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Teacher Salaries and Opportunities to Learn

by John D. Rogers and H. W. “Bud” Meyers

The challenge of escalating education costs in Vermont raises questions about the relationships between education spending, the quality of instruction, and student outcomes. In addition to the frequently discussed question of returns on investment, policies intended to reduce costs or improve outcomes demand assumptions about these relationships that must be correct if the intended results are to be achieved. The purpose of this brief is to provide an assessment of the relationships between teacher salary expenditures, a survey-based measure of opportunities to learn, and mathematics performance on the 2004 New Standards Reference Examination.

Introduction

The Vermont legislature recently commissioned the James M. Jeffords Center for Policy Research to complete a report on educational opportunities in Vermont.¹ In that study, we analyzed student perceptions of learning opportunities in relation to mathematics performance on the New Standards Reference Examination (NSRE), and found that there is a strong relationship between opportunities to learn (OTL)² and mathematics performance even after accounting for poverty status, per pupil spending, and demographic factors.

In the course of examining these relationships, questions were raised concerning the role of teacher salaries. Salaries could be viewed as a proxy for teacher quality, as better trained and more experienced teachers can be reasonably expected to command higher salaries. The analysis reported here is a preliminary exploration of these relationships. We began with the following questions: (a) Is student performance better in supervisory unions with higher teacher salaries, relative to those where salaries are lower? and (b) Is OTL rated more highly by students in supervisory unions (SU) with higher teacher salaries, relative to those where salaries are lower?

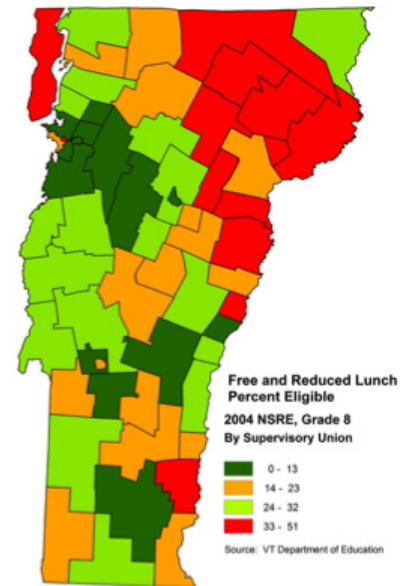
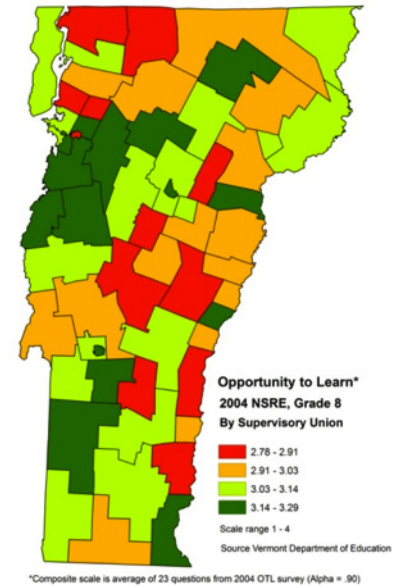
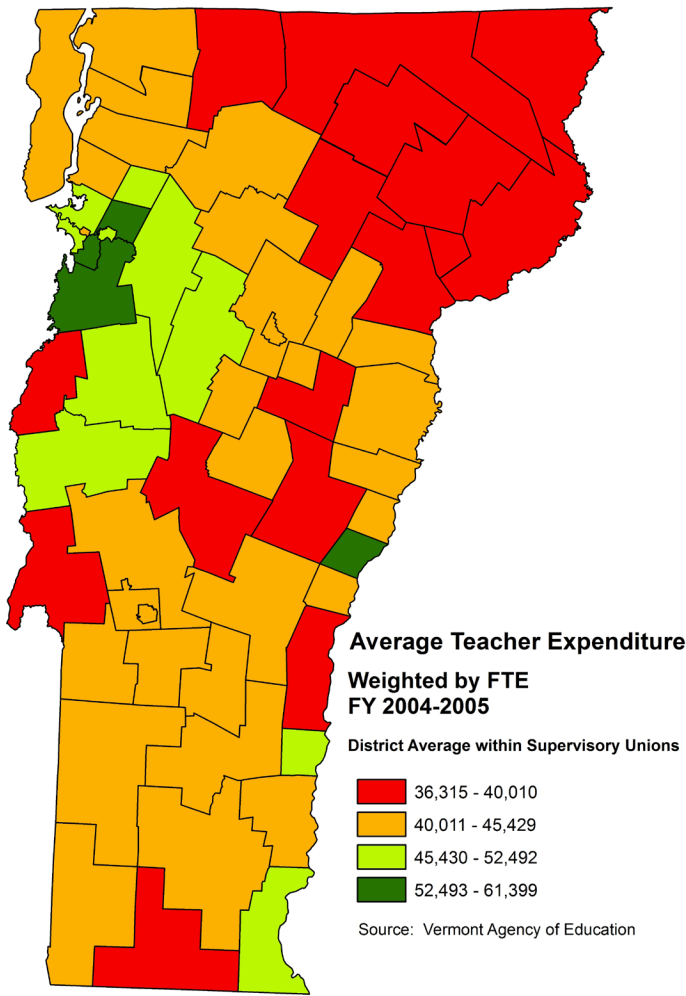
To investigate the relationship between teacher salaries, academic performance, and opportunities to learn, we retrieved annually reported salary expenditures from the website of the Agency of Education in the Teacher / Staff Full-Time Equivalency (FTE) and Salary Report.³ Reports from 60 SUs were analyzed. Entries were included for all Staff Category Descriptions referring to “teachers,” including Guidance Counselors / Directors but not including Teachers’ Aides. Reported expenditures, which do not include fringe benefits, were aggregated by supervisory union, and the totals divided by the sum of reported FTE. The resulting figures are not exactly the same as what individual teachers receive, as not all teachers are employed on a 1.0 FTE basis. These salary expenditures were averaged across districts for each supervisory union and analyzed using maps and multiple regression analysis. Average total salary expenditures in 2004 ranged from \$36,315 to \$61,399 (M = \$43,661, SD = \$5,278, Mdn = \$42,857).

OTL was measured in a survey conducted by the Department of Education in 2004, for all students in grades 4, 8, and 10. The questionnaire was attached to the New Standards Reference Examination (NSRE), which was the state’s annual assessment at the time. Mathematics performance on the NSRE was defined as the percent of students meeting the overall mathematics standard. The survey and performance data were provided by the Vermont Agency of Education, aggregated by supervisory union. Further information about the survey is available in the Jeffords Center’s full report to the Educational Opportunities Working Group.⁴

The OTL scale was defined as the average response of 24 survey questions about their experiences of different types of opportunities, each measured on a 4-point scale (options included “Not at all”, “A little bit”, “More than a little”, and “A lot”. Demographic measures available from the survey included the

Are learning opportunities better in supervisory unions with higher teacher salaries?

percent of children eligible for free and reduced lunches, gender (defined as percent male), and percent of students identifying their race or ethnicity as other than “White.” These were included as control variables, again averaged within supervisory unions.

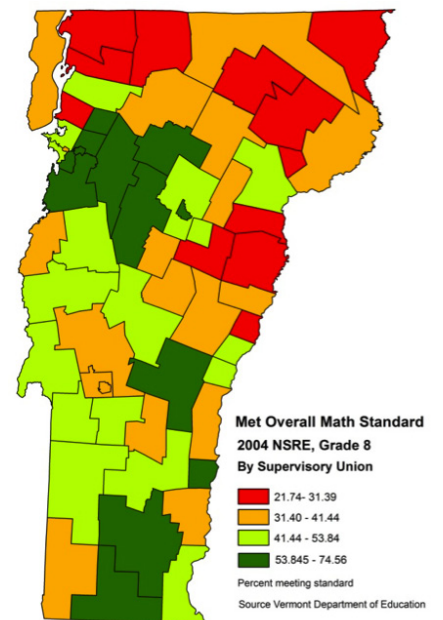


Mapping Teacher Salary Expenditures

To evaluate the extent to which salary expenditures vary by supervisory unions, and the implications of any variability, we mapped teacher salary expenditures by supervisory union. The following maps show the distribution of salaries next to maps of OTL, poverty, and mathematics performance for comparison purposes (shown for 8th grade).

The maps suggest similar spatial distributions for teacher salaries, poverty and student perceptions of OTL. In general, teacher salaries and opportunities to learn are high where poverty rates are low, although there are notable exceptions. For example, OTL ratings were high in the Orleans Central SU, despite low teacher salaries, poor mathematics performance, and a high poverty rate. Math performance was high in several SUs where salaries were low (e.g. Windham Southwest), but was rarely low in the SUs with the highest salary expenditures. It is important to understand the relationship between salaries and OTL in the context of budget concerns, so that efforts to control spending do not result in reduced opportunities to learn and achievement in districts that may already be behind in teacher and school quality.

The map and the overall range of expenditures (\$36,315 - \$61,399) illustrate a large salary gap between the Chittenden County region and the rest of the state.



Multiple Regression Analysis: Mathematics Performance

Multiple regression analysis is a statistical method for understanding the unique contributions of several combined factors on a single outcome. We used regression to examine the relationship between student-reported OTL and the percent of students meeting the overall mathematics standard for each grade level, after taking into account (“controlling for”) the distributions of gender (percent male), ethnicity (percent nonwhite), percent of students reporting free/reduced lunch eligibility, and average teacher salary expenditure. In these analyses, a statistically significant relationship does not prove that teacher salaries directly influence academic performance or learning opportunities, but it does mean that some kind of relationship is likely, which may be causal in nature.

The results of the regression analyses are shown below. Statistically significant predictors (indicating a relationship that is unlikely to have occurred by chance) are shown in bold and marked with asterisks indicating the associated probability estimate. The standardized regression coefficients indicate the amount of model-predicted change in the percent of students meeting overall math standard, in standard deviation units so that coefficients can be compared on a common metric.

For each grade level the models accounted for a substantial proportion of variability in percent of students meeting the math standard (shown on the “Model R square” line). The impacts of OTL (percent free / reduced lunch eligible) are most evident among grades 4 and 8. Salary expenditures were significantly related to 10th grade mathematics performance. An increase of one standard deviation in salary at the SU level (\$5,278) is associated with an increase of .43 standard deviations (4.5 percentage points) in the percent of 10th grade students meeting the math standard.

Standardized Regression Coefficients for Percent Meeting Overall Math Standard

	Grade 4 (n = 60)	Grade 8 (n = 59)	Grade 10 (n = 54)
OTL	.43**	.27*	.21
% Male	-.15	.01	.01
% Non-white	-.03	-.12	-.14
% Free/Reduced Lunch	-.34*	-.46***	-.12
Teacher Salary Expenditure	.16	.21	.43**
Model R square	.40	.52	.38

*p < .05; **p < .01; *** p < .001

Salary expenditures were strongly predictive of 10th grade mathematics performance.

Multiple Regression Analysis: Opportunities to Learn

We also investigated the relationship between teacher salaries and OTL ratings. In this case, we looked at the relationship between teacher salaries and student-reported OTL, controlling for the distributions of gender, ethnicity, and free / reduced lunch status.

For each grade level these models accounted for a somewhat smaller proportion of variability in OTL than was evident for mathematics performance but still showed a substantial impact, ranging between 22 and 34 percent variance explained in each model. The impact of poverty as measured by free / reduced lunch eligibility is most evident for grade 4. Teacher salary expenditures were significantly predictive of OTL ratings among students in the 8th and 10th grade (standardized coefficients = .44 and .38).

The figures below show the model-predicted variability of supervisory unions on mathematics performance and OTL ratings, controlling for demographic factors (and in the case of mathematics performance, for OTL). Although the range of OTL ratings appears small as compared to mathematics performance, this is an artifact of scale construction. Because the OTL scale is an average of 24 responses, small differences on the scale correspond to large differences in teacher salaries across supervisory unions.

Standardized Regression Coefficients for Opportunities to Learn Ratings

	Grade 4 (n = 59)	Grade 8 (n = 58)	Grade 10 (n = 54)
% Male	-.34**	.21	-.26*
% Non-white	-.01	.02	-.05
% Free / Reduced Lunch	-.41**	-.01	-.24
Teacher Salary Expenditure	.30	.44**	.38*
Model R square	.28	.22	.34

*p < .05; **p < .01; ***p < .001

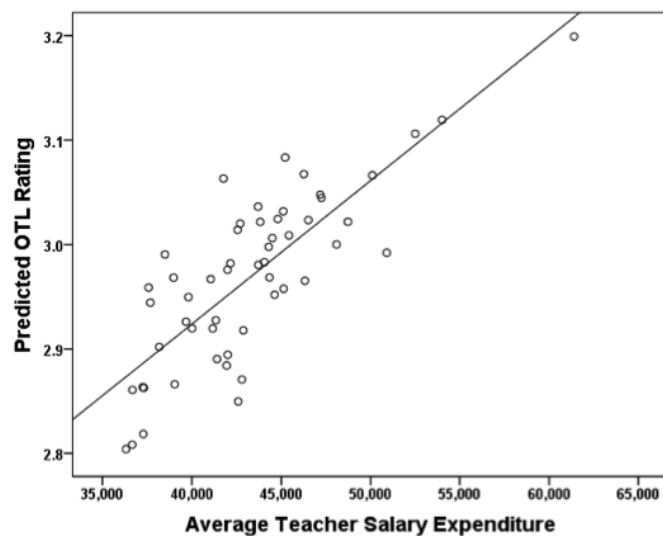
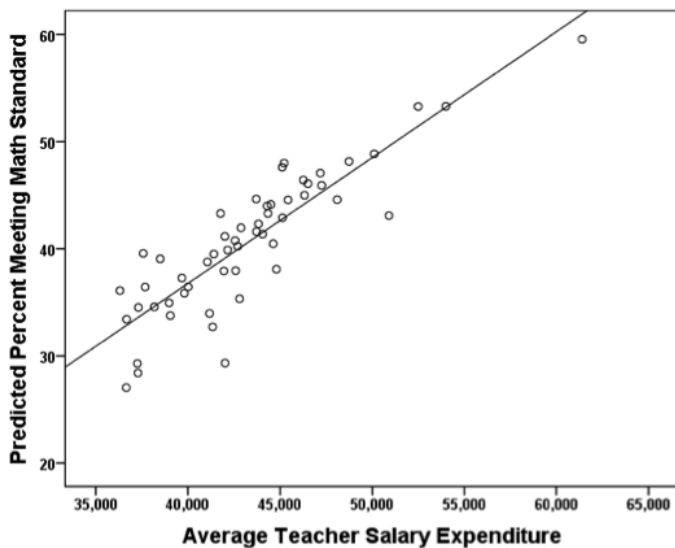
Teacher salary expenditures were strongly predictive of opportunities to learn among students in the 8th and 10th grade.

Summary Statistics for Outcome Measures

	Grade 4 (n = 60)	Grade 8 (n = 60)	Grade 10 (n = 58)
<i>OTL Scale</i>			
Mean of SUs	3.42	3.05	2.98
SD	0.15	0.13	0.15
<i>% Met math standard</i>			
Mean	52.52	43.46	40.98
SD	14.06	12.99	10.56

Conclusions

The analysis of teacher salary expenditures with the 2004 survey data reveals a complex set of relationships between salary, OTL, and mathematics performance at the level of supervisory unions. Consistent with our previous report, OTL shows the strongest relationship to performance at the early grade levels (grades 4 and 8). Salary expenditures, on the other hand, are most strongly related to performance in the 10th grade, and to OTL in grades 8 and 10. It appears that at the higher grade levels, students in supervisory unions with higher teacher salaries do in fact report higher levels of learning opportunity while performing better on mathematics examinations, relative to those in supervisory unions with lower teacher salaries.



- The map and the overall range of expenditures (\$36,315 – \$61,399) illustrate a large teacher salary gap between the Chittenden County region and the rest of the state.
- The relationships between salaries and both performance and OTL ratings are strongest at the higher grade levels. This may reflect the employment of teachers with more specialized training at higher cost, who may be more effective at teaching the more specialized content of algebra, geometry, and calculus.
- Controlling for salary, the relationship between OTL and performance is not significant at the 10th grade level, but there is still a significant relationship between teacher salary and OTL. This could indicate that the relationship between teacher salaries and student performance is mediated by OTL.
- It is not possible to infer causal relationships on the basis of these analyses, but the results do suggest possibilities that should be investigated further.
- Additional research is needed to better understand these relationships, their exceptions, and the extent to which they have changed since the most recent measurement of OTL in 2004.

There are three important factors that could potentially limit these results. First, it is possible that students at different levels of performance have different motivations when answering questions about OTL. For example, students might infer low or high opportunities to learn based on their own experiences of educational difficulty or success. The best way to address this issue would be to develop and use measures of OTL that include objective as well as subjective ratings, such as teachers' education and experience, classroom observations, or analysis of the implemented curriculum.

A second limitation is the aggregation of all data by supervisory unions. Education is delivered by individual teachers in individual schools, and received by individual students who experience multiple teachers and multiple schools throughout their educational career. Currently available data are limited because of inconsistencies of financial accounting across schools and districts, but new state initiatives (such as the development of common accounting methods and the development of new educational data systems) may in the future support multilevel analyses that combine data from individual students, teachers, schools, and districts.

Finally, additional measures would be desirable for statistical control purposes. Although we included free and reduced lunch eligibility, a good proxy for poverty rates, no data were available for the purpose of cost-of-living adjustments or controlling for teacher qualifications and experience. Planned future analyses will incorporate additional measures if and when they become available.

A better understanding of policies designed to increase educational opportunities in Vermont could greatly increase the returns Vermonters receive on their investment in public education. But this understanding can only be realized if common standards are adopted for measuring educational opportunities, spending and outcomes across all schools, districts, and supervisory unions; and if those standards are used to guide systematic data collection and comprehensive analysis. Until that time, we can only speculate about how well the costs of educational opportunity are balanced by the value of highly trained and experienced teachers.

Endnotes

1. Meyers, H.W. & Rogers, J.D. (2012). *Full Report: Educational Opportunities Working Group on Aligning Funding, Opportunities to Learn and Outcomes of the Educational System*. Report prepared for the General Assembly of the Vermont Legislature. Available at http://www.uvm.edu/~jeffords/reports/pdfs/JeffordsCenterReport_IdentifyingOpportunitiesforIntegratedServices.pdf

2. "Opportunities to learn" is a widely used term that describes the full range of opportunities available to students that provide effective preparation for their next level of schooling or career success.

3. Data file retrieved from http://education.vermont.gov/new/html/data/teacher_FTE.html

4. Meyers & Rogers, p.23.

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