DOCUMENT RESUME

ED 430 755 RC 021 986

AUTHOR	Lee, Jaekyung; McIntire, Walter G.
TITLE	Understanding Rural Student Achievement: Identifying Instructional and Organizational Differences between Rural and Nonrural Schools.
SPONS AGENCY	Department of Education, Washington, DC.
PUB DATE	1999-04-19
NOTE	20p.; Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Quebec, Canada, April 19, 1999).
CONTRACT	R902B980008
PUB TYPE	Reports - Research (143) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Economically Disadvantaged; *Educational Environment; Educational Resources; Junior High Schools; *Mathematics Achievement; Models; *Rural Schools; *Rural Urban Differences; School Culture; School Effectiveness; *Small Schools; Socioeconomic Status
IDENTIFIERS	National Assessment of Educational Progress; School Effects

ABSTRACT

National math assessment data from 3,112 eighth-grade students in 123 schools were used to determine whether location (rural versus nonrural) affects student achievement when related student and school-level factors are taken into account. Findings indicate that rural schools outperformed nonrural schools in math achievement and that the competitive edge of rural schools arose from school effects beyond the influences of school composition and individual student characteristics. Rural schools tended to have a better organizational context (teacher training, safe/orderly climate, collective support) conducive to higher performance, but suffered from poor instructional conditions (in terms of classroom resources, advanced courses, and progressive instruction), which balanced out achievement gains. Rural schools should capitalize on existing organizational and contextual strengths and also focus more effort on improving curricular and instructional weaknesses. Given that many rural students are poor and attend schools whose instructional resources and course offerings are limited, the level of their academic performance relative to their nonrural counterparts is encouraging. This study shows that rural schools can provide a model of strength worth studying and emulating. Contains 20 references and hierarchical linear regression formulas. (Author/TD)

Understanding Rural Student Achievement: Identifying Instructional and Organizational Differences between Rural and Nonrural Schools

Jaekyung Lee and Walter G. McIntire

College of Education and Human Development

University of Maine

Paper to be presented at the Annual Meeting of the AERA (Monreal, Canada, April 19, 1999)

This research was supported by Grant No. R902B980008 from the U.S. Department of Education. The views expressed herein are solely those of the authors.

Rural education often has been discussed as a deficit model of instruction from which relatively low outcomes can be expected (Edington and Koehler, 1987). While this perspective has been reinforced by some local studies, it is not supported by national data (NCES, 1994). Since the 1980s, the achievement scores of rural students have been comparable to national averages in virtually every subject tested. More important, rural student achievement has improved in recent years. There continue to be deficiencies relative to suburban settings as well as advantages over urban settings (NCES, 1997). The problem, then, is to identify both the advantages and disadvantages of being rural, particularly schooling factors impacting the gap between rural and nonrural students.

The strongest influence depressing rural performance may be the poverty of many students and families rather than any limitations imposed by type of location (Edington and Koehler, 1987). If poverty hinders student performance, what then accounts for overall rural improvement? And why do students from small schools, with relatively limited curricular opportunities, match or sometimes even surpass students from larger schools? Similarly, how can non-metropolitan students with fewer advanced courses available perform nearly as well as metropolitan students? Generally, researchers have expected inequities in what is called "opportunity to learn" to hold back rural and small school students on achievement measures (Barker, 1985; NCES, 1988). It has also been suggested that the supportive ethos of small schools intervene to offset input limitations. That rural students are outdistanced by more advantaged students suggests that with greater curricular opportunities, rural performance could further improve (Welch and Wagner, 1989). Notwithstanding many previous studies on this complex issue, it remains to be systematically examined what school-level factors affect the achievement of rural students beyond the influences of student-level factors.

Research Design

These mixed perspectives of rural student achievement have confused educators and policymakers as to important variables which might be addressed in seeking to improve rural education. Given that rural schools have both the advantage of small school sizes and the disadvantage of low income levels, we conducted a systematic analysis of the relationship among key schooling conditions and student outcomes in rural versus nonrural settings.

The primary data sources are the NAEP 1996 National Assessment, which was collected from students attending public schools in grade 8. The 1996 NAEP state data contain information on the mathematics knowledge, skills, understanding, and attitudes of a representative sample of eighth-grade students in the nation. In addition, questionnaires completed by the students, their mathematics teachers, and principals provide an abundance of contextual data within which to interpret the mathematics results.

To guide our data analyses, we developed an analytical framework (see Figure 1). In it, student achievement is related to race, socioeconomic status (SES), course-taking, and aptitude for mathematics. Given the influences of those student/family characteristics, we see the effect of rural school location on student achievement as mediated by key schooling conditions. Rural schools have unique demographic features such as smaller school size and higher poverty level which impact their schooling conditions. These schooling conditions are assumed to work as intervening factors that involve both instructional (instructional resources, advanced course, and progressive instruction) and organizational (professional training, safe/orderly climate, and collective support) features of schools.[1] We recognize that many of these school factors as predictors of student achievement are highly correlated with one another, and thus attempt to sort out each one's unique effect on achievement as an outcome variable.

In classifying schools into rural versus nonrural categories, we rely on the "type of location" variable on which the current NAEP sampling is based: Schools in Central City, Urban

[1] This differentiation builds on an important distinction articulated by Bidwell and Kasarda (1980) between the school as a context for learning and the instructional processes of schooling through which learning actually occurs.

Fringe, or Large Town are treated as "nonrural," and schools in Rural or Small Town as "rural."[2] In this study, we focus on how rural school location interacts with the above-mentioned schooling variables to affect student achievement in mathematics. We hypothesize that rural schools have both the advantage of small school size and the disadvantage of low income level, which bring about differences between rural and nonrural schools in key schooling conditions and that their mixed schooling conditions will in turn impact student achievement differentially.

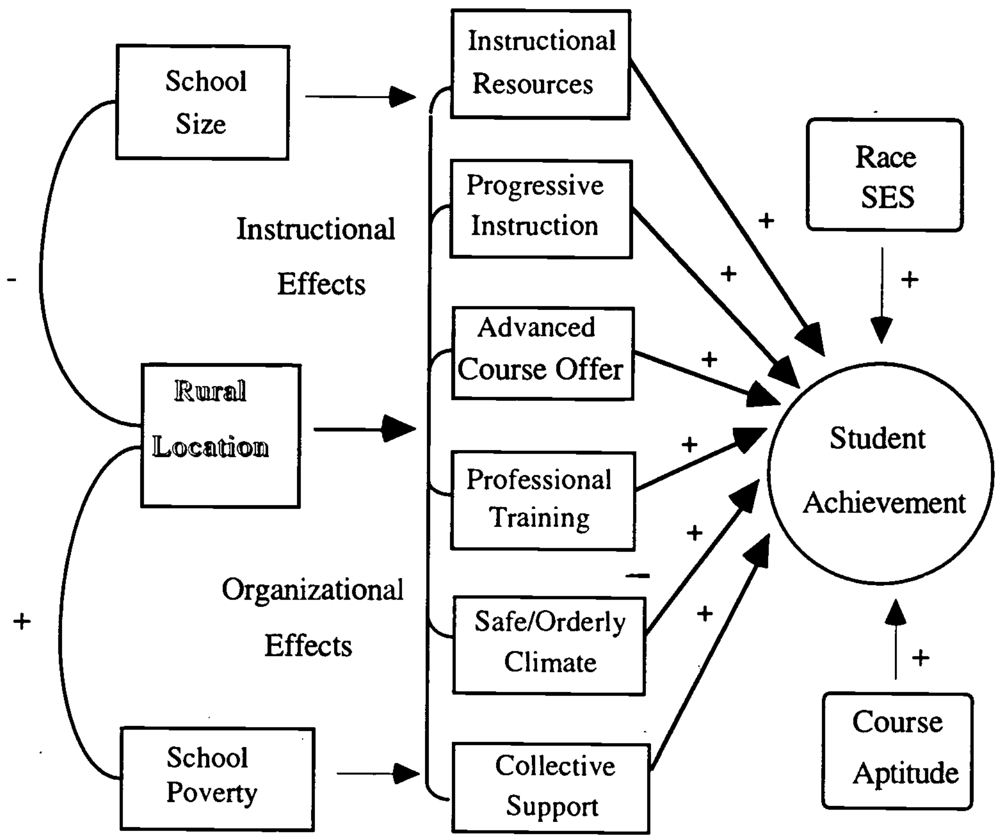

Figure 1. Hypothetical Relations of Key Schooling Conditions to Student Achievement in Rural vs. Nonrural Settings

[2] These classifications are based on geographic characteristics of the schools' locations and are determined by the Census Bureau definitions of metropolitan statistical areas (MSAs), population size, and density. Rural includes all places and areas with a population of less than 2,500. A Small Town is defined as places outside MSAs with a population of less than 25,000 but greater than or equal to 2,500. An advantage of the use of the Census definition of rural is that because schools are linked to places rather than only counties, it is possible to examine the distribution of rural schools across the different types of counties within which they are situated—including metropolitan areas. But we recognize that the Census Bureau definitions do not take into consideration the type of employment in that area and the degree of isolation (see Khattri et al., 1997 for different definitions of "rural").

Data Analyses and Findings

To explore the above-mentioned hypotheses, we constructed key schooling variables from the 1996 NAEP mathematics teacher and school principal survey data through the factor analysis method.[3] Then we examined rural-nonrural school differences across those factors through multivariate analysis of covariance (MANCOVA). Further, we analyzed student mathematics achievement scores and identified critical factors affecting the mathematics achievement of rural and nonrural students using the hierarchical linear model (HLM).

Operational Definition and Measurement of Key Schooling Factors

(1) Instructional Resources

Previous NAEP assessments in several subject areas have shown positive relationships between teachers' reports of resource availability and their students' performance (Miller, Nelson, and Naifeh, 1995). In recognition of the potential provided by calculators and computers for increasing children's mathematical power, recommendations for improving mathematics education often include more use of these tools in today's classrooms (NCTM, 1991). Items from the NAEP teacher survey are used to "measure" instructional resources (see Table 1).

(2) Progressive Instruction

To help anchor mathematical concepts for students, teachers need to present mathematics in the "everyday" context and encourage students to work together in groups to solve problems (Resnick, 1987; Romberg and Carpenter, 1986). Student-centered instructional practices with a strong emphasis on higher-order thinking skills can be considered positive signs of the

[3] In the case of teacher measures, we match the 8th grade math teachers to their students and obtain the school average of paired measures with proper weight.

Table 1. Summary of Factor Analysis Results on Key Schooling Factors

Instructional Resources: A factor composite of mathematics teacher's reports about instructional resources in the following aspects: providing resources and access to school calculators. School-level factor loadings are as follows: T041201, 0.74; T045001, 0.74. The factor has an eigenvalue of 1.09 and explains 54.6 percent of the combined variance.

Progressive Instruction: A factor composite of mathematics teacher's reports about progressive instruction in the following aspects: addressing reasoning for unique problems, communicating math ideas, how often students cooperatively solve problems, use of a calculator, writing reports/doing projects, cooperatively discuss math problems, and working real-life math problems. School-level factor loadings are as follows: T058008, 0.69; T058009, 0.58; T044512, 0.56; T044505, 0.39; T044508, 0.45; T044509, 0.63; T044510, 0.59. The factor has an eigenvalue of 2.24 and explains 32 percent of the combined variance.

Professional Training: A factor composite of mathematics teacher's reports about professional training in the following aspects of training: estimation; problem-solving; probability and statistics; manipulatives; calculators; and student's math thinking. School-level factor loadings are as follows: T057001, 0.34; T057004, 0.36; T057005, 0.45; T056905, 0.77; T056906, 0.69; T056907, 0.80. The factor has an eigenvalue of 2.17 and explains 36 percent of the combined variance.

Safe/Orderly Climate: A factor composite of principal's reports about the safe/orderly climate in the following aspects: student tardiness; student absenteeism; physical conflicts; teacher absenteeism; racial and cultural conflicts; lack of parental involvement; gang activities; and student misbehavior. School-level factor loadings are as follows: C032401, 0.72; C032402, 0.68; C032404, 0.74; C032406, 0.56; C032407, 0.54; C032409, 0.62; C032413, 0.65; C032414, 0.73. The factor has an eigenvalue of 3.48 and explains 43 percent of the combined variance.

Collective Support: A factor composite of principal's reports about the collective support in the following aspects: teacher morale, student attitudes to academics, parental support for academics, and student regard for school property. School-level factor loadings are as follows: C032502, 0.65; C032503, 0.83; C032505, 0.77; C032506, 0.73. The factor has an eigenvalue of 2.25 and explains 56 percent of the combined variance.

implementation of many recent recommendations for the reform of teaching mathematics (NCTM, 1991). Items from the NAEP teacher survey are used to "measure" progressive instruction (see Table 1).

(3) Advanced Course Offerings

For students to learn important mathematical concepts at the high school level, they must have the needed foundation in mathematics at the middle school level. While algebra seems to be the gateway toward improved mathematical learning at the secondary level, an analysis of the previous NAEP data demonstrated that course-taking is generally a powerful indicator of mathematics achievement (NCES, 1996). The National Council of Teachers of Mathematics has emphasized the need for all students at the eighth grade to be taught a wide range of mathematical topics including algebra. The school's offering an algebra course to 8th grade students for high school credit is used from the NAEP school survey (0 = no; 1 = yes).

(4) Professional Training

Improving teachers' skills and their content knowledge is also essential in enhancing the quality of public education. A rich and powerful conception of teaching knowledge is necessary to develop professional standards of practice (Shulman, 1987). Thus, teacher education and training should include not only content knowledge but also pedagogical content knowledge that provides a basis for professional decision-making. Items from the NAEP teacher survey are used to "measure" professional training (see Table 1).

(5) Safe/Orderly Climate

School organization and learning environments are likely to play an important role in shaping the classroom opportunities provided to students through which academic achievement is promoted. According to the National Education Goals, "By the year 2000, every school in the United States will be free of drugs, violence, and the unauthorized presence of firearms and alcohol and will offer a disciplined environment conducive to learning" (National Education Goals Panel, 1994) . Items from the NAEP school survey are used to "measure" safe/orderly climate (see Table 1).

(6) Collective Support

Many researchers have found that effective schools are defined in terms of a collective identity. Informal support and collegial relationships based on the sense of having a common mission is seen as essential for cultural coherence, which in turn motivates the members of a school community toward a more vigorous academic vision (Lee, Bryk, & Smith, 1993; Louis & Kruse, 1995; Newmann and Wehlage, 1995). Items from the NAEP school survey are used to "measure" collective support (see Table 1).

MANCOVA Analyses and Results

Figure 2 profiles rural (N = 58) and nonrural (N = 128) schools on common, standardized scales of their demographic, instructional and organizational variables. Relative to their nonrural counterparts, rural schools were found to be smaller and poorer, have lower levels of instructional resources, progressive instruction and algebra course-taking, and have higher levels of professional training, safe/orderly climate and collective support. Generally, these multiple comparisons reveal that rural schools have relatively disadvantaged instructional conditions as well as relatively advantaged organizational conditions. The size of those rural-nonrural school gaps in effect size unit follows this order: school size (1.1), safe/orderly climate (.72), advanced course-taking (.45), professional training (.45), instructional resources (.31), school poverty (.27), progressive instruction (.26), collective support (.1).

Since the organizational and instructional conditions of schools are interrelated and are likely to be conditional on demographic differences, a multivariate analysis of covariance (MANCOVA) design was used to analyze the differences between rural and nonrural schools in their effectiveness. The independent variable was school location (i.e., rural vs. nonrural). The dependent variables were the six instructional and organizational factor scales defined in the previous section. The covariates in the design were school size (student enrollment) and school poverty (percent students who receive free or reduced-price lunch). These covariates were included in the analysis given the extant finding that the effectiveness of rural schools is related to their advantage of being small and their disadvantage of being poor.

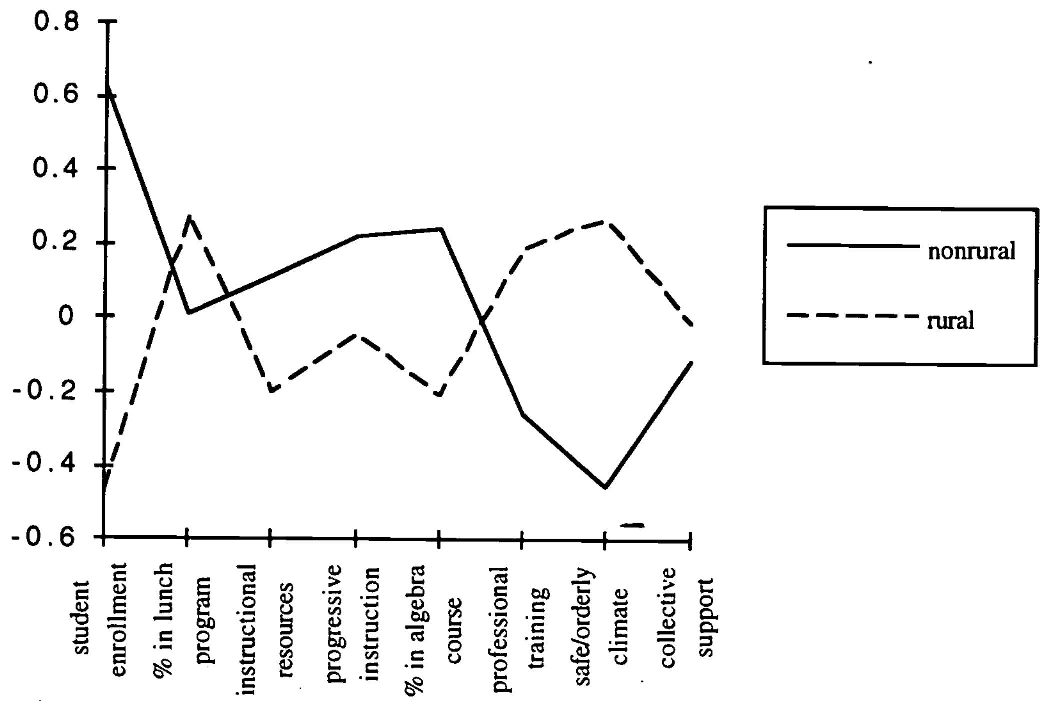

Figure 2. Profiles of Rural and Nonrural Schools on Standardized Scales (Mean=0 and Standard Deviation=1)

The schools' scores on the six instructional and organizational factor scales were adjusted to control for differences associated with the covariates because the MANCOVA test of the within-cells regression effect was statistically significant (Wilk's lamda = .66, $F = 5.54$, $p < .001$). Specifically, the effects of school size on most of the six factors were null, while school size is negatively related to safe/orderly climate. In other words, smaller schools tend to be safer and more orderly. At the same time, the effects of school poverty on most of the six factors were negative: poorer schools were having less instructional resources, providing less progressive instruction, being less safe and orderly, and getting less collective support.

The multivariate test for the school location main effect was significant (Wilk's lamda = .87, F = 3.68, p < .01), indicating rural-nonrural school differences in the six instructional and organizational effectiveness scales given their school size and poverty gaps. Individual univariate tests for each of the six scales showed that rural vs. nonrural school differences were significant (at the .05 significance level) in advanced course-taking, safe/orderly climate, and professional training but insignificant in instructional resources, progressive instruction, and collective support. Specifically, after controlling for the effects of school size and poverty, we found that rural schools were safer and more orderly, have less students taking an algebra course, and have better-trained teachers. This indicates that rural schools have still mixed schooling conditions for student learning even when they are compared with nonrural schools of similar size and poverty level.

<u>HLM Analyses and Results</u>

Student achievement is critically affected by variables operating at different levels of the school policy organization. If academic achievement depends on characteristics of students and teachers and/or the organizational context in which teaching and learning occurs, one cannot meaningfully assess the achievement gap between rural and nonrural students without considering the underlying process. In examining the effect of school location on student achievement, our strategy was to conduct a multi-level analysis of the achievement gap between rural and nonrural schools by capturing the relevant properties of both school-level and student-level variables.

The data collected under NAEP is hierarchical in nature because students are nested within schools. Hierarchical linear models (HLM) address the problem of students nested within schools (Bryk and Raudenbush, 1992). The use of HLM on NAEP data copes with the problem of sampling error resulting from the multi-stage sampling in NAEP. The data are weighted at the student and school level, and the weights at each level are normalized. The measurement error resulting from the multiple imputation of NAEP scores is taken into account by averaging the parameter estimates obtained from the HLM analyses of five plausible values. The 8th grade student composite score on the total mathematics assessment is used as the dependent variable.

Using a sample of students within each school, a student-level linear regression model was estimated for each school to predict the association of student/family characteristics with student achievement. Simultaneously, a school-level regression model was estimated for a sample of schools to predict the association of key school characteristics with school average achievement adjusted for between-school differences in student/family characteristics. Here we used the measures of key schooling conditions as defined in the previous section. Removing cases with missing values on any of the predictors produced an analytical sample of 3,112 students nested within 123 schools.

The HLM program (Bryk at al., 1996) was used to partition the total variance in mathematics achievement into its within- and between-school components. The within-school model regresses mathematics achievement for student i within school j as a function of student race, SES, aptitude and course-taking (see Level-1 model).

Level-1 model (Student Level):

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{1ij} + \beta_{2j}X_{2ij} + \beta_{3j}X_{3ij} + \beta_{4j}X_{4ij} + e_{ij}$$

Y_{ij} is the mathematics achievement of student i in school j (a composite of the five content strand scales, that is, Number Sense, Properties, and Operations; Measurement; Geometry and Spatial Sense; Data Analysis, Statistics, and Probability; and Algebra and Functions);

β_{0j} is the intercept for school j, that is, adjusted school mean score;

X_{1ij} is the indicator of student i's race, which is a dummy variable for a white student in school j;

X_{2ij} is the indicator of student i's family social status and support (a factor composite of parental education level, availability of reading materials at home, and eligibility for free/reduced-priced lunch) in school j;

X_{3ij} is the indicator of student i's taking advanced mathematics courses in school j, which is a dummy variable for currently taking an algebra course;

X_{4ij} is the measure of student i's aptitude for mathematics (a factor composite of liking mathematics, being good in mathematics, understanding mathematics class) in school j;
e_{ij} is a Level-1 random effect that represents the deviation of student $_{ij}$'s score from the predicted score based on the student-level model.

Here it needs to be noted that the Level-1 predictors are grand-mean centered so that the intercept, β_{0j}, can be interpreted as an adjusted mean for school j: this adjustment is chosen to sort out the unique effects of school location and related schooling conditions on achievement beyond the influences of student/family characteristics.[4]

(1) The Unconditional Model

The first step in the HLM estimation process involves fitting an unconditional, or random regression model. Notice that all Level-1 regression coefficients except the intercept are constrained to be constant across schools, and γ_{00} is the mean value for the school-level achievement effects beyond the influences of student/family characteristics.

Level-2 model (School Level):
$\beta_{0j} = \gamma_{00} + r_{0j}$
$\beta_{1j} = \gamma_{10}$
$\beta_{2j} = \gamma_{20}$

β_{0j} represents school j's average mathematics achievement adjusted for its composition of students' academic, racial, and social backgrounds.

(2) 'Location-Effects' Model

An indicator for the rural versus nonrural location of a school is added to the between-school model.

[4] The research on rural education often does not include adequate control variables, making it difficult to determine whether a particular phenomenon is truly "rural," or whether it is merely observed in a rural setting and could be associated with other conditions (Khattri et al., 1997).

$$\beta_{0j} = \gamma_{00} + \gamma_{01}L_j + r_{0j}$$

L_j is an indicator for the type of school j (0 = nonrural; 1 = rural). Based on the type of location variable in the NAEP data, we classify schools in Central city, Urban fringe, or Large town as "nonrural," and schools in Rural or Small town as "rural."

(3) 'Composition-Effects' Model

School size and poverty variables are included in the model for school average achievement. Since rural schools tend to be generally smaller and poorer than their nonrural counterparts, we control for these confounding factors in assessing the effect of school location on mean mathematics achievement.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}L_j + \gamma_{02}C_{1j} + \gamma_{03}C_{2j} + r_{0j}$$

C_{1j} is student enrollment in school j.
C_{2j} is the percentage of students receiving free or reduced-price lunch in school j.

(4) 'Schooling-Effects' Model

We next seek to develop explanatory models to illuminate how differences among schools in their schooling characteristics might influence the average achievement level of students in schools. This model hypothesizes joint effects of school location, composition, and schooling conditions. We note that schooling conditions in both rural and nonrural schools vary considerably and these organizational and instructional differences might affect outcomes, even after adjusting for school size and school poverty as well as the individual student characteristics already included in the Level-1 model.

$$\beta_{0j} = \gamma_{00} + \gamma_{01}L_j + \gamma_{02}C_{1j} + \gamma_{03}C_{2j} + \gamma_{0p}S_{kj} + r_{0j} \quad (p = 4 - 9;\ k=1 - 6)$$

S_{1j} is the average measure of instructional resources as reported by the mathematics teachers in school j.
S_{2j} is the average measure of progressive instruction as reported by the mathematics teachers in school j.
S_{3j} is the the indicator of offering an algebra course to 8th grade students for high school credit in school j (0 = no; 1 = yes).
S_{4j} is the average measure of professional training as reported by the mathematics teachers in school j.
S_{5j} is the measure of safe/orderly climate as reported by the principal (or other administrator) of school j.
S_{6j} is the measure of collective support as reported by the principal (or other administrator) of school j.

The results of HLM analyses are summarized in Table 2. There is much greater variation in math achievement at the student level than at the school level: within-school variance is about two times larger than between-school variance. At the student level, all of the four predictors are significantly, positively related to math achievement, and they explain about 33 percent of within-school variance. At the school level, the comparison of rural and nonrural schools without any control for other variables shows that rural schools tend to perform significantly better than nonrural schools (gap = 9.07 in "Location-Effects Model"). The academic excellence of rural schools relative to nonrural counterparts in terms of average math achievement becomes less significant when we consider school poverty and size factors (gap = 5.71 in "Composition-Effects Model"): the advantage of being smaller seems to exceed the disadvantage of being poorer.

When we further consider the effects of instructional and organizational factors along with demographic factors, the rural-nonrural achievement gap gets small enough to be insignificant (gap = 5.43 in "Schooling-Effects Model"). The six schooling-related predictors are all positively related to school average achievement, whereas only the effects of 'safe/orderly climate' and 'algebra course offered' turn out to be significant at the .05 level. Here again, the rural schools' advantage of being safer and more orderly (among other organizational factors) tends to be balanced out by their disadvantage of offering fewer advanced courses (among other instructional factors). As we take into account those key schooling factors, the percent of between-school variance explained by the model increases from 5 percent in "Location-Effects Model" to 41 percent in "Schooling-Effects Model."

Table 2. Summary of the HLM Analysis Results on Rural Student Achievement

	Estimated Coefficients			
	Unconditional Model	Location-Effects Model	Composition-Effects Model	Schooling-Effects Model
School-level Effects				
Adjusted Mean Outcome	269.85***	267.06***	268.40***	268.25***
Rural Location		**9.07***	**5.71^**	**5.43**
School Size			-5.09**	-4.35**
School Poverty			-7.77***	-5.32**
Instructional Resources				0.36
Progressive Instruction				2.42
Algebra Course Offered				8.99*
Professional Training				1.35
Safe/Orderly Climate				4.07*
Collective Support				0.23
Student-level Effects				
Race (White)	14.33***	14.33***	14.33***	14.33***
Socioeconomic Status	6.27***	6.27***	6.27***	6.27***
Math Course (Algebra)	27.93***	27.93***	27.93***	27.93***
Aptitude for Math	8.67***	8.67***	8.67***	8.67***
	Estimated Variance in Outcome Variable			
school-level	302.64	288.50	211.01	180.08
student-level	375.66	375.62	375.55	375.29
	Percent Variance Explained by Model			
school-level	--	5	30	41
student-level	33	33	33	33

Note. ^ P < .10, * P < .05, ** P < .01, *** P < .001

Summary of Key Findings

We note that the schooling conditions in both rural and nonrural schools vary considerably and these organizational and instructional differences affect outcomes, even after adjusting for school size and poverty as well as individual student characteristics. Largely consistent with our expectations, our findings on the effects of rural school location on student achievement can be summarized as follows:

- Rural Schools Show Relatively Higher Levels of Math Achievement than Their Nonrural Counterparts. The Achievement Gap between Rural and Nonrural Schools Is Attributable to School Effects beyond Student/Family Influences.

- Rural Schools' Comparative Advantage of Small Size and Disadvantage of High Poverty Lead to Their Mixed Instructional and Organizational Conditions for Effective Schooling and High Performance.

- Rural Schools Have Relatively Disadvantaged Instructional Conditions (Instructional Resources, Advanced Course-taking, Progressive Instruction), which Negatively Affect Student Achievement.

- Rural Schools Have Relatively Advantaged Organizational Conditions (Professional Training, Safe/Orderly Climate, Collective Support), which Positively Affect Student Achievement.

Conclusion

We used the most recent NAEP math assessment data to determine whether location (rural vs. nonrural) matters in student achievement if related student- and school-level factors are taken into account simultaneously; most research has not adequately accounted for such multilevel relationships. Our study found that rural schools outperform nonrural schools in student math achievement and that the competitive edge of rural schools is attributed to their schooling effects beyond the influences of school composition and individual student characteristics. In comparison with their nonrural counterparts, rural schools tend to have a better organizational context (i.e., teacher training, safe/orderly climate and collective support) conducive to higher performance, but at the same time they suffer from poor instructional conditions (i.e., classroom resources, advanced course offerings and progressive instruction) which balance out achievement gains. This indicates that rural schools should not only capitalize on existing organizational/contextual strengths but also focus more effort on improving curricular/instructional weaknesses.

Given that many rural students are poor and attend schools whose instructional resources and course offerings are limited, the level of their academic performance relative to their nonrural counterparts is encouraging. Indeed, this study shows that rural schools, having achieved so much with relatively fewer resources, can provide "a model of strength" worth studying and emulating. However, there are limits to our study. Like most studies using large datasets, it cannot offer a focused, qualitative picture of similarities and differences in schooling processes and school environment in rural and nonrural settings. Thus, we suggest that the findings of our study be used to guide subsequent in-depth case studies. Moreover, our study that examined national aggregate patterns may have obscured substantial variations among different states. The previous NAEP state assessment results have shown that some of the highly rural states perform at the top (e.g., Iowa and Maine), while others perform below the national average (e.g., Kentucky and West Virginia). It remains to be examined how rural schools in such high and low performing states differ in their organizational and instructional conditions for student learning.

References

Barker, B. (1985). Curricular offerings in small and large high schools: How broad is the disparity?. Research in Rural Education. 3, 35-38.

Bidwell, C. E., & Kasarda, J. D. (1980). Conceptualizing and measuring the effects of school and schooling. American Journal of Education. 88, 401-430.

Bryk, A. S., & Raudenbush, S. W. (1992). Hierarchical linear models. Newbury Park: Sage Publication.

Bryk, A. S., Raudenbush, S. W., & Congdon, R. (1996). HLM: Hierarchical linear and nonlinear modeling with the HLM/2L and HLM/3L programs. Chicago: Scientific Software International.

Edington, E.D., & Koehler, L. (1987). Rural student achievement: Elements for consideration. ERIC Digest. Las Crusces, NM: ERIC Clearing House on Rural Education and Small Schools.

Khattri, N., Riley, K.W., & Kane, M.B. (1997). Students at risk in poor, rural areas: A review of the research. Journal of Research in Rural Education, 13, 79-100.

Lee, V., Bryk, A., & Smith, J. (1993). The organization of effective secondary schools. Review of Research in Education. 19, 171-267.

Louis, K. S., & & Kruse, S. D. (1995). Professionalism and community: Perspectives on reforming urban schools. Thousand Oaks, CA: Corwin Press.

Miller, K.E., Nelson, J.E., & Naifeh, M. (1995). Cross-state data compendium for the NAEP 1994 grade 4 reading assessment. Washington, DC: National Center for Education Statistics.

National Center for Education Statistics (1988). 1988 Education Indicators. J. Stern (Ed.). Washington, DC: U.S. Department of Education.

National Center for Education Statistics (1994). The condition of education in rural schools. J. Stern (Ed.). Washington, DC: U.S. Department of Education.

National Center for Education Statistics (1996). Eighth-Grade Algebra Course-Taking and

Mathematics Proficiency. Washington, DC: U.S. Department of Education.

National Center for Education Statistics (1997). NAEP 1996 mathematics: state report card. Washington, D.C.: OERI.

National Council of Teachers of Mathematics (1991). Professional standards for teaching mathematics. Reston, VA: NCTM.

National Education Goals Panel. (1994). Data for the national education goals report. Washington, DC: U.S. Government Printing Office.

Newmann, F. M., & Wehlage, G. G. (1995). Successful school restructuring. A Report to the Public and Educators. Madision, WI: Center on Organization and Restructuring of Schools.

Resnick, L. B. (1987). Education and learning to think. Washington, D.C.: National Academy Press.

Romberg, T. A., & Carpenter, T. P. (1986). Research on teaching and learning mathematics: Two disciplines of scientific inquiry. In Wittrock, M.C. (Ed.), Handbook of research on teaching. New York, NY: Macmillan.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new Reform. Harvard Educational Review, 57, 1-22.

Welch, W. W., & T.G. Wagner. (1989). Science education in rural America. Elmhurst, IL: North Central Regional Educational Laboratory.