology, engineering and mathematics (STEM) (Aschbacher, Li, & Roth, 2010; National Academy of Sciences [NAS], 2007; Sad, 2012; Shumow, Lyutykh, & Schmidt, 2011). However, typical studies in this area are cross-sectional, and such studies may fail to reveal the full picture about the significance of parental involvement for students' academic achievement in science. Therefore, it is important to examine the long-term relationship between parental involvement and students' school science performance by using longitudinal data.

Many researchers supported the multidimensionality of the parental involvement construct (Christenson, Rounds, & Gorney, 1992; Epstein, 1987). This study used the typology of parental involvement as summarized by Fan and Chen (2001) from a meta-analytic study: parent-child communication, school participation, educational aspiration for children, and home supervision. Research on parental involvement related to student science achievement has focused on middle school and high school students (Catsambis, 2001; Shumow et al., 2011), and there has been a research gap on this topic for younger students, such as elementary school students. As a result, it is important to explore how parental involvement is related to younger students' science achievement. As discussed by Duncan et al. (2007), students' academic skills in their early age were found to be a strong indicator of their later achievement; students with higher achievement in science tend to show more interest in learning science, which later may turn into career interest in science related fields (Aschbacher et al., 2010; Bhattacharyya & Mead, 2011). Therefore, parental involvement as related to student science learning may have the potential to influence students' science related career interest in later years.

Empirical studies in the area of parental involvement and students' science achievement presented inconsistent findings, with some showing positive relationships (Catsambis, 2001; Olatoye & Agbatogun, 2009; Stylianides & Stylianides, 2011), and others reporting mixed results for different dimensions of parental involvement and students' science achievement (Domina, 2005; Ho, 2010). In addition, there exists an inconsistency in the operationalization of parental involvement, and some researchers operationalized parental involvement as a uni-dimensional construct (Olatoye & Agbatogun, 2009; Ratelle, Larose, Guay, & Senécal, 2005), despite the fact the researchers generally considered parental involvement as a multi-dimensional

construct. This study investigated the longitudinal relationships between student science achievement and four dimensions of parental involvement: science-related parent-child communication, school participation, educational aspiration for children, and science-related home supervision (Fan & Chen, 2001). The research questions are:

How was student school science performance related to the different dimensions of parental involvement?

How was the pattern of change of student school science performance over time related to the different dimensions of parental involvement?

Data and Methods

The data used in this study were the "Early Childhood Longitudinal Study, Kindergarten Class of 1998-99" (ECLS-K; the National Center for Education Statistics), which followed a nationally representative cohort of students from kindergarten to middle school. We used three waves of data from students' information and parents' surveys: the spring of third grade in 2002 (Wave 1), the spring of fifth grade in 2004 (Wave 2), and the spring of eighth grade in 2007 (Wave 3). Regression analyses were conducted to examine the longitudinal relationships between students' science scores in the three waves and the four dimensions of parental involvement: talking about nature or doing science projects with children every week, participating in school events or fairs, expecting children to finish a college degree or above, and helping with children's science homework every week.

Results and Discussion

Table 1 presents the weighted descriptive statistics of the participants with different levels of parental involvement in the four dimensions. The longitudinal analysis results are shown in Table 2. To begin with, students' science scores significantly increased across the three time points. Figure 1 shows the comparison of science scores between the students whose parents talked about nature or did science projects with their children every week and those whose parents did not. Together with the information related to "science-related communication" in Table 2, Figure 1 showed that students exposed to science-related topics or activities at home had significantly higher third-grade science achievement scores than students without such experiences at home. There was a significant interaction between time and science-related communication, suggesting that the estimated difference in science scores between those with home science-related communication and those without decreased slightly over time. In addition, follow-up analyses showed that students with science-related home communication also had significantly higher science achievement scores than those without such communication in the fifth and eighth grades. Thus, parental involvement in terms of talking about science and doing science projects with children in their early elementary education had consistently positive relationship with students' academic achievement in science.

Figure 2 presents the comparison among three groups of students with different levels of parents' school participation. It can be found from Table 2 that students whose parents consistently participated in elementary school activities (such as science fairs) had higher science achievement scores than those whose parents only participated sometimes, who in turn performed better than those whose parents never participated. In other words, parental participation in school activities, especially consistent participation, was also very important to student school achievement in science. Therefore, parental involvement in elementary school

events (such as science fairs) may have long-term positive relationships with student science achievement.

According to Figure 3 and Table 2, students whose parents consistently expected their children to obtain a bachelor's degree or above across three waves had significantly higher science achievement scores than those whose parents sometimes did, who in turn performed better in science than those students whose parents never had such expectation. Two interaction terms were significant, which suggested that the score differences among the three groups still increased as time went by. Students with consistent parental aspiration of higher education level scored even higher after five years than the other students. It can be inferred that parents' expectation of their children's future education level may also have consistently positive association with their science school achievement across time.

Since science-related home supervision question was only available in the last wave of data, only regression analysis for the last wave data was conducted. Table 3 shows the results for the relationship between parents' help with science homework and students' academic achievement in science in the eighth grade. Results showed that eighth grade students who received science homework help at least once a week had significantly lower science scores than those who received help less than once a week. That is to say, the amount of science homework help was negatively associated with students' school science performance.

Conclusion

Based on regression analyses, our results indicated a mixture in terms of the longitudinal relationships between different dimensions of parental involvement and students' science achievement. First, students whose parents talked about nature or did science projects with them every week had better science performance than the students without such experiences across all the three waves. Early exposure to science related topics in the family environment was very important to student science performance in school at that time and in the future, and this finding is consistent with those of several studies (Bhanot & Jovanovic, 2009; McNeal, Jr., 1999). Parents are encouraged to talk about science related topics or do science projects with their children at home so as to have a positive influence on their children's science performance in school.

Second, our study showed that parental participation in school activities was consistently and positively associated with students' science school achievement. This finding is not consistent with Ho (2010), who reported a negative relationship between parents' communication with and participation in school and student school science performance. However, our finding is aligned with some other studies (Domina, 2005; Ho & Willms, 1996). Future studies should further examine this issue of how parental participation in specific school or class events such as science fair is associated with student science performance.

Third, parental educational expectation was found to be significantly related to student school science performance, which re-emphasizes what was shown in previous research (Catsambis, 2001; Fan, 2001; Muller, 1993). Parents need to have high educational aspiration/expectation for their children. Finally, we found that the amount of parental help with science homework was negatively associated with student science achievement in school, which is consistent with previous studies (Bhanot & Jovanovic, 2009; Domina, 2005; Fehrmann, Keith, & Reimers, 1987). As discussed in Fan (2001), the reason for such a negative relationship was that, such help might be the result of responding to poor school performance of the students in school.

In summary, parental involvement (except for home supervision) in early childhood may have long term and consistently positive impact on student science performance in school. The findings suggest that, while their children are still young, parents should (1) engage their children in science-related topics and activities at home, (2) participate in science-related school events, and (3) maintain a high expectation of their children's future education attainment. Meanwhile, schools and communities are encouraged to provide opportunities for child-parent interactions in science-related activities. Finally, researchers are suggested to explore in details the mechanisms of how parental involvement is associated with their children's science performance through different paths.

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Table 1

Frequencies and Percentages of Participants by Different Levels of Parental Involvement

Dimension of parental involvement	Subsample	Percentage of sample
Science-related parent-child communication[a]		
Science-related communication or activities	11047	82.73
No science-related communication or activities	2306	17.27
Total	13353	100.00
School participation[b]		
Always participated	6426	63.92
Sometimes participated	2644	26.30
Never participated	983	9.78
Total	10053	100.00
Education aspiration for children[c]		
Always expected bachelor or above	4733	59.06
Sometimes expected bachelor or above	2325	29.01
Never expected bachelor or above	957	11.94
Total	8015	100.00
Science-related home supervision[d]		
Helped with science homework at least once a week	2875	36.58
Helped with science homework less than once a week	4985	63.42
Total	7860	100.00

Note.The total numbers of samples in each dimension of parental involvement were not the same due to missing data. [a]Variable only available in Wave 1. [b]Variable available in Waves 1 and 2. [c]Variable available in Waves 1, 2 and 3. [d]Variable only available in Wave 3.

Table 2

Longitudinal Model Results

Variable	Estimate	Standard Error	*t*	*p* Value
Independent Variables				
Science-Related Communication	2.4630	0.4924	5.00	<.0001
School Participation-All	3.8991	0.4917	7.93	<.0001
School Participation-Some	1.2417	0.5118	2.43	0.0153
Bachelor's + Expectation-All	6.6023	0.6288	10.50	<.0001
Bachelor's + Expectation-Some	1.5297	0.6572	2.33	0.0200
Time	5.9685	0.09510	62.76	<.0001
Time * Science-Related Communication	-0.1824	0.06980	-2.61	0.0090
Time * Bachelor's+ Expectation-All	0.8271	0.08565	9.66	<.0001
Time * Bachelor's+ Expectation-Some	0.5985	0.09272	6.45	<.0001
Control Variables				
Gender (Female)		Included		
Ethnicity		Included		
Family Background[a]		Included		

[a]Family background includes: parental occupation, education level, immigration status, marital status, and family socioeconomic status.

Table 3
Regression Results

Variable	Estimate	Standard Error	*t*	*p* Value
Independent Variable				
Science homework help at least once a week	-4.87196	0.35099	-13.88	<.0001
Control Variables				
Gender (Female)		Included		
Ethnicity		Included		
Family Background[a]		Included		

[a]Family background includes: parental occupation, education level, immigration status, marital status, and family socioeconomic status.

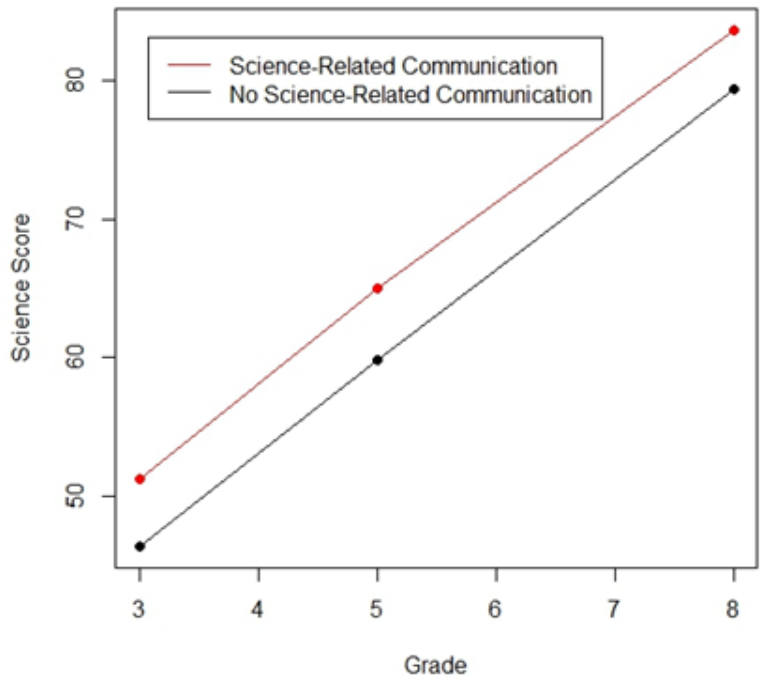

Figure 1. Students' average science scores by different levels of science-related parent-child communication over time.

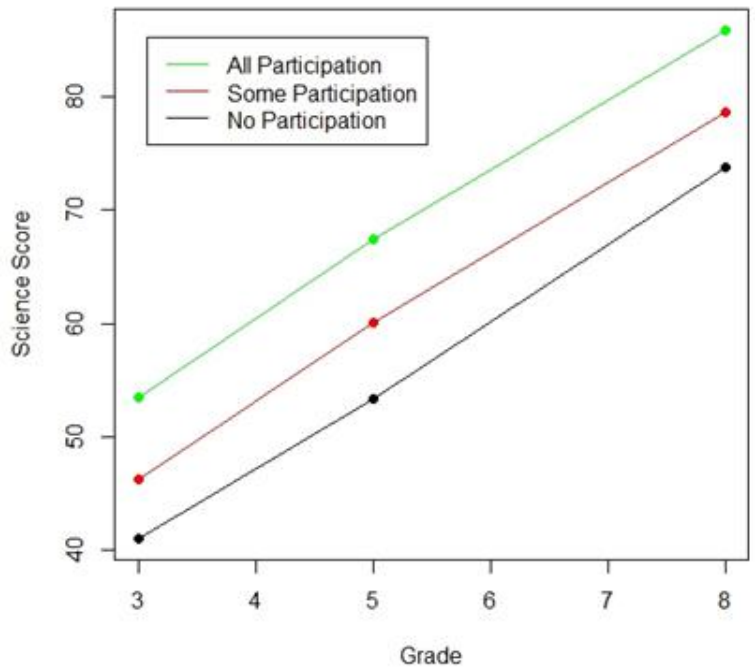

Figure 2. Students' average science scores by different levels of parents' school participation over time.

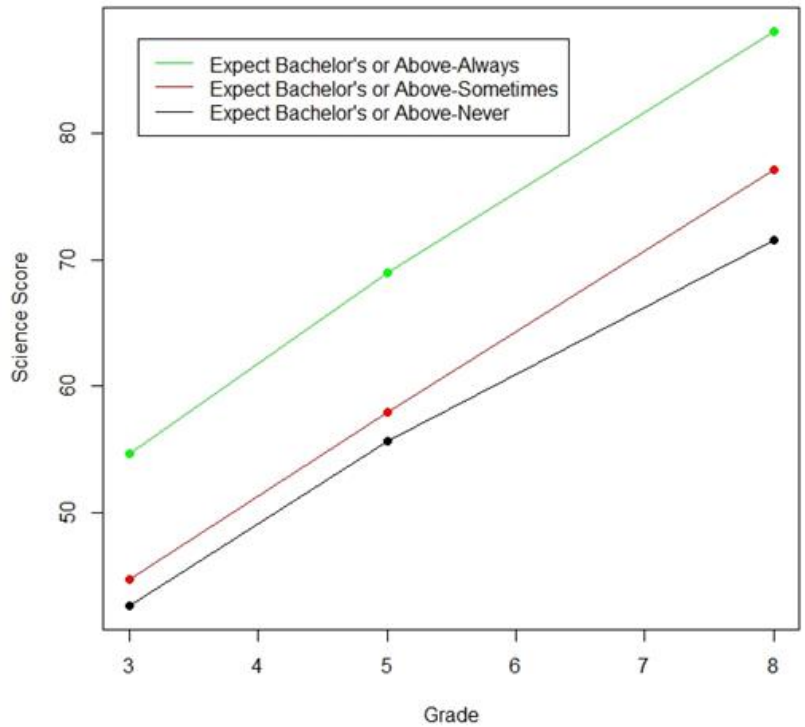

Figure 3. Students' average science scores by different levels of parental educational aspiration over time.