Journal of Research in Rural Education, Summer, 1992, Vol. 8, No. 2 pp. 58-70

Grade Span and Eighth-Grade Academic Achievement: Evidence From a Predominantly Rural State

David F. Wihry
Theodore Coladarci
Curtis Meadow
University of Maine

Although the twentieth century has witnessed two major waves of grade reorganization in American public schools, little empirical evidence exists pertaining to the effects of grade span — the range of grades making up schools — on academic achievement. In the present study, a series of production functions was employed to examine the influence of grade span, and several control variables, on eighth-grade student performance on a state-wide test of academic achievement. Results suggested that, other things equal, the elementary setting (K-8, K-9, 3-8) surfaced as the most favorable location for the eighth grade, and the junior/senior setting the least favorable. The junior high and middle grade-span arrangements emerged as more effective than the junior/ senior setting, but less effective than the elementary grade span. These findings point to the importance of continued research on the effectiveness of policy and practice characterizing various grade-span arrangements in which eighth grades are located, as well as on the social environment these arrangements present to the student.

Introduction

This paper presents empirical findings bearing on the relationship between grade-span arrangement — the range of grades making up a school — and the academic achievement of eighth-grade students. Despite two major waves of grade span reorganization in the present century — the junior-high and middle-level movements — little evidence exists that grade-span arrangements (hereafter referred to simply as "grade span") differ in their effects on important educational outcomes. Recent interest in differences among grade spans in educational policies (e.g., McPartland, Coldiron, & Braddock, 1987) and in-school social climate (e.g., Blyth, Hill, & Smyth, 1981), coupled with the attention focused on middle-level education by the Carnegie Council report, *Turning Points* (Carnegie Council on Adolescent Development, 1989), suggest that the relative effectiveness of grade spans warrants further examination as an empirical question.

The study reported here took advantage of the availability of one measure of educational outcomes — performance on a state-developed test of academic achievement — and, further, recognized that the quantitative assessment of grade-span effects is best done in a multivariate context. A multiple regression model, based on the production-function approach to determining the influence of educational inputs on outcomes, was constructed and fitted to available data in Maine. We begin by reviewing the empirical literature on grade spans and their effects, and follow with a discussion of factors that may account for grade-span effects.

Grade Organization

Surprisingly, there is little evidence bearing on the relationship between grade organization and academic achievement. Calhoun's (1983) review of the grade-

David F. Wihry is Associate Professor in the Department of Economics, University of Maine, Orono, Maine 04469. **Theodore Coladarci** is Associate Professor in the College of Education, University of Maine. **Curtis Meadow** is a Graduate Assistant in the Department of Computer Science, University of Maine.

The authors gratefully acknowledge the assistance of Suzan Cameron (Maine Department of Educational and Cultural Services), as well as the helpful comments from Thomas Duchesneau (University of Maine), Richard A. Moreau (School Union 87, Maine), and the anonymous reviewers. (Ed. Note: This manuscript was accepted for publication under the previous editor.)

organization literature through 1982 uncovered few studies that addressed this question empirically. Stout (1962) found higher achievement among seventh- to twelfth-grade students when these grades were organized into a three-and-three, rather than a combined seven-through-twelve, grade span. In another study, White (1964) reported higher achievement among seventh graders in stand-alone seventh-grade schools or in schools comprising both seventh and eighth grades, when compared with any other grade span (including the six-year junior/senior high school). The few studies that addressed sixth- and ninth-grade performance showed no consistent relationship between academic achievement and the school's span of grades. Finally, studies of the relative effectiveness of middle and junior-high schools either favored middle schools or found no differences.

Unfortunately, the literature reviewed by Calhoun (1983) was characterized by bivariate models. That is, rarely did researchers attempt to control for confounding influences on both grade span and academic achievement (e.g., community socioeconomic status), which renders problematic any attribution of effects to the grade-span variable itself. This methodological limitation continues to characterize the extant research on "middle-level" school effectiveness (e.g., George & Oldaker, 1985/1986; Hough, 1989), a more specific program of research within the grade-span tradition.

A search of the literature subsequent to the Calhoun (1983) review revealed little additional empirical evidence on the relationship between grade span and academic achievement. Moore (1984) found higher reading achievement among seventh and eighth graders in K-8 schools than in junior-high schools, as well as higher attendance, self-esteem, and attitudes toward school. And in his multivariate analysis of sixth-grade achievement, Becker (1987) reported a significant advantage to locating the sixth grade in the elementary, rather than middle, grade span. Interestingly, Becker also found that the elementary-school advantage declined as student socioeconomic status (SES) rose. In fact, sixth graders in the upper tail of the SES distribution performed slightly better in non-elementary settings.

Schooling as a Production Process

The concept of "educational production function" provides a useful framework for structuring multivariate analyses of educational outcomes. Much of the empirical work on the between-school determinants of educational outcomes has been conducted in the context of production function models (e.g., see Hanushek, 1986; Monk, 1989).[1] The grade organization studies are a conspicuous exception.

In the production function view of schooling, increments in educational outputs are a function of various inputs to the educational process. The coefficients of multiple regression models provide estimates of the degree of association between an input and some measure of output, taking into account the influence of other inputs in the model. Despite their limitations (Hanushek, 1986; Monk, 1989), production function formulations provide a theoretical rationale for a multiple regression model of determinants of academic outcomes. Indeed, the voluminous production function literature furnishes an ample supply of hypotheses and empirical findings within which an examination of the effects of grade span on academic achievement can be conducted.

Perhaps the absence of grade span in production function models stems, in part, from the fact that this variable is not a well-defined measure of resource quality or quantity — that is, not an "input" in the narrow sense — and, as such, does not appear to fit readily into the input/output framework of a production function model. However, we submit that grade span does have a place in a properly specified schooling production function insofar as grade span constitutes a proxy for one or more factors that are likely to influence the effectiveness with which conventional inputs are combined. Put another way, if grade spans differ in their effectiveness, they do so not simply because of the nominal characteristic of encompassing one set of grades versus another, but because they differ systematically in underlying characteristics and processes that make for greater school effectiveness. Two categories of such characteristics and processes

[1]The term "production function" can encompass any multivariate model of academic achievement, regardless of whether the model is nominally formulated as such. Two of the many studies that fall into the latter category are (a) the seminal study of the differential effects of school and student-background characteristics conducted by Coleman et al. (1966), and (b) the more recent study by Walberg and Fowler (1987), who examined the effects of school size and expenditure levels.

are what will be referred to here as the school's instructional and social environments.

Instructional environment. Used here, this phrase refers to the manner in which instructional inputs are combined to yield educational outcomes. Thus, instructional environment encompasses a large number of school characteristics and processes such as departmentalization, curriculum, class size, within- and between-class ability grouping, homework policies, testing and assessment, and teaching practices, and could be extended to include additional considerations such as the roles of students and teachers in governance and the extent of decentralization of decision-making. In short, this class of variables represents all of the institutional elements — as opposed to student characteristics — that influence school effectiveness.

Systematic differences in instructional environment among grades and grade spans have been documented. McPartland, Coldiron, and Braddock (1987), using both state and national data, found grades and grade spans to vary in grouping, staffing, and scheduling practices (also see Becker, 1987). Instructional practices were observed to be more pupil-oriented in the lower grades and more subject-matter oriented in the higher grades. These researchers summarized their findings this way:

> Elementary grades are much more likely to assign teachers to self-contained classes with heterogeneous student enrollments, in which within-class ability grouping is used to focus instruction in reading and sometimes in math to match individual student differences. At the other end of the continuum, secondary students are usually in departmentalized schools that establish separate tracks and/or classes in which enrollment is determined by students' measured academic performance, and in which between-class groupings usually remain static for the entire school term or school year. The middle grades have a nearly equal representation of schools using each major staffing, scheduling, and grouping practice, including intermediate and mixed practices such as small teams of teachers using semi-departmentalization and both between- and within-class groupings. (p. 26)

However, differences in instructional environment can account for differences in academic performance across grade spans *but at the same grade level* only if the instructional environment at a given grade level differs across grade spans. In regard to ability grouping, for example, the important question is whether ability-grouping practices differ between eighth grades located in elementary schools versus those located in middle, junior high, or junior/senior high schools.

Most educators will accept as a given that instructional environments differ in their effectiveness, although there is likely to be considerable disagreement over the relative merits of specific policies and practices. For example, the middle-level movement is based, in part, on the conviction that early adolescents require a distinctly tailored educational program and school environment (e.g., Lipsitz, 1984; Merenbloom, 1988; Ward, Mergendoller, & Mitman, 1982). However, little evidence is available on whether instructional environments that are likely to be effective at a given grade level are more characteristic of some grade spans than others.

McPartland et al. (1987), interestingly, found that staffing, scheduling, and grouping practices of a school's lower grades in a given grade span were influenced by the practices characterizing the higher grades within the same grade span. For instance, fourth-grade practices in K-6 schools were more similar to those of the sixth grades in these schools than they were to fourth grade practices in K-4 schools. An analogous finding was reported by these researchers where the focus was on sixth grade practices, although not where seventh- and ninth-grade practices were examined.

Evidence bearing on eighth grade students — the context of the present study — is unavailable. However, should the educational practices of eighth grades vary with grade span, this variation should generate systematic differences in academic achievement across grade span.

Social environment. Another way in which grade spans differ is in the social environment they present to the middle-level student (e.g., Merenbloom, 1988). For example, the eighth-grader who is in the youngest age group in the junior/senior high school doubtless is subjected to substantially different social influences than the eighth-grade student in a K-8 school. As a case in point, Blyth et al. (1981) found that "the presence or absence of older students in a school has a significant effect on attitudes, behavior, and experiences of younger students in the same schools" (p. 106). For instance, the absence of ninth graders was associated with decreased tobacco use, greater perception of control, lowered feelings of anonymity, less fear of

"being picked on," and less frequent drug offers for the younger students.

Further, there is evidence suggesting that an elementary school environment may be more conducive to adolescent adjustment than an environment in which upper grades are represented. Simmons and Blyth (1987) examined adolescent adaptation to developmental tasks among sixth graders moving into seventh and, later, eighth grades in two grade span sequences: the K-8 school followed by the senior high, and the K-6 followed by the junior and then senior high school. These researchers concluded that "a small elementary school is more beneficial for the early adolescent than a large, impersonal environment; that being a member of the highest ranking cohort . . . is more beneficial than ranking the lowest; and that the change from a small elementary school to a large impersonal junior high school has a negative impact on the early adolescent child" (p. 226).

In neither of these studies was academic achievement among the dependent variables examined. However, it is not unreasonable to speculate that insofar as the presence of older students may compromise the social environment of schools for early adolescents, then academic outcomes may suffer for the latter students, as well.

While, strictly speaking, instructional and social environment are not "inputs" in the education production process, they nonetheless are potentially significant influences on outcomes and, therefore, constitute important ways in which the educational production process may differ by grade span within a grade level. Because information bearing on instructional and social environment was not readily available from Maine data sources, it seemed plausible to begin assessing the possible influence of such factors on educational outcomes by examining the influences of grade span, itself. In short, "grade span" served as a proxy for school characteristics and processes that doubtless covary with alternative grade-span arrangements (Becker, 1987; McPartland et al., 1987).

Method

Using a production function formulation, the present study assessed the effects of grade span on the academic achievement of eighth-grade students. Additional variables were incorporated into these analyses as statistical controls. These variables were known or hypothesized to affect educational outcomes and, further, have been shown to correlate with grade span (Braddock, Wu, & McPartland, 1988). Below, we describe the dependent and independent variables, subjects, and statistical analyses.

Dependent Variables

Data from the Maine Educational Assessment (MEA), a measure of academic achievement administered annually to all public school students in fourth, eighth, and eleventh grades (Maine Department of Educational and Cultural Services, 1989), were used to form the dependent variables. The MEA comprises six content areas: reading, writing, mathematics, science, social studies, and humanities. In the present study, analyses were limited to full-scale scores (i.e., across all six scales) and reading and mathematics subscale scores. All analyses were based on eighth-grade data from fall 1987.

Unit of analysis. MEA scores were aggregated at the school level. Independent variables, described below, similarly reflected school-level characteristics. However, data for some independent variables were available only at the level of the Local Educational Agency (LEA), which is a collective of schools. So that the school unequivocally would be the unit of analysis, any LEA comprising multiple eighth-grade schools was omitted from the analyses. Further omitted were five Indian and special-purpose schools, 16 schools for which MEA data were not available, and four schools encompassing grades K-12, as well as eight "outlier" schools having standardized residuals with an absolute value greater than 2.0 (e.g., Judge, Hill, Griffiths, Lutkepol, & Lee 1988); 163 observations remained.

Independent Variables

Grade span. In Maine, as elsewhere, eighth-grade students may be in one of several grade spans. Four grade organizations were represented among these 163 schools: elementary (E), middle (M), junior high schools (J), and junior/senior high schools (JS) (see Table 1).

It should be emphasized that, here, the term "middle" does not necessarily correspond to a school subscribing to the currently popular "middle-level" philosophy (e.g., Johnston & Markle, 1986; Merenbloom, 1988). Indeed, given our operational definition of grade span (Table 1), a middle-level school might be found in either a "middle" or "junior high"

Table 1
Grade-span Classification and Frequencies

Grade span	Grades represented	Number of schools in sample
Elementary (E)	K-8, K-9, 3-8	70
Middle (M)	4-8, 5-8, 6-8	48
Junior High (J)	7-8, 7-9	23
Junior/Senior High (JS)	6-12, 7-12, 8-12	22

setting. With the available data, unfortunately, we were unable to identify the philosophical tenets of a school which, consequently, precluded any analyses directly and unequivocally involving the middle-level concept.

Socioeconomic status. The relationship between SES and academic achievement is virtually axiomatic (e.g., White, 1982). Other things equal, indices of SES correlate positively and meaningfully with a wide range of achievement criteria.

Two valid measures of SES were initially considered for the present study: a community's average per-capita income and the proportion of community residents having completed four or more years of post-secondary education. The former, of course, is only one dimension of community SES. The latter adds another dimension worth considering, especially in Maine where, in some communities, income may be relatively high but educational attainment relatively low (e.g., paper-mill jobs). We ultimately decided to use only the educational attainment variable (COLGRAD) as a proxy for community SES because (a) this variable and per-capita income were correlated (r = .57) and (b) the latter variable added little to the explanatory power of the statistical model with COLGRAD included.

COLGRAD was based on information provided by the Maine State Planning Office. These raw data, reported by town, were aggregated at the LEA level and then weighted for each LEA according to population figures.

School characteristics. Despite the fact that the production function literature has provided few aggregate characteristics of schools that consistently predict academic achievement, we included in our analyses some of the traditional predictor variables to assure consistency with previous studies (e.g., Glasman & Biniaminov, 1981; Hanushek, 1986; Walberg & Fowler, 1987) and, as noted above, to control for factors known to correlate with grade span (Braddock et. al., 1988). This approach permitted an assessment of the additional contribution of grade span to whatever understanding of academic achievement can be gleaned from past production function studies. Further, insofar as school characteristic variables correlate with both grade span and academic achievement, inclusion of these variables in the regression equations contributed to the goal of achieving unbiased estimates of the impact of grade span on achievement.

Regular instructional expenditures (INREG) is composed principally of teacher salaries and expenditures on instructional materials. These data, provided by the Maine Department of Educational Cultural Services (MDECS), were taken from the 1986-1987 academic year. Expenditures data reflected both general and special revenue funds. Per-pupil expenditures for each LEA were computed by removing expenditures for tuition to other schools and then dividing the remainder by the average daily membership for 1987.

Intuition suggests that INREG should correlate positively with academic outcomes. That is, more instructional dollars available per pupil should permit the purchase of more effective instructional resources. Interestingly, there is little evidence that school administrators consistently can transform bigger budgets into achievement gains (Hanushek, 1981; Walberg & Fowler, 1987).

Also included was a measure of *school size* (SCHSIZE). This variable, determined from MDECS documents, figures prominently in the production function literature. While the school consolidation movement is premised, in part, on the belief that larger schools, as a result of economies of scale, will be more effective than smaller schools, extant research has found either no relationship — or an inverse one — between school size and educational outcomes (Guthrie, 1979; Walberg & Fowler, 1987). In the present

sample, the average school had 318 students, ranging from 19 schools with fewer than 100 students to three schools with more than 700 students.

A *pupil-staff ratio* (PSRATIO), also taken from MDECS documents, was included in the analyses as well. Here, "staff" reflected teachers, aides, support personnel, counselors, and administrators. While one would assume that a lower ratio would be associated with higher educational outcomes, research, interestingly, does not consistently support this hypothesis (Hanushek, 1986).

Teacher attributes. Two teacher attributes were included: *post-baccalaureate education* (PCBPLUS) and the average *tenure* of elementary school teachers in the LEA (YRS). Post-baccalaureate education, defined here as the proportion of full- or part-time teachers having more than 15 credit hours of education beyond the baccalaureate, has not been a consistent correlate of student achievement, although educational policy often is based on the assumption that it is (Hanushek, 1981). In contrast, there is some evidence that teacher experience and educational outcomes bears such a relationship (Hanushek, 1986). Both variables were taken from a data tape provided by MDECS.

Analyses

Ordinary least-squares multiple regression was employed to examine the effects of grade span on eighth-grade achievement, holding constant the effects of remaining independent variables. Such a procedure, of course, carries the assumption that academic achievement is a linear and additive function of grade span and the other independent variables. Unstandardized regression coefficients are reported below; thus, a variable's effect is expressed directly in the MEA metric (adjusted for the confounding influences of remaining variables in the equation).

Given the categorical nature of our grade-span variable, separate dummy variables were required to assess the effects of each grade span relative to the others (see Table 2). A dummy variable was coded *1* for the grade span in question (e.g., elementary) and *0* for the remaining three grade spans. With such a procedure, it was necessary to omit one grade span from each equation — the "reference" grade span against which all others were compared (e.g., Pindyck & Rubinfeld, 1981). Thus, the first equation (Table 2, Model A) comprised separate dummy variables for middle (M), junior high (J), and junior/senior (JS) schools, omitting the "elementary" grade span. Consequently, the unstandardized partial regression coefficient for, say, the M dummy variable represents the difference in academic achievement between eighth grades located in "middle" versus "elementary" grade spans, holding constant COLGRAD, INREG, SCHSIZE, PSRATIO, PCBPLUS, and YRS. Coefficients for the junior and junior/senior dummy variables are interpreted similarly. Since all grade spans are equally suitable reference categories, four separate equations — each model having a different reference category — were specified for each dependent variable.

Table 2
Multiple Regression Equations For Assessing Grade-span Effects

Model A: $\text{Mean MEA test score} = a + b_1\text{COLGRAD} + b_2\text{INREG} + b_3\text{SCHSIZE} + b_4\text{PSRATIO} + b_5\text{PCBPLUS} + b_6\text{YRS} + b_7\text{M} + b_8\text{J} + b_9\text{JS} + e$

Model B: $\text{Mean MEA test score} = a + b_1\text{COLGRAD} + b_2\text{INREG} + b_3\text{SCHSIZE} + b_4\text{PSRATIO} + b_5\text{PCBPLUS} + b_6\text{YRS} + b_7\text{E} + b_8\text{J} + b_9\text{JS} + e$

Model C: $\text{Mean MEA test score} = a + b_1\text{COLGRAD} + b_2\text{INREG} + b_3\text{SCHSIZE} + b_4\text{PSRATIO} + b_5\text{PCBPLUS} + b_6\text{YRS} + b_7\text{E} + b_8\text{M} + b_9\text{JS} + e$

Model D: $\text{Mean MEA test score} = a + b_1\text{COLGRAD} + b_2\text{INREG} + b_3\text{SCHSIZE} + b_4\text{PSRATIO} + b_5\text{PCBPLUS} + b_6\text{YRS} + b_7\text{E} + b_8\text{M} + b_9\text{J} + e$

Table 3
Means, Standard Deviations, and Intercorrelations

Variable	M	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) FULL-SCALE	262.68	48.47												
(2) READ	257.97	57.49	.85											
(3) MATH	288.45	63.00	.79	.58										
(4) COLGRAD	13.71	6.65	.62	.50	.54									
(5) INREG	1518.51	239.00	.22	.16	.23	.22								
(6) SCHSIZE	317.63	194.12	-.07	-.04	-.02	.09	-.03							
(7) PSRATIO	14.27	2.68	.00	.03	-.06	-.18	-.40	.05						
(8) PCBPLUS	42.91	20.12	.06	.16	-.01	.26	.12	.20	-.14					
(9) YRS	11.84	3.19	.05	.10	.05	.01	.07	.39	.05	.30				
(10) E	.43	.49	.14	.12	.01	-.04	.01	-.40	.04	-.22	-.49			
(11) M	.29	.46	.00	-.01	.00	-.01	.03	.01	.19	.10	-.19	-.56		
(12) J	.14	.35	-.01	.02	-.09	.03	-.12	.21	-.06	.14	.21	-.35	-.26	
(13) JS	.13	.34	-.19	-.18	-.03	.04	.07	.36	-.24	.06	.24	-.34	-.26	-.16

Results

Descriptive statistics and intercorrelations for all variables appear in Table 3. Results from the regression analyses are presented separately by dependent variable: Full-scale analyses appear in Table 4, while reading-scale and mathematics-scale analyses appear in Tables 5 and 6, respectively. Each table presents the results associated with each of the four regression models. Overall, the values of R^2 indicate that the model accounted for a substantial portion of variance in full-scale performance (R^2 = .50), although less so for performance on the reading and mathematics scales (R^2 = .35 and .36, respectively).

Control Variables

Although the explanatory value of each control variable was not the focus of this study, we offer a few observations on their signs and significance levels vis-a-vis extant research.

As expected, SES emerged as a major influence on MEA scores. Where full-scale MEA scores were the dependent variable, the unstandardized regression coefficient for COLGRAD (b = 4.81) indicates that test scores increased almost 5 points for every one-point increment in the percentage of community members who had completed four or more years of college. This effect is equivalent to a 32-point increase in MEA scores — two thirds of a standard deviation — with a variation of one standard deviation in COLGRAD. The coefficient for this variable is highly significant for the reading and mathematics subscales, as well.

Teacher experience (YRS) also was a significant predictor of student performance on the MEA. For example, a student's reading achievement increased almost 4 points with every additional year of teacher experience, corresponding roughly to 12.5 MEA points (or roughly a fifth of a standard deviation) for each standard deviation increase in teacher experience.

In contrast, per-pupil instructional expenditures (INREG) had only a marginally significant, positive influence on full-scale MEA scores, and no influence on either reading or mathematics performance. This is not surprising, of course, given the literature considered above. Similarly, neither school size (SCHSIZE) nor pupil-staff ratio (PSRATIO) surfaced as a significant predictor of any achievement criterion. Although post-baccalaureate education (PCBPLUS) emerged — unexpectedly — as a *negative* predictor of MEA scores (see Tables 4 and 6), the magnitude of these effects was exceedingly small and of little practical or theoretical import.

Grade Span

Grade span, the principal variable in this study, emerged as a significant predictor of academic achievement. As a group, grade-span variables were related more to full-scale and reading achievement than to achievement in mathematics.

Table 4
Multiple Regression Results: FULL-SCALE

Variable	Coefficient	Standard error	T-statistic
COLGRAD	4.81	.45	10.79**
INREG	.03	.01	1.90*
SCHSIZE	-.02	.02	-1.01
PSRATIO	1.81	1.23	1.47
PCBPLUS	-.27	.15	-1.78*
YRS	3.05	1.08	2.83**
	Model A: Reference category = E		
CONST	125.61	31.84	3.94
M	-15.25	7.28	-2.09 **
J	-14.60	9.81	-1.49
JS	-38.35	10.60	-3.62**
	Model B: Reference category = M		
CONST	110.36	33.22	3.32
E	15.25	7.28	2.09**
J	.65	9.46	.07
JS	-23.10	10.18	-2.27**
	Model C: Reference category = J		
CONST	111.02	32.07	3.46
E	14.60	9.81	1.49
M	-.65	9.46	-.07
JS	-23.75	10.83	-2.19**
	Model D: Reference category = JS		
CONST	87.27	32.25	2.71
E	38.35	10.60	3.62**
M	23.10	10.18	2.27**
J	23.75	10.83	2.19**

Note: $R^2 = .50$, $F = 16.89$ ($p < .01$).
*Significant at the .10 level for a two-sided test with 120 d.f.; critical value = 1.658.
**Significant at the .05 level for a two-sided test with 120 d.f.; critical value = 1.980.

For full-scale MEA scores, two patterns of grade-span effects were evident (see Table 4). First, the elementary setting held a distinct advantage over the other three grade spans as a location for the eighth grade (Model A). For example, the average eighth-grade performance in schools in either middle (b = -15.25) or junior-high (b = -14.60) grade spans fell approximately 15 points below eighth graders in elementary settings, or almost one third of the full-scale MEA standard deviation. Although one of these effects did not reach statistical significance, the consistency in sign and magnitude is noteworthy. Relative to the elementary grade span, the junior/senior high school fared the poorest: Roughly 38 full-scale MEA points —

Table 5
Regression Results, Dependent Variable = READ

Variable	Coefficient	Standard error	T-statistic
COLGRAD	4.38	.60	7.29**
INREG	.02	.02	1.14
SCHSIZE	-.01	.02	-.61
PSRATIO	2.35	1.66	1.42
PCBPLUS	.09	.21	.42
YRS	3.93	1.45	2.70**
	Model A: Reference category = E		
CONST	103.38	42.97	2.41
M	-22.17	9.83	-2.25**
J	-18.01	13.24	-1.36
JS	-48.18	14.30	-3.37**
	Model B: Reference category = M		
CONST	81.21	44.83	1.81
E	22.17	9.83	2.25**
J	4.11	12.77	.32
JS	-26.01	13.73	-1.89*
	Model C: Reference category = J		
CONST	85.32	43.28	1.97
E	18.01	13.24	1.36
M	-4.11	12.77	-.32
JS	-30.12	14.61	-2.06**
	Model D: Reference category = JS		
CONST	55.20	43.52	1.27
E	48.18	14.30	3.37**
M	26.01	13.73	1.89*
J	30.12	14.61	2.06**

Note: $R^2 = .35$, $F = 9.18$ ($p < .01$).
*Significant at the .10 level for a two-sided test with 120 d.f.; critical value = 1.658.
**Significant at the .05 level for a two-sided test with 120 d.f.; critical value = 1.980.

.79 of a standard deviation — separated the average school in these two grade spans.

The second pattern to emerge from the full-scale analyses was the consistent and statistically significant disadvantage of eighth grades located in the junior/senior grade span (Table 4, Model D). This effect relative to the elementary setting was just reported. Similar, albeit smaller, effects were observed relative to the middle ($b = 23.10$) and junior ($b = 23.75$) grade spans, corresponding to almost half of a standard deviation in academic achievement.

These two patterns of effects were more pronounced where reading achievement served as the dependent variable (see Table 5). For example,

Table 6
Multiple Regression Results: MATH

Variable	Coefficient	Standard error	T-statistic
COLGRAD	5.39	.65	8.25**
INREG	.03	.02	1.67
SCHSIZE	.01	.02	-.30
PSRATIO	.78	1.81	.43
PCBPLUS	-.56	.22	-2.50**
YRS	3.46	1.58	2.19**
	Model A: Reference category = E		
CONST	150.71	46.72	3.23
M	-13.76	10.69	-1.29
J	-26.23	14.39	-1.82*
JS	-24.55	15.54	-1.58
	Model B: Reference category = M		
CONST	136.96	48.74	2.81
E	13.76	10.69	1.29
J	-12.48	13.88	-.90
JS	-10.80	14.93	-.72
	Model C: Reference category = J		
CONST	124.48	47.05	2.65
E	26.23	14.39	1.82*
M	12.48	13.88	.90
JS	1.68	15.89	.11
	Model D : Reference category = JS		
CONST	126.16	47.31	2.67
E	24.55	15.54	1.58
M	10.80	14.93	.72
J	-1.68	15.89	-.11

Note: $R^2 = .36$, $F = 9.60$ ($p < .01$).
*Significant at the .10 level for a two-sided test with 120 d.f.; critical value = 1.658.
**Significant at the .05 level for a two-sided test with 120 d.f.; critical value = 1.980.

the advantage of the elementary setting (Model A) ranged from over a third of a standard deviation (b = -18.01) to a full standard deviation (b = -48.18). The disadvantage associated with the junior/senior grade span similarly was more marked (Model D).

In neither the full-scale nor the reading subscale analyses was a significant difference obtained for the middle versus junior-high comparison. This is not surprising insofar as these two grade spans, arguably, are more similar than not, both in the grades they comprise (see Table 1) and the instructional and social environments they represent.

Curiously, only one of the grade-span comparisons was statistically significant ($p < .10$) in the analyses

involving mathematics achievement (see Table 6). Specifically, the elementary-school eighth grade had higher achievement than the junior-high eighth grade (b = 26.23).

Discussion

These findings strongly suggest that the grade span in which the eighth grade is located influences student achievement, even once community SES and various school and teacher attributes are taken into account. Within the confines of the data and statistical models examined here, the elementary setting appeared to be the most favorable location for eighth grades in Maine, resulting in achievement advantages ranging from one third to a full standard deviation, depending on the criterion variable. In contrast, the junior/senior setting was the least successful location for eighth grades.

We hasten to acknowledge that these conclusions are tenable only insofar as no important control variables were overlooked. For example, if locating the eighth grade in the elementary grade span were significantly correlated with some neglected variable Z, and Z, in turn, were correlated with achievement and *un*correlated with existing control variables, then by overlooking Z one overestimates the regression coefficient for the elementary grade-span variable. That is, effects attributed to grade span would reflect, in part, a misspecified model.

However, while countless variables were not represented in the regression equations above, we believe that we did include the more salient considerations. Further, potentially important variables that were not present in these analyses (e.g., classroom management) probably would correlate with variables that *were* included (e.g., pupil-staff ratio) and, therefore, would attenuate any estimation bias due to the former's omission.

In contrast, a more serious limitation of this study is that we were unable to collect data bearing on school characteristics and processes for which grade span, admittedly, served as a proxy. Consequently, any explanations of grade-span effects that we wish to proffer would be entirely speculative. In this regard, the import of our findings would strengthen considerably had we obtained additional data of this kind and assessed the degree to which grade-span effects diminished once the additional variables were entered into the regression equations.

Does this latter limitation gainsay the validity and utility of our results? We think not. First, the effects above clearly indicate the systematic relationship between grade span and academic achievement, the nature of which is consistent with the findings of others (e.g., Becker, 1987; Moore, 1984).[2] Why did the elementary grade-span appear to have the advantage? Again, we cannot say with confidence. However, we agree with Becker (1987) and McPartland et al. (1987) that subsequent research should examine various grade spans for possible differences on such considerations as instructional specialization (e.g., departmentalization), tracking, and within-class ability grouping, as well as staff recruitment and training practices, expectations for student performance, and sensitivity to individual differences among students.

Further, the continuity of context and experience that the elementary grade span affords, too, could translate into an achievement advantage. That is, perhaps Feld et. al. (1979) were right: "Early adolescent students experience so much change that they could benefit from a secure, familiar school setting" (quoted in Moore, 1984, p. 2). Factors worth exploring include curriculum discontinuity that may occur when a grade change entails a change in building, as well as possible discontinuity associated with school policies regarding student conduct and homework.

In short, our findings point to the continued importance of research on grade span, particularly in regard to critical aspects of schools and schooling that may underlie grade span. But these findings also serve a second purpose, albeit indirectly: They call into question any simplistic assertion regarding the superiority of (nominally) middle-level schools.

While we did not directly test the relative effectiveness of middle-level schools, any achievement

[2]As indicated earlier, we excluded observations with standardized residuals greater than 2.0 (e.g., Judge, Hill, Griffiths, Lutkepol, & Lee, 1988). Inspection of the eight outlier schools yielded no *a priori* hypotheses that would have supported e.g., see altering the model to account for whatever processes may have produced residuals of such magnitude. When these discrepant cases were included in the analyses, the b-coefficients associated with the grade-span variables were, with one exception, of the same sign as those reported above, although generally failed to reach statistical significance. The inferiority of the junior/senior location relative to the elementary location remained evident. It also remained the case that the middle and junior high school settings were not more effective than the elementary setting. The distribution of excluded observations and a copy of the regression results with the outliers included are available from the first author.

advantage associated with schools of this kind would have resulted in higher achievement for "middle" and "junior high" schools in our sample — the grade spans in which middle-level schools would be located. That these two grade spans consistently fell *below* elementary schools in academic achievement suggests (a) a middle-level advantage was not present in these data and/or (b) many schools in these two grade spans were not middle-level schools, in the true sense of the term. These data would seem to suggest that age segregation simply is not enough. To be effective, such segregation must be coupled with the faithful implementation of the middle-level philosophy governing both the structure and the process of schooling (e.g., Merenbloom, 1988). What is needed, of course, is research that, like the present study, employs a multivariate statistical methodology but, unlike this study, is able to incorporate rich, descriptive process measures that reflect the major tenets of middle-level philosophy.

In summary, while grade-span effects were obtained in this study, firm policy conclusions are forestalled by the absence of additional data that would speak unequivocally to the underlying causes of these effects. Indeed, the principal significance of our findings may lie in their support not for the conclusion that grade span matters, but, rather, that factors contributing to school effectiveness within the eighth-grade context appear to vary by grade span. In this light, the results of this study argue for further research to explore more descriptively what these factors are and, in turn, how they combine with grade span to influence academic achievement.

References

Becker, H. J. (1987). *Addressing the needs of different groups of early adolescents: Effects of varying school and classroom organizational practices on students from different social backgrounds and abilities.* Report No. 16. Baltimore, MD: The Johns Hopkins University Center for Research on Elementary and Middle Schools.

Blyth, D. A., Hill, J. P., & Smyth, C. K. (1981). The influence of older adolescents on younger adolescents: Do grade-level arrangements make a difference in behaviors, attitudes, and experiences? *Journal of Early Adolescence, 1,* 85-110.

Braddock, J. H., Wu, S-C, & McPartland, J. (1988). *School organization in the middle grades: National variations and effects.* Report No. 24. Baltimore, MD: The Johns Hopkins University Center for Research on Elementary and Middle Schools.

Calhoun, F. S. (1983). *Organization of the middle grades: A summary of research.* Arlington, VA: Educational Research Service, Inc.

Carnegie Council on Adolescent Development (1989). *Turning Points.* New York: Carnegie Corporation of New York.

Coleman, J., et al. (1966). *Equality of Educational Opportunity.* Washington, D.C.: U.S. Government Printing Office.

Feld, M. M., et al. (1979). *A report on the feasibility of a grade level reorganization for the Providence School System: Phase 1 Final Report.* Providence, RI: University of Rhode Island.

George, P. S., & Oldaker, L. L. (1985/1986). A national survey of middle school effectiveness. *Educational Leadership, 43*(4), 79-85.

Glasman, N. S., & Biniaminov, I. (1981). Input-output analyses of schools. *Review of Educational Research, 51,* 509-539.

Guthrie, J. W. (1979). Organizational scale and school success. *Educational Evaluation and Policy Analysis, 1,* 17-27.

Hanushek, E. A. (1981). Throwing money at schools. *Journal of Policy Analysis and Management, 1,* 19-41.

Hanushek, E. A. (1986). The economics of schooling: Production and efficiency in public schools. *Journal of Economic Literature, 24,* 1141-1177.

Hough, D. L. (1989). *Vertical articulation for the middle grades.* Riverside, CA: California Educational Research Cooperative. (ERIC Document No. ED 315 896)

Johnston, J. H., & Markle, G. C. (1986). *What research says to the middle level practitioner.* Columbus, OH: National Middle School Association.

Judge, G. G., Hill, R. C., Griffiths, W. E. Lutkepol, H., & Lee, G-C. (1988). *Introduction to the theory and practice of econometrics.* New York: John Wiley.

Lipsitz, J. (1984). *Successful schools for young adolescents.* New Brunswick, NJ: Transaction Books.

Maine Department of Educational and Cultural Services (1989). *Guide to the Maine Educational Assessment.* Augusta, ME: Author.

McPartland, J. M., Coldiron, J. R., & Braddock, J. H. (1987). *School structures and classroom practices in elementary, middle, and secondary schools.* Report No. 14. Baltimore, MD: The Johns Hopkins University Center for Research on Elementary and Middle Schools.

Merenbloom, E.Y. (1988). *Developing effective middle schools.* (2nd ed.). Columbus, OH: National Middle School Association.

Monk, D. H. (1989). The education production function: Its evolving role in policy analysis. *Educational Evaluation and Policy Analysis, 2*(1), 31-45.

Moore, D. W. (1984). *Impact of school grade-organization patterns on seventh- and eighth-grade students in K-8 and junior high schools.* (ERIC Document Reproduction Service No. ED 245 346).

Pindyck, R. S., & Rubinfeld, D. L. (1981). *Econometric models and economic forecasts* (2nd ed.). New York: McGraw-Hill.

Simmons, R. G., & Blyth, D. A. (1987). *Moving into adolescence.* New York: Aldine DeGruyter.

Stout, D. J. (1962). *Some characteristics and practices in junior high schools in five midwestern states.* Unpublished doctoral dissertation, University of Iowa.

Walberg, H. J., & Fowler, W. J. (1987). Expenditures and size efficiencies of public school districts. *Educational Researcher, 16*(7), 5-13.

Ward, B. A., Mergendoller, J. R., & Mitman, A. L. (1982). *The years between elementary schools and high school: What schooling experiences do students have?* Invited paper prepared for the National Commission on Excellence in Education. Washington, D.C.: National Commission on Excellence in Education.

White, K. R. (1982). The relation between socioeconomic status and academic achievement. *Psychological Bulletin, 91*, 461-481.

White, W. D. (1964). *The effect of the grade combination of the junior high school upon pupil progress in seventh grade.* Unpublished doctoral dissertation, University of Denver.