The Relationships Between Parental Influence and Student Achievement in Seventh Grade Mathematics

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Parental influence has been identified as an important factor affecting student achievement, but the variables addressed by various parent-school partnership programs vary, and lack literature support. This deficiency was ameliorated in this study through an analysis of a national data base from the Longitudinal Study of American Youth (LSAY). All parental variables investigated in LSAY were considered in this study, and significant variables of students' achievement in seventh grade mathematics were selected through the Backward Elimination Procedure in the Statistical Analysis System (SAS). The results show that those variables significant at $\alpha = .05$ have accounted for around 22% variability of the student achievement. A further analysis of the empirical results seems to indicate that parent education and encouragement are strongly related to improved student achievement. However, parents should attempt to understand students' feeling, and expect students to take the full responsibility for their successes in the school.

Parental influence has been identified as an important factor affecting student achievement (Miller, 1980; Dryfoos, 1990), but the variables addressed by various parent-school partnership programs vary, and lack literature support. Neuman, Hagedorn, Celano and Daly (1995) pointed out: "Although parent involvement programs in early intervention are abundant and thriving, critics have questioned their benefits for improving the lives and the educational success of young children (Diaz, Neal, & Vachio, 1991; Kochanska, Kuczynski, & Radke-Yarrow, 1989; Stevens, 1984; White, Taylor, & Moss, 1992)" (p. 802). Improvement in these programs demands a further identification of significant factors of parental influence (Suter, 1992; Wang & Wildman, 1995). In spite of the imperative need for a thorough assessment of parental influence, neither empirical results nor theoretical models have yet been reported in recent research literature in the area of mathematics education. In part, this is the result of the formidable difficulties in identifying common indicators of parental influence for a variety of programs in practice (Paulson, 1992; Waggener & Smith, 1993).

The importance of this seventh grade investigation also hinges on the fact that most students around this age are seeking self-identity and independence from their parents (Erikson, 1963), and school mathematics has a vital role to play in their independent life in the future (Burns & Lash, 1988; Friend, 1985; Lawrenz & Orton, 1989). Although many action studies have been conducted in mathematics education at the seventh grade (Courcier & Stephens, 1993; Fisher & Stephens, 1992; Garofalo, Goodwin, & Mitchell, 1989; Jackson & Phillips, 1985), few of them were based on an analysis of a national data base, and thus, the factors identified in those studies have limited generalizability. The purpose of this research is to examine the relationships between parental influence and student achievement through analyses of the Longitudinal Study of American Youth (LSAY) data base.

Research Questions

The National Center for Education Statistics (NCES) has been collecting longitudinal data base to reflect the trend of American education since 1972. Thus far, three projects, the *National Longitudinal Study of the High School Class of 1972* (NLS-72), *High School and Beyond* (HS&B), and the *National Education Longitudinal Study of 1988* (NELS:88), were conducted, but none of them covered students at the seventh grade (Davis & Sonnenberg, 1995).

On the other hand, the Longitudinal Study of American Youth (LSAY) is a national longitudinal study supported by the National Science Foundation (NSF). A major focus of the LSAY is to collect information on public middle and high school students in mathematics and science education. Approximately 3000 seventh grade students were randomly selected in 1987 and tracked for four years. LSAY is the only existing comprehensive data base which traced students from the seventh grade through high school. Variables recorded in the middle school data base include information about parents' education, assistance, and expectations, as well as student perspectives toward the parent support. All these variables reflect

parental influence in education, and are employed in this study to investigate the following questions:

1. What parental variables significantly affect student achievement in seventh grade mathematics?

2. How much variance in student achievement is explained by the significant variables of parental influence?

3. How should the significant variables of parental influence be interpreted?

Methods

The seventh grade student information was collected in the first year LSAY middle school survey. Wang and Wildman (1995) employed a subset of the parental variables to investigate students' family commitment on science education. Parallel to Wang and Wildman's (1995) research, this study examine the relationships between parental influence and student achievement in seventh grade mathematics. Deletion of outliers and missing values was conducted following the instructions in the LSAY codebook (Miller, et al., 1992).

Student achievement in seventh grade mathematics was measured in LSAY using the high quality items from the National Assessment of Educational Progress (NAEP). According to the LSAY codebook, "Item analyses were performed using data from the NAEP 1985-86 assessment of mathematics and science to select subsets of items that reliably measured the cognitive processes of interest" (p. 57, Miller, et al., 1992). The LSAY items were calibrated using a three-parameter logistic model (Hambleton & Swaminathan, 1985; Hulin, Drasgow, & Parsons, 1983; Lord, 1980; Miller, et al., 1992). Based on the recommendation of the LSAY codebook, the IRT scores were chosen as the outcome variable related to parental influence.

To fully utilized the existing information on parental influence, the backward elimination procedure in SAS was adopted in this study to select significant variables of mathematics achievement from all parental variables collected in LSAY (Table 1). Ott (1993) outlined:

> In a typical regression problem, you ascertain which variables are potential candidates for inclusion in a regression model (step 1) by discussions with experts and/or by using any one of a number of possible selection procedures. For example, we could run all possible regressions, apply a best-subset regression approach, or follow a stepwise regression (a backward elimination) procedure. (p. 659)

Graybill (1976) asserted that the backward elimination procedure took all potential variables into consideration, and thus fully utilized the information in a data base.

Table 1. *Parental Influence Variables Investigated in LSAY*

Variable[1]	Label
X_1	Father's education
X_2	Mother's education
X_3	Parents: Insist on homework
X_4	Parents: Proud of good grade
X_5	Parents: Find time to talk
X_6	Parents: Want me to use computer
X_7	Parents: Encourage to work on math
X_8	Parents: Encourage to work on science
X_9	Parents: Expect college degree
X_{10}	Parents: Buy me math and science games and books
X_{11}	Parents: Confident in my ability
X_{12}	Parents: Encourage me in sports
X_{13}	Parents: Help me with homework
X_{14}	Parents: Reward good grades
X_{15}	Parents: Too busy to spend time with me
X_{16}	Parents: Expect me to do well in science
X_{17}	Parents: Expect me to do well in math
X_{18}	Parents: Do not understand my feelings
X_{19}	Parents: Think math is important
X_{20}	Parents: Think science is important
X_{21}	Parents: Question my performance in school
X_{22}	Parents: Want me to have a career in science, medicine, or engineering
X_{23}	Parents: Well informed about political and social issues
X_{24}	Parents: Active in community affairs
X_{25}	Parents: Vote in most elections
X_{26}	Parents: Know a lot about science
X_{27}	Parents: Good at math
X_{28}	Parents: Read a lot of papers and magazines
X_{29}	Parents: Read a lot of books
X_{30}	Parents: Enjoy doing things with me

[1]X_1-X_{30} correspond to variables FATHED, MOTHED, AA19A - AA19Z, AA19AA, and AA19BB in the LSAY Codebook (Miller, et al., 1992).

Results

The significant variables selected through the backward elimination procedure are listed in Table 2. The small p-values indicate that the corresponding regression coefficients are significantly different from zero.

Hence, the impact of those significant factors on the students' achievement is not negligible at $\alpha = .05$. The empirical model constructed by the significant factors is:

$$y = 41.132 + 1.276*X_1 + 1.684*X_2 + 2.051*X_9 - 1.544*X_{10} + 2.119*X_{11} - 1.287*X_{13} - 2.380*X_{14} + 2.020*X_{16} - 1.077*X_{18} + 1.512*X_{23} + 3.021*X_{25} - 1.160*X_{29}$$

where y = math IRT score, and the X_i's were defined in Table 1.

variables investigated in LSAY (Table 1) had significant relations with students' mathematics achievement at the seventh grade. Among the twelve variables significant at $\alpha = .05$, many suggested the needs of strengthening parental involvement to improve students' mathematics achievement.

On one hand, because students at the seventh grade tended to seek self-identity and independence from family, parents who did not understand the students' feeling could negatively affect the students' achievement (X_{18}). On the other, parents' reward of good grades (X_{14}) and help with homework (X_{13}) could

Table 2. *Significant Variables of Parental Influence*

Variable	Parameter (b_i)	*p*-value
Father's education (X_1)	1.276	.0001
Mother's education (X_2)	1.684	.0001
Parents: Expect college degree (X_9)	2.051	.0001
Parents: Buy me math and science games and books (X_{10})	1.544	.0111
Parents: Confident in my ability (X_{11})	2.119	.0001
Parents: Help me with homework (X_{13})	-1.287	.0204
Parents: Reward good grades (X_{14})	-2.380	.0001
Parents: Expect me to do well in science (X_{16})	2.020	.0001
Parents: Do not understand my feelings (X_{18})	-1.077	.0209
Parents: Well informed about political and social issues (X_{23})	1.512	.0033
Parents: Vote in most elections (X_{25})	3.021	.0001
Parents: Read a lot of books (X_{29})	-1.160	.0140

The coefficient of determination (R^2) for this empirical model is .217. Sprinthall (1994) clarified: "The coefficient of determination is used to establish the proportion of the variability among the y scores that can be accounted for the variability among the X scores" (p. 216). Hence, it is concluded that around 22% of the variability in student math achievement is explained by the significant variables of parental influence $(R^2 = .217)$. These results seem to reconfirm the findings of many researchers (e.g., Miller, 1994; Pedersen, 1986; Reynolds, 1991; Reynolds & Walberg, 1991; Walberg, 1981; Wang & Staver, 1994) that parental influence remains a significant factor in mathematics achievement, in spite of the fact that students around the seventh grade are seeking self-identity and independence from family (Erikson, 1963).

Discussion

The data analyses revealed that not all parental

mislead the students to treat the study as an obligation of the parents, and conceal their personal responsibility of success in school, such as those indicated by their mathematics achievement (Table 2).

This empirical study also confirmed the positive relations between student achievement and variables in parent expectations $(X_9$ and $X_{16})$, education $(X_1$ and $X_2)$, and support $(X_{10}$ and $X_{11})$. Meanwhile, it is interesting to note that additional positive factors have been found from the extracurricular variables related to parents' understanding of political and social issues (X_{23}) and their participation in election (X_{25}). A plausible interpretation of this finding hinges on the fact that these activities may have enhanced students' independent skills in logic reasoning, an important competence demanded in mathematics which can rarely be nurtured through the ordinary book reading (X_{29}).

In summary, based on the results of this investigation, further enhancement of the parental influence should be approached through strengthening the impact of positive

factors and controlling the contribution of negative variables. In this regard, the aforementioned findings can be employed by mathematics educators in providing parents with appropriate guidelines, such as the following, to improve student achievement:

1. Express confidence in students' abilities.

2. Encourage students to do their homework independently;

3. Promote students' intrinsic interest in mathematics, whereby learning mathematics becomes its own reward.

4. Enhance students' independent logic reasoning through extracurricular activities.

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