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High School Achievement in Maine: Where You Come From Matters More Than School Size and Expenditures

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High School Achievement in Maine: Where You Come From Matters More Than School Size and Expenditures

By Fern Desjardins and Gordon A. Donaldson Jr.



Fern Desjardins and Gordon Donaldson report on their research examining the relationship between academic achievement in Maine's public high schools and school size, per-pupil operating costs, and socioeconomic status. Using aggregated Maine Educational Assessment (MEA) scores, their study confirmed previous research that socioeconomic status (using both family and community measures) is the most important factor associated with achievement, while school size is not a critical factor. Additionally, the authors found that per-pupil operating costs are higher in the state's largest and smallest high schools. The authors suggest that the creation of larger districts and larger schools, as supported by recent state policies, will not necessarily mitigate inequities in student achievement resulting from family and community socioeconomic status, and may not yield the desired cost savings. 🐉

INTRODUCTION

Since the turn of the last century, state leaders and the Maine legislature have sought to improve educational quality and to equalize educational costs and benefits for all children across the state. As the state's resources have ebbed and flowed, both our will and our ability to distribute resources in the service of equal benefits have varied. In the present-day environment, the concern for providing every Maine child an equal opportunity to learn is often overshadowed by efforts to contain costs and to assert uniform practices and structures on schools. As we seek higher student achievement at lower public cost, will we sacrifice our commitment to educational equity?

Two recent education policy initiatives operate from the premise that higher student achievement at lower public cost—that is, greater efficiency—will result from creating larger schools and larger school units. Maine's Essential Programs and Services (EPS) funding program explicitly rewards schools with enrollments above specified minimums with higher state subsidy. The state's 2007 school administrative reorganization law seeks to consolidate administrative and educational functions, a shift that typically leads to the consolidation of schools themselves (Johnson 2006). Does the evidence support the premise that increasing the size of schools will raise achievement and reduce cost? In particular, will policy initiatives such as EPS and the reorganization law make educational opportunity more equitable statewide?

The research reported in this article examines the extent to which differences in school size, per pupil operating costs, and socioeconomic status appear to affect the academic achievement of Maine's public high school students. These three variables—school size, funds spent for operating schools, and socioeconomic characteristics of communities and families—are commonly examined in studies of school efficiency (Andrews, Duncombe and Yinger 2002; Hanushek 1997). The results of our study help to understand how differences in achievement—outcome inequalities—occur across Maine high schools of different sizes, with different socioeconomic conditions, and with different expenditure profiles. Our findings are

considered in light of the current policy preference for larger schools and school districts and point toward ways that we might equalize every Maine child's opportunity to learn to high standards.

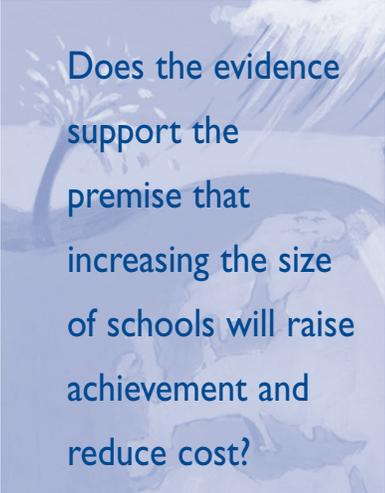
THE STUDY

This study compared student achievement, socioeconomic status (SES), and per pupil operating costs over a three-year period (school years ending in 2000, 2001, and 2002) across the 118 public high schools in Maine to determine if these factors varied as school enrollment increased or decreased (Desjardins 2005). The sample did not include private, completely state-funded, alternative, and career and technical schools for grades 9–12 because not all data required for the study were available from those schools. We especially wanted to know if school size was a significant predictor of student achievement and, if so, how its impact compared to the predictive power of socioeconomic status and per pupil operating expenditures.

High school size was calculated by averaging the total enrollment in grades 9–12 in each public high school over the three-year period of this study using the October and April enrollment reports to the Maine Department of Education (MDOE). Enrollment included resident and tuition students and was provided by the MDOE.

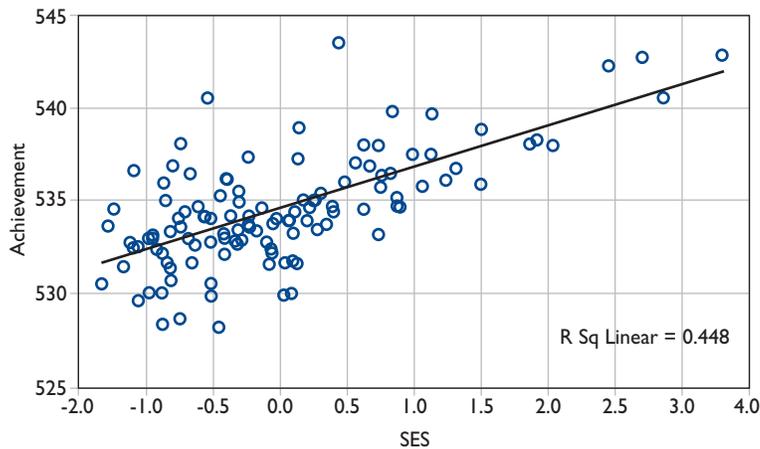
Student achievement was measured in reading, writing, and mathematics using three-year average scores (weighted grand means) on the grade 11 Maine Educational Assessment (MEA) tests. The MEAs were selected because they were the only tests that all Maine high school students were required to take at the time of the study. A weighted grand mean was computed for each of the three content areas and to calculate an overall achievement score for each high school because student enrollment varies from year to year.

The percentage of students eligible for free and reduced-price school meals is often used as the only



Does the evidence support the premise that increasing the size of schools will raise achievement and reduce cost?

FIGURE 1: Scatterplot of SES and Achievement



indicator of student socioeconomic status in Maine's education policy decisions. That measure, however, is quite inaccurate, particularly at the high school level where not all eligible families apply for assistance.¹ This study increased the reliability and validity of the SES variable by averaging four indices of wealth for each high school. Three community measures—median household income, percentage of the population with a bachelor's degree or higher, and percentage of the population employed in management, professional, and related occupations—were calculated for each high school based on the percentages of students enrolled from each community it served. For example, to calculate the median household income for each high school, we calculated the three-year mean percentage of students from each sending community that the high school served (resident and tuitioned students). That percentage was multiplied by each sending community's median household income. These weighted income indices for each sending community were then added to obtain the median household income for the population of students attending each high school. Similar calculations were done for the other two community SES measures. Community data were obtained from the 2000 U.S. Census.

A fourth measure, percentage of students eligible for free and reduced-price school meals, was calculated from the free and reduced school lunch report (form ED534) at the MDOE Web site (2004) or directly from schools not participating in the school lunch

program. Given the instability of the high school eligibility data, we compared free and reduced lunch data for K-12, K-8, and 9–12 populations in each high school catchment area. We determined that the three-year average percentage of students eligible for free and reduced price meals in all the elementary schools within each SAU with a high school provided the most valid free and reduced data for the high school (Desjardins 2005).

We analyzed the four variables to determine if they cohered and appeared to be getting at the same construct, socioeconomic status. Scatterplots of the six bivariate correlations indicated strong linear relationships between all pairs of variables, and all six correlations (range of $r = 0.69$ to $r = 0.92$, $p < 0.01$) were statistically significant. This indicated that the four variables cohered well and that a mean z score would be an appropriate measure of socioeconomic status.

After converting each SES variable to a z score, we averaged them to obtain a mean z score for each high school. These aggregate z scores, then, represented the student population within the school system (free and reduced price lunch data) and the communities in which the high school students resided (median household incomes, education of adults, and employment status of residents).

A per pupil operating cost was calculated for each high school from expenditure figures provided by the MDOE for each of the three years of the study. Operating costs included salaries, benefits, student and staff support services, supplies, building maintenance, and utilities; they did not include more variable costs such as special education, vocational education, transportation, and debt service. To calculate a per pupil three-year mean operating expenditure for each high school, we used the actual enrollment—including both resident and tuition students.

Analyses of the data began with basic descriptive statistics and advanced to increasingly more complex calculations. They included correlations, tests for curvilinearity among the variables (to determine if there were diminishing returns as school size increased beyond a certain point), and multiple regressions that examined the independent and combined effects of school size, socioeconomic status, and per pupil oper-

ating cost on student achievement. Using multiple regression, the study also examined if school size diminishes the relationship between socioeconomic status and student achievement. That is, we wanted to know if students from poorer communities do better in smaller schools and students from affluent communities do better in larger schools.

FINDINGS

What explains differences in achievement among Maine high school students? What are the relative effects of school size, per pupil operating costs, and community and family socioeconomic status on achievement?

Community and Family Socioeconomic Status

The correlation between socioeconomic status and student achievement ($r = 0.67$, $p < 0.01$) was by far the strongest correlation with achievement among the three variables of school size, operational costs, and socioeconomic status (Table 1). The scatterplot in Figure 1 further demonstrates the strong trend between each high school's three-year mean MEA scores in reading, writing, and math and community and family socioeconomic status. Students in schools with lower free and reduced price lunch eligibility rates and from communities with higher median household incomes, adults with a bachelor's degree or higher, and higher rates of employment in management or related occupations were two-thirds more likely to achieve at higher

levels than students from communities with a lower socioeconomic profile.

A more sophisticated analysis with multiple regression further demonstrated that the *only significant predictor of student achievement was socioeconomic status* (Table 2). The regression model with the three predictors (school size, socioeconomic status, and operating costs) significantly predicted achievement, with the three together explaining 45 percent of the variance in achievement. However, only socioeconomic status was determined to significantly and independently predict student achievement ($t = 8.83$, $p < 0.01$). There was an increase of 0.69 of a standard deviation in student achievement associated with one standard deviation increase in socioeconomic status, holding constant school size and school expenditures. In other words, as one goes from a less privileged to a more affluent status, high school achievement rises even when school enrollment and per pupil expenditures remain the same.

Differences in Expenditure Levels

Per pupil operating cost and student achievement demonstrated no correlation ($r = 0.02$, $p < 0.01$). The regression model also showed that operating expenditures did not significantly predict the achievement levels of Maine high school students ($t = -1.06$, $p > 0.05$). In fact, there was an achievement decline of nine percent of a standard deviation (-0.09) for each standard deviation increase in operating costs, holding constant school size and socioeconomic status.

TABLE 1: Intercorrelation between SES, Size, Cost, and Achievement (n = 118)

Public high schools	Achievement	Size	Cost
SES	0.67*	0.33*	0.13
Size	0.24*	--	-0.49*
Cost	0.02	--	--

* $p < 0.01$, one-tailed.

TABLE 2: Summary of Multiple Linear Regression Analysis for Three Variables Predicting High School Achievement (n = 118)

Variable	B	SE B	B
Intercept: 535.91		1.45	
SES	2.27	0.26	0.69*
Size	-2.42E-04	7.86E-04	-0.03
Cost	-2.02E-04	1.90E-04	-0.09

Note. $R^2 = 0.45$ * $p < 0.01$

How much a high school spends to educate its students (within normal limits) is not likely to substantially help or hinder how well students do in school.

School Size and Student Achievement

School size, by itself, showed a modest correlation with student achievement ($r = 0.24$, $p < 0.01$). This would suggest that as enrollment increases, student achievement tends to be higher. The scatterplot of the statistically significant relationship between school size and student achievement showed a wide scattering of data points, indicative of a weak correlation (Figure 2). Upon further analyses with multiple regression, we found that school size, like school expenditures, was not statistically significant in predicting student achievement ($t = -0.31$, $p > 0.05$). In fact, there was a decline in achievement of three percent of a standard deviation (-0.03) for each standard deviation increase in school size (Table 2, page 87), holding constant socioeconomic status and operating costs. That is, as high school enrollment increases by one standard deviation, student achievement is likely to go down by three percent of a standard deviation when socioeconomic status and per pupil operating costs remain the same.

School Size and Socioeconomic Status

The product of school size and student socioeconomic status in a regression equation enables us to test

for the statistical interaction between the two variables in affecting student achievement (Allison 1999: 166–169). The statistical significance of this product would mean that school size and socioeconomic status interact in influencing student achievement—that the effect of size on achievement depends on the SES level of the school. Multiple linear regression analysis revealed no statistically significant effect in this regard ($t = -0.07$, $p > 0.05$). That is, school size does not appear to influence the effect of poverty on achievement among Maine high school students.

Thus far, correlation and regression analyses show that socioeconomic status is a powerful factor in the achievement of Maine high school students and that school size and operational expenditures have little, if any, statistically significant relationship to achievement after socioeconomic status is taken into account. Our study looked more deeply at the relationships between achievement, school size, socioeconomic status, and per pupil operating costs by testing each bivariate association for curvilinearity (Allison 1999: 156–159).

We found curvilinear relationships between school size and socioeconomic status and between school size and per pupil operating costs. Socioeconomic status tended to be depressed at the small and large school ends of the graph compared to the middle (Figure 3). Expenditures tended to be higher at the small and large school ends of the scatterplot in comparison to the middle (Figure 4). That is, mid-sized high schools tend to have students from communities with higher average socioeconomic status and to cost less to operate than do small or large Maine high schools. These analyses led to two further findings.

Socioeconomic Status and School Size

When comparing the socioeconomic status of students across Maine high schools, the smallest and largest school populations tend to display lower socioeconomic status. Indeed, many of our smallest high schools are in more economically limited rural towns and many of our largest are located in cities with diverse populations and income levels. Mid-sized high schools tend to educate more affluent students and to serve communities with greater educational privilege than do our largest and our smallest high schools. As school size increases to approximately 830 students,

FIGURE 2: Scatterplot of Size and Achievement

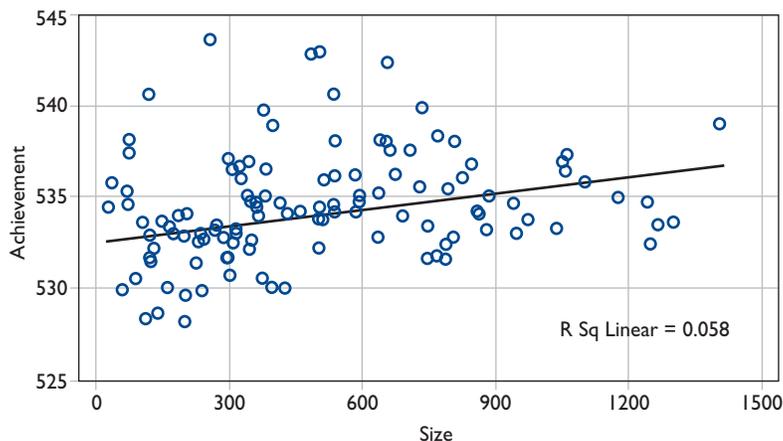
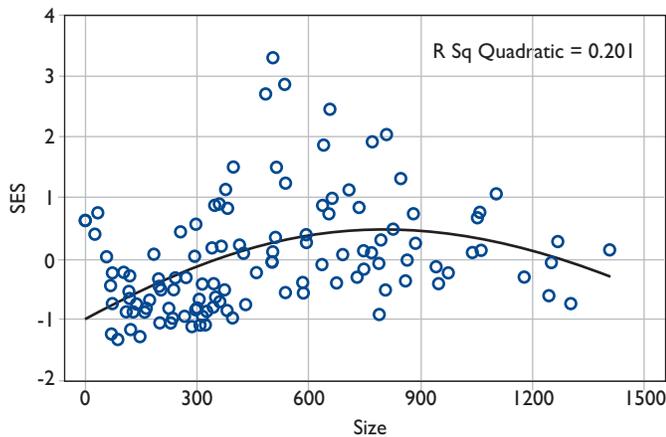


FIGURE 3: Quadratic Fit Line between Size and SES



socioeconomic status also increases. Beyond enrollments of 830, as student enrollment increases, socioeconomic status decreases. Maine's most affluent communities tend to have public high schools in the 500 to 1,150 range.

Costs and Schools Size

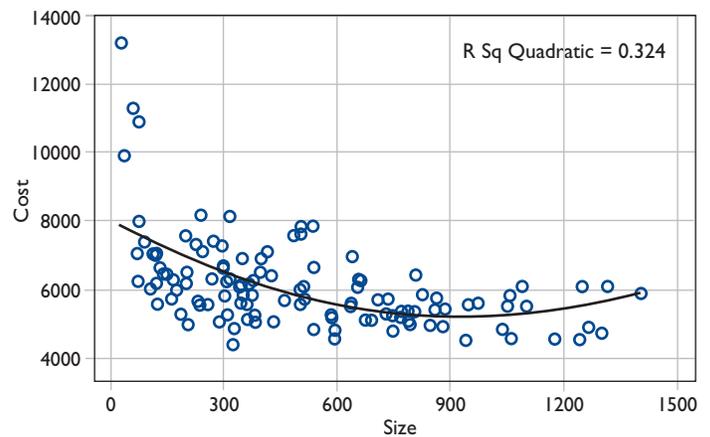
There is a strong perception in Maine communities that small schools are more costly to operate. That is partially true. Generally, the smallest Maine high schools (fewer than 100 students) have the highest per pupil operating costs. The majority of these small schools are located either on islands or in rural regions with high poverty levels (northernmost and easternmost parts of Maine). Here, again, however, we found a curvilinear relationship. High schools with enrollments of more than 900 are increasingly more expensive to operate as enrollment increases. The schools in the high-medium-sized range tend to have lower per pupil costs. That is, there are diminishing financial economies as schools enroll more than 900 students.

Summary

This study of Maine's 118 public high schools found the following:

1. Bivariate analysis revealed that 11th grade academic achievement is not correlated with high school per pupil operating expenditures, is weakly correlated with school size, and is strongly correlated with family and community socioeconomic status.

FIGURE 4: Quadratic Fit Line between Size and Cost



2. When entered into a regression analysis, however, neither expenditure nor school size have any predictive power for student achievement; differences in socioeconomic status explain any differences in achievement that might appear between smaller and larger schools. Further, the effect of socioeconomic status on student achievement is not influenced or mitigated by school size.
3. Scatterplots of the bivariate relationships between the four variables demonstrate that some relationships have both a linear component and a curvilinear component.
 - a. Both smaller and larger high schools tend to serve students from more socioeconomically challenged Maine communities than do mid-sized high schools. As high school enrollment increases to approximately 830 students, socioeconomic status also increases; beyond enrollments of 830, socioeconomic status drops as enrollment increases.
 - b. Both smaller and larger high schools tend to spend more per pupil for operations than do mid-sized high schools. As high school enrollment increases to approximately 900 students, per pupil costs decrease; beyond enrollments of 900, per pupil costs increase as enrollment increases.

These findings, clearly, are limited by the measures we have used. Although grade 11 Maine Educational Assessment test scores were the only uniform statewide metric for achievement available to us, our study would be strengthened were we to use a more comprehensive metric that aggregated multiple measures of academic growth. In the face of limited availability of student-level socioeconomic status data, we have relied upon an aggregate measure of family and community affluence, education, and employment, which is, we think, a more robust measure of socioeconomic status than commonly informs Maine policy studies. Finally, our measure of per pupil operating cost was computed from operating expenditures that are uniformly reported across Maine high schools and it accounts for both resident and tuitioned students in each school. It is as powerful a metric as is available.

...the consolidation law appears to have little empirical foundation for the proposition that larger districts (and larger schools) will mitigate the inequities in achievement among Maine's children that result from community and family socioeconomic status.

DISCUSSION

What does our study teach us about the importance of high school size as a factor in shaping student achievement and containing the increasing costs of education in Maine? The state legislative and executive branches have invested heavily in a policy direction that posits that higher achievement and lower cost will result by forming larger schools and school units from Maine's smallest schools and school systems. Though policymakers and the MDOE maintain that the reorganization law is not aimed at closing small schools, educators and citizens believe that it will

inevitably lead to the closing of schools in Maine as it has in other rural states (Johnson 2006). Does this policy direction appear likely to ensure equity of educational results across all of our students and communities? If not, what alternative directions does our study indicate?

Our study of the 118 public high schools in Maine found that the size of a high school makes very little, if any, statistical difference in the achievement of students. While simple correlation analysis indicates a weak positive association between size and achievement, this association disappears in the face of more sophisticated analyses exploring the effects of school size, per pupil operating cost, and socioeconomic status on achievement. That is, socioeconomic conditions in Maine communities washed out any statistical effect of school size and achievement appearing in bivariate analyses. In general, students from communities with higher eligibility for subsidized school meals, with lower median household incomes, and with residents who have less formal schooling and who tend to hold more blue-collar jobs or be unemployed achieve at lower levels on the MEAs whether they attend small, medium, or large high schools. Students from more affluent communities with more highly educated adults score higher regardless of the size of school they attend.

The proposition that larger sized high schools will lead to high achievement, then, is not supported by this study. Instead, policies aimed at raising achievement would more wisely address, first and foremost, the family and community conditions that appear to shape learning outcomes most powerfully. Trostel and Reilly's study of Maine district size yielded similar findings to our study's: "If socio-economic factors are taken into account, there is essentially no relationship between school district size and educational outcomes in Maine" (2005: 1).

To what extent are EPS and school reorganization sensitive to these important SES variations across Maine communities? While the EPS funding formula includes a socioeconomic factor for low SES students, it relies heavily on self-reported eligibility for free and reduced price school meals. We suggest that a more sophisticated measure of socioeconomic status such as the one used in this study be used. Furthermore, the state

should evaluate the three years of EPS's impacts by asking, "Is EPS providing the necessary resources to each Maine school that will enable it to offset the effects of socioeconomic status on its students' learning?" To the extent that resource distribution to high schools remains insensitive to the educational needs of important sub-populations, high schools with low SES profiles will, we believe, struggle to mount creative programs and services to address those needs.

Similarly, the argument underlying the current district reorganization law (Brookings Institution 2006; School Administrative Unit Study Group 2004; Task Force on Increasing Efficiency and Equity in the Use of K-12 Resources 2004) seldom acknowledges how powerfully socioeconomic conditions shape student achievement. In the few instances where empirical results have been used to justify the formation of larger school districts, one study used a more complex measure of socioeconomic status and concluded that district size made no difference in educational quality (Trostel and Reilly 2005). Others (Andren 2003; Maine Department of Education 2002; McCarthy and Silvernail 2003) were limited by the use of the unreliable free or reduced price lunch measure of socioeconomic status. Hence, the consolidation law appears to have little empirical foundation for the proposition that larger districts (and larger schools) will mitigate the inequities in achievement among Maine's children that result from community and family socioeconomic status.

Policymakers and educational leaders can draw on substantial long-term data describing socioeconomic conditions in Maine's communities to attune education policy and practice to the important community differences that affect so clearly schooling and achievement. Two strategies seem promising in this respect. First, school reforms must reach beyond the schools alone and partner with other interventions to address family and community factors. Richard Rothstein writes, "the association of social and economic disadvantage with a student achievement gap has been well known to economists, sociologists, and educators. Most, however, have avoided the obvious implication of this understanding: raising the achievement of lower-class children requires amelioration of the social and economic conditions of their lives, not just school reform" (2004: 11). Linking the state's community development, economic develop-

ment, and school improvement efforts in regions where low educational attainment is endemic would seem a prudent, even urgent, policy priority for Maine.

Second, the state should explicitly target those schools serving our least educationally privileged communities for the most creative and energetic school reform efforts. To offset these inequalities in children's educational "starting lines," more and different resources should be directed to their classrooms, schools, and communities than to those with starting lines closer to the "finish line" (Darling-Hammond 1997; Rothstein 2008). Our study suggests that communities served by mid-sized high schools (500–1,150) need fewer such resources than do communities served by smaller and larger high schools.

What form might these resources take? Our study joins many others (summarized in Hanushek 1997) in observing that money alone will not raise test scores. Nor will bigger schools necessarily yield the cost savings that policymakers, educators, and community members anticipate. While Maine's smallest high schools do spend more per student to operate than do larger schools, our largest high schools (>900 enrollment) are also more expensive to run than our mid-sized high schools. Again, the simplistic mantra that "bigger is more efficient" does not hold. We need to look more closely at why our smallest and largest high schools cost more. Cost-effectiveness analyses can reveal how Maine schools can be operated to raise achievement and save money, not simply in a manner that saves money. Clearly, the educational value comes more from how money is spent than from how much money is spent or how many students the school enrolls.

How can we target operational expenditures so they will make a difference in each Maine high school's achievement profile? Clearly, students vary widely within most Maine high schools; differentiating programming and resources to address these variations is important to students' success (Darling-Hammond 1997; Lee and Burkam 2002). Such differentiation must include individual learning plans, close partnerships between teachers and parents, and frequent assessment and instructional adjustment. Indeed, this is the most promising strategy for addressing the often profound differences in students' family and community conditions. We suggest that differentiating



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spending to intensify services to the most needy within each high school is a better way of creating efficiencies than to form larger high schools on the assumption that larger schools, by themselves, will generate higher achievement at lower cost.

Trostel and Reilly conclude their analysis of Maine districts as follows: “There is no firm basis on which to argue that educational quality would generally improve or worsen if Maine’s small school districts consolidated. [It would likely] improve some dimensions of educational quality [and] harm others” (2005: 31). They found that individual variations in quality and cost from district to district suggest that it is the instructional and management practices in a district or school that mitigate the effects of socioeconomic status on achievement in one place while not in another. Our findings for Maine high schools suggest the same conclusion: one-size-fits-all funding and programming policies are unlikely to make substantial improvement in all high schools—for all Maine students who struggle to learn to high standards. Research by others that demonstrates the educational benefits of specific practices and structures in smaller schools and districts can be helpful in this regard (Howley 2000; Jimerson 2006; Lawrence et al. 2002).

Maine’s stated commitment to educational quality and equity is as laudable as it is difficult to realize in a state with our extremes of wealth and educational privilege. Current economic weakness not only in Maine but in the country has understandably focused us more on reducing funding for schools and bringing tax relief to Mainers than on ensuring that our resources, however diminished, are spent in the service of educational equity. Our study reinforces the importance of community and family conditions in any state policy aimed at this goal. Current funding and reorganization laws seem, respectively, to undervalue and to ignore altogether the power of socioeconomic status. We hope that our research will help policymakers and citizens alike to look beyond simple “bigger is better” and “bigger is more efficient” slogans to address the real challenges our high schools face in ensuring powerful learning outcomes for every child in every Maine community. 🐟

ENDNOTE

1. This study found that 97 percent of School Administrative Units in Maine had a lower percentage of students eligible for subsidized lunches at the high school level than at the elementary level.

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